PRECISION | COMMUNICATION | ACCOUNTABILITY

CONSTRUCTION SOIL AND WATER MANAGEMENT PLAN

MOOREBANK LOGISTIC PARK PRECINCT WEST STAGE 2

MOOREBANK AVENUE

MOOREBANK NSW

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1 INTRODUCTION

1.1 Background

Costin Roe Consulting Pty Ltd has been commissioned by Qube Holdings Limited (Qube) to prepare this Construction Soil and Water Management Plan (CSWMP) for construction of Moorebank Precinct West as approved by the Independent Planning Commission (IPC) and the NSW Department of Planning, Infrastructure & Environment (DPIE) SSD_7709 (dated 11 November 2019) consent.

The submission of the CSWMP for approval by DPIE has been completed in accordance with **Conditions of Consent (CoC) C1,** and **B29** through **B35** as approved by DPIE. This CSWMP forms part of the *Construction Environmental Management Plan (CEMP)* as required of **CoC C2** & **C3**.

The subject area of this CSWMP comprises the earthworks within Stages 2 of the MPW development extent (as defined in the *CEMP Figure 1-2*). These works include road and infrastructure drainage construction throughout MPW S2A, required for the construction of Warehouses 1 through 6, and the interstate terminal. It is noted that this CSWMP sets out the overall requirements of the precinct relating to construction soil and water management measures and that further detailed building specific Erosion and Sediment Control Plan (ESCPs) may be necessary throughout the work period subject to detailed building layouts being defined and designed.

It is also noted that the Australian Government (Department of Environment and Energy) *Concept Approval EPBC 2011/6086* dated 27 September 2019 Condition 9(a) to (d) are addressed in this CSWMP.

It is further noted that this CSWMP has been completed with consideration to the Arcadis Document included in Appendix 2 of the approved SSD_7709 "*Applicants Management and Mitigation Measures*" submitted 2/ 11/ 2018, being the Final Compilation of Mitigation Measures (FCMM). The requirements outlined in the FCMM are consistent with the requirements of *Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004)* as set out in this document.

1.2 Scope

This CSWMP provides details of the design principles and construction requirements for soil and water management, as part of a CEMP required for the DPIE submission approval under **CoC B29**.

This plan details the site management procedures to control the severity and extent of soil erosion and pollutant transport during the pre-construction and construction phase of the development as described in **Section 1.1** and **Section 2.2** of this CSWMP.

The CSWMP will be read in conjunction with the *Erosion and Sediment Control* design package, drawings **PIWW-COS-CV-DWG-0200, 0201, 0211, 0212, 0213, 0246, 0247, 0248, 0249, 0250 & 0251** as included in **Appendix A**.

1.3 Conditions of Consent & Final Environmental Mitigation Measures Matrix

The CSWMP and associated ESCP have been completed in accordance with the approved stormwater management strategy and EIS defined by Arcadis and approved in the NSW DPIE in SSD_7709 and FCMM in Appendix 2 of the Consent (SSD_7709).

We provide the following tables which confirms how and where, within the report or respective drawings and models, each of the requirements of SSD_7709 **CoC B29** through **B35** and requirements of the *Landcom Managing Urban Stormwater-Soils and construction 4th Edition (2004) – the "Bluebook"* have been met, and *Applicants Management and Mitigation Measures Items 5A to 5G*:

<u>SSD7709 Consent Condition Matrix</u>

CoC No.	*Item and Response*
A7	*Only VENM, ENM, or other imported fill material approved in writing by EPA is to be placed on the site.* <u>Response</u> The requirement for VENM and ENM is included in **Section 3.4** of the **CSWMP**.
A8	*The total volume of uncompacted fill to be imported must not exceed 1,600,000 m^3.* <u>Response</u> The requirement for a maximum imported volume of uncompacted fill of 1,600,000 m^3 on site is included in **Section 3.4** of the **CSWMP**.
A9	*Importation of imported fill must not exceed a total of 22,000 m^3 of material per day across this development and MPE Stage 2 (SSD 7628) on the same day.* <u>Response</u> The requirement for a maximum of 22,000 m^3 of material imported per day is included in **Section 3.4** of the **CSWMP**.
A10	*No construction (including clearing and maintenance access) is permitted within the riparian corridor except for that identified on the revised drawings approved under **Condition B2** and activities associated with vegetation and stormwater management.* <u>Response</u> The requirement for restriction of works relating to riparian corridors is included in **Section 5.1, Table 5.1** and **Section 7.2** of the **CSWMP**.

CoC No.	Item and Response
B20	*Discharge of stormwater from the development must not cause scour/ erosion of the banks or bed, or pollution of the Georges River or Anzac Creek.* *Note: Pollution of waters as defined under section 120 of the POEO Act.* <u>Response</u> The design of specific erosion and sediment controls for outlets to the Georges River have been included in the ESCP design drawings **PIWW-COS-CV-DWG-0246, 0247 & 0248** as included in **Appendix A.** Measures proposed have been designed to ensure erosion potential is minimised during the construction works period. During the operational period, specific outlet structures which include rip-rap, energy dissipators and permanent scour protection during have been designed to ensure erosion is minimised. Refer **Stormwater Design Development Report (SDDR)** as required of **CoC B4**. Discharge of stormwater during construction is required out to meet criterium (per *Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004)* and the NSW EPA Environmental Protection License (EPL)) as included in **Section 3.6** of this **CSWMP**.
  B29	***Construction Erosion and Sediment Control*** *Prior to commencement of construction, the Applicant must prepare a* ***Soil and Water Management Plan*** *(SWMP) in accordance with the requirements of Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004) and submit it to the Planning Secretary for approval. The SWMP must be certified by a Certified Professional in Erosion and Sediment Control (CPESC) that it is fit for purpose, addresses the constraints posed by site conditions and complies with statutory requirements. The CPESC must have demonstrated experience in the identification, management and mitigation of erosion and sedimentation in dispersive and non-cohesive soils and be approved by the Planning Secretary* <u>Response</u> The CSWMP and associated erosion and sediment control plans have been completed as required of *Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004)*, and per accepted engineering and best practice. This CSWMP has been prepared for the applicant by Costin Roe Consulting Pty Ltd, civil and structural consulting engineers. Costin Roe Consulting is experienced in the preparation and

CoC No.	Item and Response
	implementation of staged *Soil and Water Management Plans* for industrial developments of similar scope to the MPW development. Recent similar projects include SSD approved developments such as Eastern Creek Business Park Stages 4 & 5, The Horsley Drive Business Park Stage 1 at Wetherill Park, Altis First Estate at Erskine Park, Prestons Industrial Estate at Prestons and the DEXUS Quarry at Greystanes. The CSWMP has been reviewed and endorsed by Mr Carl Vincent of ErSed, being a certified CPESC and approved by the NSW DPIE (refer DPIE Letter DOC19/1037798 dated 2/12/2019) as being suitable to undertake the certification under the requirements of this **CoC**. Refer to **Appendix F** should be made for the CPESC letter of endorsement and certification letter.
B30	*The SWMP must form part of the CEMP required by Condition C2 and, in addition to the general management plan requirements listed in Condition C1, the SWMP must include, but not be limited to:* <u>Response</u> The CSWMP forms part of the CEMP and is included as a sub-plan in *Appendix F* of the CEMP.
B30 *Item(a)*	*erosion and sediment control hazard assessment that includes:* *(i) monthly rainfall erosivity,* *(ii) flooding liability,* *(iii) topography,* *(iv) physical and chemical properties of in-situ and imported soil,* *(v) sensitivity of the receiving environment;* <u>Response</u> The CSWMP has been completed in accordance with the above noted items. Refer to **Table 3.4, Section 3.5**, for confirmation of how each item has been reviewed and assessed, and relevant sections of the CSWMP. K, R and LS factors required for the RUSLE (revised universal loss equation) assessment are included in design drawing **PIWW-COS-CV-DWG-0201** in **Appendix A** and listed in **Section 6.1(4)** of the **CSWMP**. Monthly rainfall erosivity was estimated from monthly rainfall data using the methodology discussed in a study by Hernando and Romana. Refer to **Appendix G** for the calculation and monthly rainfall erosivity values.

CoC No.	Item and Response
	Site filling and existing levels are noted to be above the 1% AEP flood level and clear of the 1% AEP flood zone associated with the adjacent Georges River. Appropriate provision for drainage and diversion drains has been made to ensure site runoff is drained to respective sediment controls and sediment basins which have also been sited above the 1% AEP flood level in the Georges River as included in **Section 2.8**. Existing and proposed topography has been considered with staged erosion and sediment control plans which manage site and upstream runoff throughout the works period, accounting for sensitive areas of the site including The Georges River. Outlet specific erosion and sediment control designs have been completed in accordance with WaterNSW Riparian Corridor requirements and The Blue Book. The completed RUSLE assessment (refer **Section 6.1**) shows a soil loss of 68 m^3/Ha which is considered to be low risk per *Blue Book Section 3.2.5 and Table 4.2*. Refer drawings **PIWW-COS-CV-DWG-0201, 0211, 0212 & 0213** & **0249** for main works areas drawings **PIWW-COS-CV-DWG-0246-0248** for works pertaining to outlet structures. Further, geotechnical and soil information refer **Sections 2.3** to **2.6**, which includes confirmation of physical and chemical properties of soils can be located in **Appendix D**. In relation to the sensitivity of the receiving environment, *Section 5.4.2 of the Arcadis Biodiversity Assessment Report* 2016 (included in the SSD_7709 EIS) defines the Georges River as being a 6th order stream as defined in the Strahler Stream Classification system. As such a dedicated riparian buffer is necessary to be maintained to the Georges River and management measures set out for a *Category 1: Environmental Corridor* included in *Table 5* of the *Landcom Blue Book* are necessary for the works. Refer to **Section 2.4** of the CSWMP pertaining to outlet requirements.
B30 *Item(b)*	*management strategies to address the identified erosion and sediment control hazard that consider:*
	(i) statutory and environmental management requirements including: *− minimising the extent and duration of land disturbance,* *− controlling water movement through and from site,* *− locating sediment basins in areas not subject to local-stormwater flooding* *− minimising soil erosion,*

CoC No.	Item and Response
	− maximising sediment retention on site, *− prompt and progressive stabilisation of disturbed areas,* <u>Response</u> The extent and duration of land disturbance will be kept to minimum duration, and maximum land disturbance of 65 Ha (as required of **CoC B41**) at any one time until a C-Factor (per Blue Book) of less than 0.05 is achieved or more than 75% of construction is achieved. Note that methods to achieve the required stabilisation per *Landcom Blue Book* meeting C-factor being less than 0.05 per **Section 5.8** of this report. Water movement through and from the site is managed via dedicated flow paths and drainage swales to sediment basins, as shown on ESCP drawings **PIWW-COS-CV-DWG-0201, 0211, 0212 & 0213** & **0249 in Appendix A**. Sediment basins are located clear of flood prone areas of the site as discussed in **Section 2.8** of the CSWMP and **ESCP** in **Appendix A**. Soil erosion will be minimised by limiting exposed area and duration throughout the works, and managing measures as set out in **Section 5** of this CSWMP. Sediment from site runoff will be retained through implementation of sediment basins which will collect and store the majority of all site runoff as set out in **Sections 5 & 6**, and **ESCP** in **Appendix A**. Prompt and progressive stabilisation of the site will be achieved using accepted methods set out in **Section 5.8** of this document.
	(ii) maintenance of drainage, erosion and sediment control measures, <u>Response</u> Reference to **Sections 3.4 to 3.6, Section 5, Section 6** and **Section 8** of this CSWMP should be made for guidance on maintenance requirements for erosion and sediment control measures. Further, reference to **Appendix B** will be made for daily and weekly site check sheets to be used by the contractor during the works period to ensure maintenance, monitoring and ongoing adjustments are made to achieve the necessary performance standards.
	(iii) monitoring and adjusting drainage, erosion and sediment control measures to achieve necessary performance standards, <u>Response</u>

CoC No.	*Item and Response*
	Reference to **Section 8** of this CSWMP should be made for guidance on maintenance requirements for erosion and sediment control measures. Further, reference to **Appendix B** will be made for daily and weekly site check sheets to be used by the contractor during the works period to ensure maintenance, monitoring and ongoing adjustments are made to achieve the necessary performance standards.
	(iv) planning for predicted rainfall and winds events and shut down periods <u>Response</u> Reference to **Section 5.8** of the CSWMP should be made for controls related to planned shutdown periods, predicted rainfall and wind events.
B30 *Item(c)*	*a schedule of construction activities for the development, installation and removal of control measures and temporary and permanent stabilisation works,* <u>Response</u> **Sections 4** and **5** of the CSWMP provide controls relating to construction activities and required timing for installation and removal of control measures. Reference to *Section 1.2.1* of the CEMP should be made for a specific schedule of items and activities.
B30 *Item(d)*	*Erosion and Sediment Control Plans, including:* *(i) existing and proposed contours and drainage path,* *(ii) all access points and facilities associated with the development,* *(iii) limits of disturbance including protected areas and features,* *(iv) extent of earthworks,* *(v) areas of cut and fill,* *(vi) location of all drainage, erosion and sediment control measures including numbering for identification, and* *(vii) surface water monitoring locations;* <u>Response</u> Erosion and sediment control plan (ESCP) drawings have been prepared and are included in **Appendix A** of the CSWMP. Reference to **Appendix A** should be made for drawings which include existing and proposed contours, exit and entry locations, drainage paths, limits of disturbance, earthworks extent ad erosion

CoC No.	*Item and Response*
	and sediment control locations as required of Items (i) to (vii) above.
B30 *Item(e)*	*specific operating procedures such as dewatering and the treatment of water and sediment collected in basins; and* <u>Response</u> Reference to **Section 6** and **Section 8** of the CSWMP should be made for specific operating and monitoring requirements relating to treatment and sediment collected in basins, and/or the decommissioning of sediment basin structures. Reference can also be made to the *Erosion & Sediment Control Plans* **PIWW-COS-CV-DWG-0200, 0201, 0210- 0213, 0246-0249, 0250 & 0251** provided in **Appendix A** for these requirements. Reference to **Section 5** of the CSWMP should be made for specific requirements pertaining to the management of building works, including access to the site from off-site areas. Reference can also be made to the *Erosion & Sediment Control Plans* provided in **Appendix A** for these requirements. Further reference to the *Acid Sulfate Management Plan* (EP Risk, *EP1340.001-MPW_ASSMP*) should be made pertaining to specific measures relating to management of Acid Sulfate Soils (which may potentially be present in detention basin locations and temporary sediment basins).
B30 *Item(f)*	*details on methods of temporary and permanent slope stabilisation to adjacent lands (including the riparian corridor).* <u>Response</u> Reference to **Section 5.8** of the CSWMP should be made for slope stabilisation requirements.
B31	*Erosion and Sediment Control Plans must be updated as construction progresses, and site conditions change.* <u>Response</u> Plans will be updated as required, on site and by the site management team and contractor, as site conditions change based on the anticipated site conditions. The on-site adjustments will be made utilising the framework of the staged Erosion and Sediment Control Plans and CSWMP, and the CEMP. Changes to the ESC and CSWMP can be reviewed and endorsed by the CPESC as required during the works. Reference to **Section 3.11** should be made in relation to ongoing updates to the CSWMP.

CoC No.	Item and Response
B32	*The CPESC must undertake monthly inspections during construction, report on implementation of the SWMP and recommend any improvements to the SWMP and site control measures. The CPESC's report must be provided to the Planning Secretary monthly for the duration of construction or another time period as agreed by the Planning Secretary.* <u>Response</u> Refer to **Section 8** for inspection and reporting as required to be undertaken per the requirements of this **CoC**. Reference to **Section 3.11** should also be made pertaining to review and improvements to the CSWMP during the works.
B33	*All temporary construction stage erosion and sediment control infrastructure that is intended to be converted to permanent stormwater quality or on-site detention infrastructure must be constructed in accordance with the revised stormwater design drawings approved by the Planning Secretary under* ***Condition B4****.* <u>Response</u> Temporary construction stage erosion and sediment control infrastructure required to be converted to permanent stormwater quality or on-site detention infrastructure will be constructed in accordance with the revised stormwater design drawings approved by the Planning Secretary under **CoC B4,** and rehabilitation as set out in **Section 5.8, 6.4 & 7** of this CSWMP.
B34	*Conversion of construction stage erosion and sediment control infrastructure into permanent stormwater quality or on-site detention infrastructure must only occur once the civil works (roads and drainage) have been completed for the associated site sub-catchment.* <u>Response</u> Conversion of construction stage erosion and sediment control infrastructure into permanent stormwater quality or on-site detention infrastructure will not occur once the civil works (roads and drainage) have been completed for the associated site sub-catchment in accordance with this **CoC**. Refer **Section 5.8 & 6.4** of **CSWMP** for details regarding the conversion of construction stage erosion and sediment control infrastructure into permanent stormwater quality or on-site detention infrastructure.
B35	*Where construction of sediment basins and stormwater outlet works (including clearing, scour protection/ erosion control) are*

CoC No.	Item and Response
	to be undertaken outside the site on Crown land (being the banks and bed of the Georges River), design those works must be prepared with the input of an aquatic ecologist, and evidence of DPI (Crown Lands) approval is to be provided to the Planning Secretary prior to commencement of construction. Details of finished works are to be submitted to DPI (Crown Lands) for information. <u>Response</u> The majority of the construction works will remain clear of Crown Land, other than local works associated with outlet structures. No works in relation to sediment basins, filling works or bulk earthworks are proposed outside the site development boundary or on Crown Lands. Existing discharge points will be maintained during construction works until development requires upgrade to the new drainage outlet arrangements. Reference to the SSDR under **CoC B4**, and ecologist report should be made pertaining to designs and assessments associated with outlets. All works within Crown Land will be completed in accordance with the noted conditions and in consultation with the NSW Office of Water, and have outlet specific sediment controls in place during construction. Reference is to be made to the review and consultation of ecological requirements completed byCumberland Ecology Reference to drawings **PIWW-COS-CV-DWG-0246-0248** to be made in relation to outlet sediment controls. Refer to **Section 7** of the CSWMP pertaining to outlet requirements.
B41	*Land disturbance and land filling activities must be undertaken:* *(a) in a phased manner, impacting a maximum contiguous are of 65 Ha at any one time; and.* *(b) with no disturbance (including vegetation clearing) of another area (other than the construction of erosion and sediment control measures and associated drainage for the separation of clean and dirty water) until:* *(i) a C-Factor of 0.05 has been achieved on the previous phase; and* *(ii) at least 75% of the permanent stabilisation works have been implemented for the previous phase; and* *(iii) at least 95% all of the permanent stabilisation works on any other previously disturbed area have been implemented.* *<u>Note</u>:* *For the purposes of this condition, permanent stabilisation works include established grass cover for the southern fill area where*

CoC No.	Item and Response
	future warehousing is proposed, must be in accordance with Condition B65. <u>Response</u> The management measures required to meet **CoC B41** have been defined and set out in **Section 5.8** of this CSWMP.
B42	*Stockpiling of imported fill is not permitted for longer than 6 months before placement.* <u>Response</u> The stockpile management has been set out in **Section 5.3** of this CSWMP in accordance with **CoC B42** and **B43**.
B43	*Stockpiles must:* *(a) not exceed 10m in height.* *(b) be benched over 4m in height* *(c) have a maximum slope of 1v:3h slopes; and* *(d) be stabilised if not worked on form more than 10 days.* <u>Response</u> The stockpile management has been set out in **Section 5.3** of this CSWMP in accordance with **CoC B42** and **B43**.
B44	*Placed Fill must be stabilised if not worked on for more than 10 days.* <u>Response</u> The management measures required to meet **CoC B41** have been defined and set out in **Section 5.8** of this CSWMP.
B45	*The design of fill batters must ensure stability, mitigate visual impacts, provide for maintenance activities and demonstrate that there are no impacts on adjacent lands, including bio-diversity offset areas and the riparian corridor.* <u>Response</u> The design of short-term construction batters has been completed with maximum slopes of 1v:2h as defined in Golders Geotechnical report. The design of operational batters, including visual impacts, does not form part of this CSWMP. In relation to demonstrating that there are no impacts on adjacent lands relating to fill batters, we confirm that all works (including fill batters) have been designed to be completed within the defined development boundary. This includes for a buffer zone, as defined in Reid Campbell Architects Masterplan, required of **CoC B2(a)(i)** and **B2(a)(ii).** The **CoC** which requires a buffer

CoC No.	Item and Response
	zone on the Georges River property frontage as the most inland of 40m from top of bank or the 1% AEP flood level, and allowing for an additional 10m where native vegetation is located adjacent to the buffer zone. The construction activities are to be completed in accordance with the approved design documents, hence impacts on adjacent areas should be mitigated.
B65	*The southern fill area where future warehousing is proposed must be topsoiled and hydroseeded with native grasses.* Response The requirement for the southern fill area where future warehousing is proposed to be topsoiled and hydroseeded with native grasses is included in **Section 3.4** of the **CSWMP**.
B66	*Perimeter fill batters must be stabilised with vegetation.* Response The requirement for fill batters to be stabilised with vegetation is included in **Section 3.4** of the **CSWMP**.
B186	***Crushing Plant*** *The CEMP required under Condition C2 must include mitigation, monitoring and management procedures specific to the crushing plant that would be implemented to minimise environment and amenity impacts.* Response Construction activities relating to the Crushing Plant are described in **Section 2.2** of the **CSWMP** and *Section 2.4.2.1* & *Appendix Q* of the *CEMP*. The ESC and stockpile measures and controls included in this CSWMP are to be applied to the crushing plant and associated crushing plant activities. Defined stockpile locations are to be provided and managed per the *Spoil and Stockpile Management* measures set out in **Section 5.3**. Removal of and waste management to be completed in accordance with the *Construction Demolition & Waste Management Plan* - Refer *CEMP Appendix P*.
C1	***Management Plan Requirements***
C1(a)	*Detailed Baseline Data* Response Detailed baseline data pertaining to soil soil and water is included in **Section 2** and **Appendices C, D & G** of the CSWMP.

CoC No.	Item and Response
C1(b)	*Details of:* *(i) The relevant statutory requirements (including relevant approval, licence or lease conditions);* *(ii) Any relevant limits or performance measures and criteria; and* *(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 measures.* Response Statutory requirements are included in **Section 3.3** of the CSWMP. Discharge control criteria, being the measure of performance and performance indicators, are provided in **Section 3.6** of the CSWMP.
C1(c)	*A description of the measures to be implemented to comply with the relevant statutory requirements, limits or performance measures and criteria* Response Measures required to be implemented are included in the ESCP in Appendix A, and as per requirements set out in **Sections 3.4, 3.6, 6, 7 & 8** of the CSWMP.
C1(d)	*A program to monitor and report on the:* *(i) Impacts and environmental performance of the development* *(ii) Effectiveness of the management measures set out pursuant to paragraph (c) above.* Response Inspection and monitoring requirements have been included in **Section 8** of the CSWMP. Additional reference to **Sections 3.7 to 3.11** should be made for contingency planning, incident classification and notification, environmental auditing and reporting, non-compliance, non-conformance and actions, and review and improvement requirements respectively.
C1(e)	*A contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible.* Response

CoC No.	*Item and Response*
	Reference to **Section 3.7** of the CSWMP for contingency planning.
C1(f)	*A program to investigate and implement ways to improve the environmental performance of the development over time.* <u>Response</u> Reference to **Sections 3.11** should be made for review and improvement requirements.
C1(g)	*A protocol for managing and reporting any:* *(i) Incident and any non-compliance (specifically including any exceedance of the impact assessment criteria);* *(ii) Complaint;* *(iii)Failure to comply with statutory requirements;* <u>Response</u> Reference to **Sections 3.8, 3.9 & 3.10** should be made for, incident classification and notification, environmental auditing and reporting, non-compliance, non-conformance and actions requirements respectively
C1(h)	*Roles and responsibilities for implementing the plan.* <u>Response</u> Reference to **Section 3.2** should be made pertaining to roles and responsibilities.
C1(i)	*A protocol for periodic review of the plan.* <u>Response</u> Reference to **Sections 3.11** & **8.3** should be made review and improvement requirements.
C3	*As part of the CEMP required under Condition C2 of this consent, the Applicant must include the following:* *(a) Soil and Water Management Plan (see Condition B29)* *(b) Acid Sulfate Soils Management Plan (see Condition B39)* *(c) Construction Traffic and Access Management Plan (see Condition B113)* *(d) Construction Noise and Vibration Management Plan (see Condition B134)* *(e) Out-of-hours work Protocol (see Condition B135(g))* *(f) Construction Flora and Fauna Management Plan (see Condition B154); and* *(g) Unexpected Finds Protocols (see Condition B175)* <u>Response</u> This **CSWMP** forms *Appendix F* of the *CEMP*.

Applicants Final Compilation of Mitigation Measures (FCMM) Matrix

FCMM No.	***Item and Response***
0B	*The Construction Environmental Management Plan (CEMP), or equivalent, for the Proposal would be based on the PCEMP (Appendix I of this EIS), and include the following preliminary management plans:* ▪ *Preliminary Construction Traffic Management Plan (PCTMP) (Appendix M of the EIS)* ▪ *Air Quality Management Plan (Appendix O of the EIS)* ▪ *Erosion and Sediment Control Plans (ESCPs) and Bulk Earthworks Plans, within the Stormwater Drainage Design Drawings (Appendix R of the EIS)* *As a minimum, the CEMP would include the following sub-plans:* ▪ *Construction Traffic Management Plan (CTMP)* ▪ *Construction Noise and Vibration Management Plan (CNVMP), prepared in accordance with the Interim Construction Noise Guideline* ▪ *Cultural Heritage Assessment Report/Management Plan* ▪ *Construction Air Quality Management Plan* ▪ *Construction Soil and Water Management Plan (SWMP), prepared in accordance with Managing Urban Stormwater, 4th Edition, Volume 1, (2004).* ▪ *Erosion and Sediment Control Plan* ▪ *Flood Emergency Response and Evacuation Plan* ▪ *UXO, EO, and EOW Management Plan* ▪ *Acid Sulfate Soils Management Plan* ▪ *Bushfire Management Strategy* ▪ *Community Information and Awareness Strategy.* ▪ *Flora and Fauna Management Plan (FFMP)* ▪ *Groundwater Monitoring Program (GMP)* ▪ *Stockpile Management Protocol* <u>Response</u> This **CSWMP** forms *Appendix F* of the *CEMP* and has been prepared in accordance with the required **CoC** and **FCMM’s** listed and responded to in **Section 1.3** of the **CSWMP**.
0E	*The Proposal is not anticipated to include any works within the Georges River. Should works be required within the Georges*

FCMM No.	Item and Response
	River consultation with the Department of Primary Industries (Crown Lands) would be undertaken. Response No works are proposed in the Georges River. Drainage discharge works will be completed adjacent to the river and within the banks of Georges River and are defined in the SDDR per **CoC B20** to **B22**. No work shall be undertaken until consultation with DPI (Crown Lands) has been undertaken and a Controlled Activity Approval been granted for the works within 40m of Georges River. ESC measures relating to Georges River Discharge have been included in Appendix A. No works would be made until consultation process with DPI (Crown Lands) has been completed.
1H	*Importation of fill to site during construction of the Proposal is to not exceed a total of 22,000 m3 of material per day. This limit is to be further reduced by an amount equivalent to any fill being imported to the MPE Stage 2 Proposal (SSD 7628) on the same day such that the combined importation of fill to the Proposal site and MPE site does not exceed 22,000 m3 on any given day.* Response Refer **CoC A9** response.
4M	*Erosion and sediment control measures such as silt fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality. The erosion and sediment controls to be included to avoid, minimise and mitigate against the potential for construction of the Proposal to result in erosion and sedimentation impacts will be determined in consideration of the erosive potential of locally occurring soils, and the characteristics of the clean general fill to be imported as part of construction of the Proposal.* Response This CSWMP and associated erosion and sediment control plans have been completed as required of *Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004)*, and per accepted engineering and best practice. The proposed measures, as reviewed and assessed by a CPESC, Mr Carl Vincent (ERSED), include measures to avoid, minimise and mitigate against the potential for the construction of the Proposal to result in erosion and sedimentation impacts. The design considers local soil properties and erosive potential of the local soils as set out in listed in **Section 6.1(4)** of the

FCMM No.	***Item and Response***
	CSWMP, and monthly rainfall erosivity in **Appendix G.** Consideration to the erosion potential for imported soils has been based on worst case of expected imported soil types (residual clays or crushed sandstone) and is considered conservative in nature.
4Q	*The detailed design process would consider the potential groundwater impacts on groundwater-dependent ecosystems. In most cases, these impacts, if evident, would be mitigated at the design phase.* <u>Response</u> Reference to be made to **Section 2.4** of the CSWMP and geotechnical information in **Appendix D**. Groundwater is noted to be 8-12m below existing ground levels and will not be impacted by proposed works. Any groundwater-dependent ecosystems would as such have minimal to no impact relating to the works. The geotechnical information shows that some isolated perched water systems could be present around existing ponds. Management of groundwater in these locations would be completed in accordance with the CPESC and any associated ecosystems managed as set out in Section 3.1 of the Construction Flora and Fauna Management Plan (CEMP Appendix K).
4T	*The proposed stormwater basin outlets would be designed to minimise biodiversity impacts by incorporating native revegetation and fauna habitat features as far as possible.* <u>Response</u> This measure is noted to be required for the operational phase of the development and not relevant to the **CSWMP** or response contained herein. It is noted however that native revegetation is proposed as part of the operational phase designs and has been documented in the Landscape Architect designs by Ground Ink. Refer Landscape Architect design package.
5A	*A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be prepared for the Proposal. The SWMP and ESCPs would be prepared in accordance with the principles and requirements of the Blue Book and based on the Preliminary ESCPs provided in the Stormwater and Flooding Assessment Report (refer to Appendix R of the EIS).*

FCMM No.	*Item and Response*
	The following aspects would be addressed within the SWMP and ESCPs: *▪ Minimise the area of soil disturbed and exposed to erosion* *▪ Priority should be given to management practices that minimise erosion, rather than to those that capture sediment downslope or at the catchment outlet* *▪ Divert clean water around the construction site or control the flow of clean water at non-erodible velocities through the construction area* *▪ Provision of boundary treatments around the perimeter of construction areas to minimise the migration of sediment offsite* *▪ Permanent or temporary drainage works (in particular OSDs) would be installed as early as practical in the construction program to minimise uncontrolled drainage and associated erosion* *▪ Stockpiles would be located away from flow paths on appropriate impermeable surfaces, to minimise potential sediment transportation. Where practicable, stockpiles would be stabilised if the exposed face of the stockpile is inactive more than ten days, and would be formed with sediment filters in place immediately downslope* *▪ Disturbed land would be rehabilitated as soon practicable* *▪ The wheels of all vehicles would be cleaned prior to exiting the construction site where excavation occurs to prevent the tracking of mud. Where this is not practical, or excessive soil transfer occurs onto paved areas, street cleaning would be undertaken when necessary.* *▪ A requirement to inspect all permanent and temporary erosion and sedimentation control works prior to and post rainfall events and prior to closure of the construction area. Erosion and sediment control structures must be cleaned, repaired and augmented as required.* *▪ Where required, sediment basins and their outlets would be designed to be stable in the peak flow from at least the 10-year ARI time of concentration event. Sediment basins should be sized to accommodate the 5 day, 80th percentile storm event, with sufficient size and capacity to manage Type F soils. Sediment basins must be regularly cleaned to maintain the design capacity.* *Prior to discharge from sediment basins, water would be tested for the following parameters to identify construction impacts:* *– pH*

FCMM No.	*Item and Response*
	– Turbidity / TSS *– Oil and grease.* *▪ Sediment fences are to be provided around the perimeter of the site to ensure no untreated runoff leaves the site, and around the existing and proposed drainage channels to minimise sediment migration into waterways and sediment basins* *▪ The following management measures would be implemented during works in and adjacent to Georges River to mitigate potential impacts on water quality during OSD channel construction:* *– All reasonable efforts would be taken to program construction activities during periods when flood flows are not likely to occur* *– The construction site, on completion of construction works, would be left in a condition that promotes native revegetation* *– The management principles outlined in Managing Urban Stormwater (Landcom 2004) for sites with high erosion potential would be implemented.* <u>Response</u> The extent and duration of land disturbance will be kept to minimum duration, and maximum land disturbance of 65Ha (as required of **CoC B41**) at any one time until a C-Factor (per Blue Book) of less than 0.05 is achieved or more than 75% of construction is achieved. Note that methods to achieve the required stabilisation per Landcom Blue Book meeting C-factor being less than 0.05 per **Section 5.8** of this report. Water movement through and from the site is managed via dedicated flow paths and drainage swales to sediment basins, as shown on drawings **PIWW-COS-CV-DWG-0201, 0211, 0212 & 0213** & **0249**. Diversion swales have been designed with either non-erodible velocities or where velocity is higher than erosion potential include measures to reduce erosion potential to at or below acceptable levels per Blue Book. These include rock check dams, jute (or other similar lining), rock base channel, geotextile lined channel and low velocity channels. Boundary treatment including diversion swales, silt fencing, berms and acceptable measures per Blue Book have been included in the design. Refer design drawings noted. Permanent and temporary drainage measures will be constructed as early as practical with sediment basins to be constructed initially as per **Section 6 & 8** of this CSWMP.

FCMM No.	***Item and Response***
	Stockpiles are located away from any proposed waterways or diversion paths and as per requirements set out per **Section 5.3** of this CSWMP. Sediment basin design and management is set out in **Section 6** of this CSWMP for Type F Soil Texture Group and Type D Hydrologic Group soil. Further information pertaining to acceptable discharge criteria (including confirmation of pH, turbidity and oil/grease) are included in **Section 3.6**. It is noted that an 85th percentile rainfall has been adopted in the design which is higher than the recommended measure. Inspection of measures will be completed by a CPESC as required of **CoC B32.** Works specific to outlets and Georges River have been included in **Section 7** of the CSWMP.
5B	*Proposal site exits would be fitted with hardstand material, rumble grids or other appropriate measures to limit the amount of material transported offsite.* <u>Response</u> Site entry and exits have been designed with Stabilised Construction Access measures per Landcom Blue Book and generally as noted above. Refer drawings **PIWW-COS-CV-DWG-0201, 0211, 0212 & 0213, 0249 & 0250** as included in **Appendix A** for locations and details. An existing automated wheel washer is also present on site which will be maintained throughout the construction period. Management and details of this system are included in the *Construction Traffic and Access Management Plan* (CTAMP Section 3.5).
5C	*The following measures would be considered during the development of construction methodology for the Proposal to mitigate flooding impacts:* ▪ *For all site works, provide temporary diversion channels around temporary work obstructions to allow low and normal flows to safely bypass the work areas* ▪ *Locate site compounds, stockpiling areas and storage areas for sensitive plant, equipment and hazardous materials above an appropriate design flood level, outside of the PMF extent at the northern section of the construction area, to be determined based on the duration of the construction work.* <u>Response</u>

FCMM No.	*Item and Response*
	Local and temporary diversion channels have been included in the Erosion and Sediment Control design drawings. These include clean water diversions around works areas and dirty water conveyance to sediment control basins. It is noted that the site construction levels are all above the 1% AEP flood level (being the normally adopted flood level) and generally above the PMF flood level associated with The Georges River. The main site compound is proposed on the southern third of the precinct and above the PMF event. Temporary and permanent drainage provisions have been made for the compound. Other minor compounds are sited as required above the 1% and PMF flood level and extent. Refer **Section 2.**8 and drawings **PIWW-COS-CV-DWG-0201, 0211, 0212 & 0213** & **0249** as included in **Appendix A.**
5D	*To minimise potential flood impacts during construction of the Proposal, the following measures would be implemented and documented in the SWMP:* ▪ *The existing site catchment and sub-catchment boundaries would be maintained as far as practicable* ▪ *To the extent practicable, site imperviousness and grades should be limited to the extent of existing imperviousness and grades under existing development conditions* ▪ *Smaller detention storages that provide adequate rainfall runoff mitigation during partial construction/site development would be considered.* ▪ *Temporary structures used to convey on site run-off during construction would be designed to accommodate flows during prolonged or intense rainfalls. The existing stormwater conduit conveying flows from Moorebank Avenue to the Georges River would be assessed to ensure it is adequate to accommodate runoff from the construction area.* Response Consideration of measures noted above have been made in the **CSWMP** and associated ESC designs. Existing site catchments have been maintained as far as practical, and generally in accordance with catchments included in the EIS design and confirmed in the SDDR. Site imperviousness and works areas will be limited in duration and extent (<65Ha) as per the CoC and as set out **Sections 4** & **5** of the CSWMP.

FCMM No.	*Item and Response*
	Sediment basins (refer **Section 6** of CSWMP) will be constructed prior to site disturbance to ensure that adequate rainfall runoff mitigation during construction has been made. Temporary drainage paths have been designed per Landcom Blue Book requirements and the existing drainage channel from Moorebank Avenue to the Georges River is not proposed to be utilised to convey construction runoff, hence the capacity assessment noted is not relevant to the proposed designs.
5E	*A Flood Emergency Response and Evacuation Plan, or equivalent, would be prepared and implemented for the construction phase of the Proposal to allow work sites to be safely evacuated and secured in advance of flooding occurring at the Proposal site. The plan would be prepared in consultation with the State Emergency Service.* <u>Response</u> A *Construction Emergency Response Plan* (ERP) has been prepared for the precinct by Arcadis. Section 3.12 addresses flooding and should be referred to in relation to pertaining to flood associated risks and responses. This ERP is noted to form part of the CEMP.
5F	*Stormwater quality improvement devices would be designed to meet the performance targets identified in the Stormwater and Flooding Environmental Assessment (Appendix R of the EIS), and civil design drawings. Maintenance of the bio-retention structures would be in accordance with the maintenance requirements set out in Gold Coast City Council's Water Sensitive Urban Design Guidelines 2007 and would be included in the OEMP.* <u>Response</u> This measure is noted to form part of operational phase design requirements and not relevant to the CSWMP measures or scope items set out in this report. It is noted that detailed modelling of stormwater quality improvement devices have been included in the operational stormwater system design and documented in the SDDR (per **CoC B4** to **B6**) and supporting design drawings. Refer separate report and drawings as required.
5G	*Operational water quality monitoring is to be carried out and included in the OEMP with the objective of maintaining or improving existing water quality.* <u>Response</u>

FCMM No.	*Item and Response*
	This measure is noted to form part of operational phase design requirements and not relevant to the CSWMP measures or scope items set out in this report. It is noted that a future Operational Water quality Monitoring Plan will be prepared as required under the CoC to future approval phases of the development.
5H	*A Flood Emergency Response Plan (FERP) would be prepared and implemented for the operational phase of the Proposal. The FERP would take into consideration, site flooding and broader flood emergency response plans for the Georges River floodplains and Moorebank area. The FERP would also include the identification of an area of safe refuge within the Proposal site that would allow people to wait until hazardous flows have receded and safe evacuation is possible. The FERP would be prepared in consultation with the State Emergency Service.* Response As noted in Response 5E, a *Construction Emergency Response Plan* (ERP) has been prepared for the precinct by Arcadis. Section 3.12 addresses flooding and should be referred to in relation to pertaining to flood associated risks and responses. This ERP is noted to form part of the CEMP. The operational phase FERP is noted to form part of operational phase design requirements and not relevant to the CSWMP measures or scope items set out in this report. A future operational phase response plan would be prepared for future development approval phases of the precinct.
5I	*Stockpile sites established during construction are to be managed in accordance with stockpile management principles set out in Appendix L of this RtS.* *Mitigation measures within the Stockpile Management Protocol include:* ▪ *In order to accept fill material onto site, material characterisation reports/certification showing that the material being supplied is VENM/ENM must be provided.* ▪ *Each truck entering the MPW Stage 2 Proposal site will be visually checked and documented to confirm that only approved materials that are consistent with the environmental approvals are allowed to enter the site.* ▪ *Only fully tarped loads are to be accepted by the gatekeeper.* ▪ *Environmental Assurance of imported fill material will be conducted to confirm that the materials comply with the NSW*

FCMM No.	Item and Response
	EPA Waste Classification Guidelines and the Earthworks Specification for the MPW site. The frequency of assurance testing will be as nominated by the Environmental assuror/auditor. *▪ All trucks accessing the site for the purpose of clean general fill importation would enter and exit via the existing main MPW Stage 2 site access located in the intersection of Moorbank Avenue and Chatham Avenue.* *▪ Ingress and egress to the stockpiling areas would be arrangedso that the reversing of trucks within the site is minimised.* *▪ Stockpiles would not exceed ten-metres in height from the final site levels, with battered walls at gradients of 1V:3H For any stockpile heights greater than 4 m, benching would be implemented.* *▪ For any stockpile heights greater than 4 m, benching would be implemented.* *▪ Where reasonable and feasible, and to minimise the potential for erosion and sedimentation of stockpile(s), stockpile profiles would typically be at angle of repose (the steepest angle at which a sloping surface formed of loose material is stable) with a slight concave slope to limit the loss of sediments off the slope, or through the profile and the formation of a toe drain.* *▪ The top surface of the stockpile(s) would be slightly sloped to avoid ponding and increase run off.* *▪ Topsoil stockpiles would be vegetated to minimise erosion.* *▪ Stockpiles would be protected from upslope stormwater surface flow through the use of catch drains, berms, or similar feature(s) to divert water around the stockpile(s).* *▪ A sediment control device, such as a sediment fence, berm, or similar, would be positioned downslope of the stockpile to minimise sediment migration.* *▪ Any water seepage from stockpiles would be directed by toe drains at the base of the stockpiles toward the sediment basins or check dams and away from the emplacement or extraction working face.* *▪ Newly formed stockpiles would be compacted (sealed off) using a smooth drum roller at the end of each working day to minimise water infiltration.* *▪ Haul roads would be located alongside the stockpile to the work/tipping area. As per best practice, the catchment area of haul roads for surface water runoff would be approximately 2530 m lengths, facilitated by the provision of spine drains which would*

FCMM No.	Item and Response
	convey water from the haul road to toe drains at the base of the stockpile, and then to sediment basins. ▪ *Temporary sediment basins would be established in accordance with the ESCP prepared for the site.* ▪ *Stockpiling of clean fill material is to be carried out during Works Period A (pre-construction) and Works Period D (bulk earthworks).* ▪ *Any imported clean general fill material that would be subject to stockpiling within the Proposal site for more than a 10-day period without being worked on, would be subject to stabilisation works, to minimise the potential for erosion.* ▪ *Where the material being stockpiled is less coarse or has a significant component of fines then surface and slope stabilisation would be undertaken. Methods for slope stabilisation may include one or a combination of the following:* *– Application of a polymer to bind material together* *– Application of hydro-seed or hydromulch* *– Covering batters with mulch to provide ground cover.* *– Covering batters with geofabric* *– Use of a simple sprinkler system for temporary stockpiles, including use of radiating sprinkler nozzles to maintain fine spray over exposed surfaces.* *– Other options identified by the Contractor.* ▪ *Topsoil stockpiles would be seeded with a grass/legume or nitrogen fixing species (such as acacia) to assist in erosion control and reduce loss of beneficial soil nutrients and micro-organisms.* Response Items 1-6 above are confirmed in Appendix F of the Construction Traffic and Access Management Plan (CTAMP). Stockpiling requirements have been completed per Landcom Blue Book and **CoC B42** & **B43** requirements, and per the above FCMM items. Refer to **Section 5.3** of this CSWMP and drawings **PIWW-COS-CV-DWG-0201, 0211, 0212 & 0213, 0249 & 0250** as included in **Appendix A** pertaining to stockpile locations and details**.**
5J	*Gross pollutant traps would be provided at basin inlets for all permanent basins during operation.* Response

FCMM No.	*Item and Response*
	This measure is noted to form part of operational phase design requirements and not relevant to the CSWMP measures or scope items set out in this report. It is noted that Gross pollutant traps have been included in the operational stormwater system design and documented in the SDDR (per **CoC B4** to **B6**) and supporting design drawings. Refer separate report and drawings as required.
5K	*Hydraulic modelling of OSD outlet channels (using HEC-RAS software) would be undertaken during detailed design, to facilitate the design of the channels and demonstrate their effectiveness with respect to energy dissipation and scour protection elements* <u>Response</u> This measure is noted to form part of operational phase design requirements and not relevant to the CSWMP measures or scope items set out in this report. It is noted that detailed modelling of outlets have been included in the operational stormwater system design and documented in the SDDR (per **CoC B4** to **B6**) and supporting design drawings. Refer separate report and drawings as required.
6d	*An Asbestos in Soils Management Plan (AMP) is to be implemented as part of the CEMP in accordance with the Safe Work NSW requirements, including but not limited to:* ▪ *the Guidelines for Managing asbestos in or on soil (2014), and* ▪ *Codes of Practice - How to Safely Remove Asbestos (2011) and* *How to Manage and Control Asbestos in the Workplace (2011).* <u>Response</u> Refer to the *Asbestos and Impacts Register* and *Contamination Management Plan* included in CEMP Appendices B and L respectively pertaining to asbestos management.
6e	*An Acid Sulfate Soils Management Plan (or equivalent) would be prepared as part of the CEMP in accordance with the ASSMAC Assessment Guidelines (1998), for areas identified as being of low or high risk i.e. works within close vicinity of the Georges River (Figure 13-2 of this EIS).* *In addition, a risk assessment quantifying the risks associated with the volumes of soil to be disturbed, the laboratory results from ASS testing undertaken, the end use of the materials and the proximity to sensitive environments is to be undertaken.*

FCMM No.	Item and Response
	All offsite disposal would be in accordance with the NSW Waste Classification Guidelines Part 4: Acid Sulfate Soils (2009). Response Refer to the *Acid Sulfate Soils Management Plan* included in CEMP Appendix M and **Section 2.6** of the CSWMP.
6J	*In order to accept fill material onto site, the following will be undertaken:* *• Material characterisation reports/certification showing that the material being supplied is VENM/ENM must be provided.* *• Each truck entry will be visually checked and documented to confirm that only approved materials that are consistent with the environmental approvals are allowed to enter the site. Only fully tarped loads are to be accepted by the gatekeeper. Environmental Assurance of imported fill material will be conducted to confirm that the materials comply with the NSW EPA Waste Classification Guidelines and the Earthworks Specification for the MPW site. The frequency of assurance testing will be as nominated by the Environmental assuror/auditor.* Response Management and details of the acceptance of fill protocols are included in the *Construction Traffic and Access Management Plan* (CEMP Appendix F).
6L	*In areas where placement of fill would occur to final site levels, but hardstand and warehousing is not currently proposed, exposed surfaces would be stabilised using hydroseeding, or the application of a bitumen emulsion or a similar stabilisation method.* Response Stabilisation of exposed surfaces is to be completed in accordance with **Section 3.4** and **Section 5.**8 of this CSWMP.

<u>Moorebank Intermodal Terminal Project – Concept, Moorebank, NSW (EPBC 2011/6086)</u>

EPBC No.	*Item and Response*
9	*Sections of the CEMP and OEMP relating to water must be prepared by a suitably qualified expert and must:* *a) be consistent with the Water Quality, Stormwater and Flooding Provisional Environmental Management Framework (2 July 2014), provided at Appendix O to the finalised EIS* *b) incorporate all measures 9A to 9AG from Table 7.1 of the finalised EIS that are described as 'mandatory'* *c) explain how all measures 9A to 9AG from Table 7.1 of the finalised EIS that are described as 'subject to review' have been addressed* *d) be approved by the Minister or a relevant New South Wales regulator.* <u>Response</u> The recommendations of *Section 6.1.2 Management Control – Early Works and Construction phase* of the *Water Quality, Stormwater and Flooding Provisional Environmental Management Framework (2 July 2014), provided at Appendix O to the finalised EIS* document have been followed. The recommendations of this document for a Soil and Water Management Plan which includes Erosion and Sediment Controls has been met through the provision of this CSWMP and ESCP. In relation to Table 7.1: • Item 9A – no works are proposed in Conservation Areas as part of this CSWMP. • Item 9B – All site compounds, stockpile areas and storage areas are proposed clear of any flood affected areas. Refer **Section 2.8** and **ESCP** in **Appendix A**. • Items 9C to 9J (which relate to Bridging of Georges River) are not relevant to the project. • Item 9K - Sediment basins are proposed for management of sediment laden water as shown on and **ESCP** in **Appendix A** and **Section 6**o the CSWMP. These generally align with future detention and bio-retention basins which will be constructed for operational phase of the development • Item 9L - The recommendations of this document for a Soil and Water Management Plan which includes Erosion and Sediment Controls has been met through the provision of this CSWMP and ESCP. • Items 9M to 9Z are not relevant to the construction phase of the development.

EPBC No.	*Item and Response*
	• Items 9AA to 9AG are not relevant to the soil and water management noting regional groundwater systems (being 8-12m below excavation levels) are not expected to affected by the development. Refer **Section 2.4** of the CSWMP.

2 DEVELOPMENT SITE

2.1 Site Description

The MPW development footprint is irregular in shape being bounded by the Georges River on the west, M5 Motorway on the north (and existing ABB Facility), Moorebank Avenue and Moorebank Precinct East (MPE) On-Site Detention (OSD) Basin 10 on the east, and undeveloped crown land to the south. Adjacent to the eastern development extent is MPE OSD 10 (being constructed on the western side of Moorebank Avenue as part of MPE.

Access to the site is via Moorebank Avenue and the Moorebank Avenue interchange with the M5 Motorway.

The site is noted to be located within Liverpool City Council Local Government Area. The development location plan is shown as **Figure 2.1** (Source Figure 1-1 CEMP).

The site is noted to comprise relatively flat topography. The highest level on the site is RL 17.8m AHD located at the south-east corner of the site. The lowest level is RL 3.0m AHD adjacent to Georges River. Generally, the levels over the site fall between a range of RL 13.5m AHD to RL 7.5m AHD. Site grading is flat to undulating, as noted, however generally falls from east to west at grades of 0.5% to 1%.

Moorebank Avenue reaches levels of RL 25.2m AHD at the East Hills Railway Line crossing and associated bridge abutment approach at the southern end of the development footprint.

As referenced in the MPES2 CSWMP Section 3.1.2 (Arcadis 2018):

> *The Georges River and Anzac Creek are classified as lowland aquatic ecosystems of south-eastern Australia. The Project EIS states that water quality parameters were found to be within the guidelines with the exception of pH and dissolved oxygen (DO). Spot measurements within the Georges River and Anzac Creek demonstrated pH 6.06 and 5.62 respectively (guideline value 6.50) and DO below the lower guideline value of 60% saturation in both locations (ALS Water Sciences, 2011).*
>
> *This was generally supported by baseline monitoring undertaken in Anzac Creek in accordance with*
>
> *MPE CoC B106 in Autumn 2018 which identified a moderate level of stream impairment and poor water quality, with an impoverished macroinvertebrate community (Biosis, 2018). Water quality monitoring identified reduced dissolved oxygen values and elevated Aluminium levels outside of guideline values within areas able to be sampled. The pH values recorded were considered to be nominal.*
>
> *Further detail of the existing water quality in adjacent waterways can be found in the Baseline Monitoring Report, Biosis 2018, prepared in accordance with MPE CoC B106.*

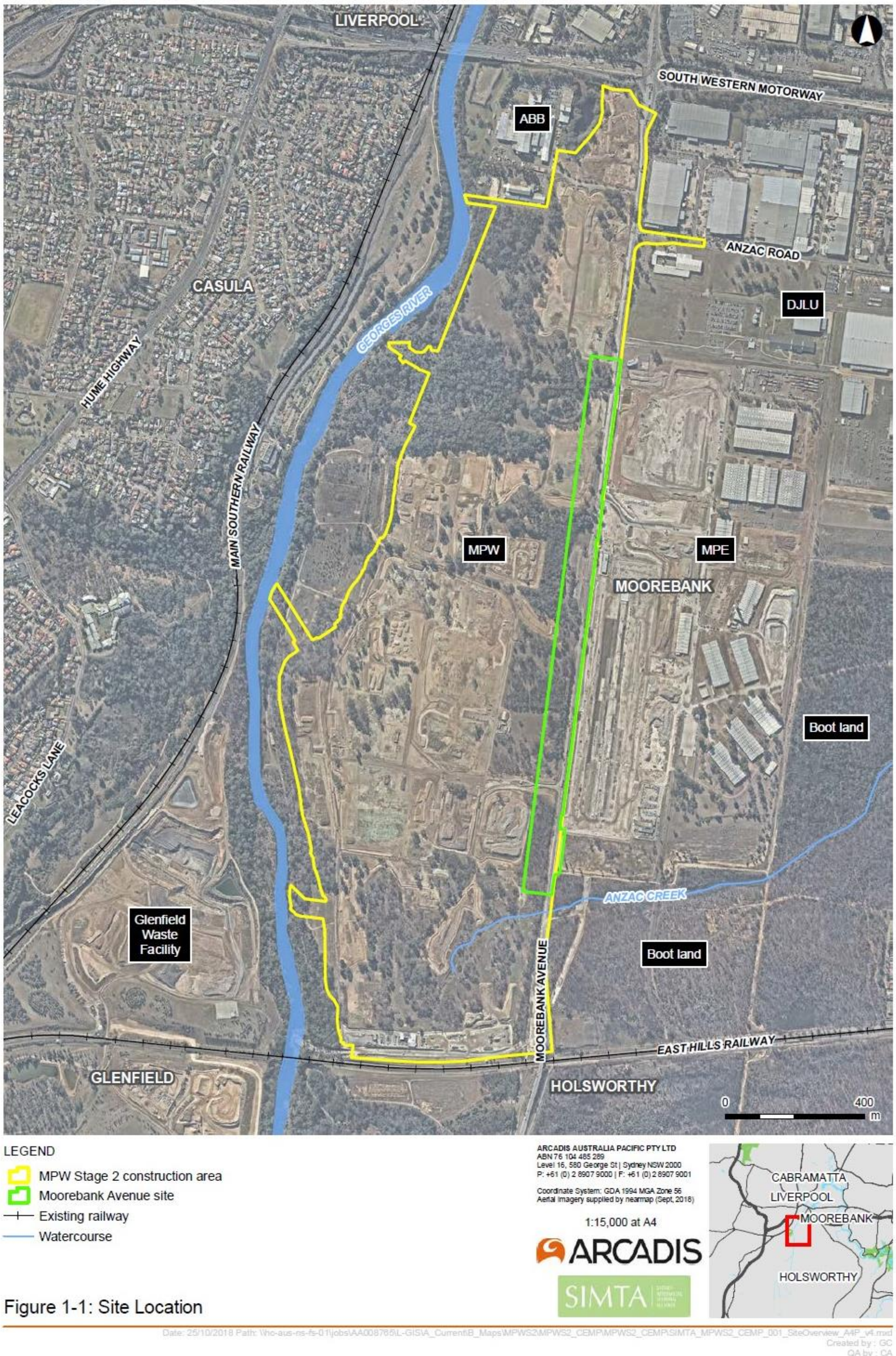


Figure 2.1 Locality Plan (Source: *CEMP Figure 1-1, Arcadis*)

The MPW site comprises five (5) key existing drainage catchments. Four of the five drainage catchments (totaling 121.2 Ha) drain in a westerly direction and directly to The Georges River. The fifth catchment (24.82 Ha), located at the south-east of the development area, drains south-east across Moorebank Avenue via Anzac Creek.

Refer to Arcadis *Figure 5-1: Existing Site Conditions (EIS Appendix R – Stormwater & Flooding Environmental Assessment)* for existing site conditions, and Costin Roe Consulting drawing **PIWW-COS-CV-DWG-0420** for existing catchment layout, areas and drainage outlet positions – refer **Appendix H**.

It is also noted that, a catchment of approximately 75 Ha from MPE (IMEX & MPE OSD 10 – 62.7 Ha, MPE OSD 9 and part of Warehouse 5 (West) – 12.3 Ha, and DJLU) drains through the site via an existing open drainage channel. The existing channel is in a state of poor maintenance and will be upgraded as per the SMP for MPE Stage 2. The channel will remain operational during the construction of MPW Stage 2. This will assist in ensuring that potential for scour erosion is minimised and associated environmental impact associated with the construction is also minimised.

2.2 Proposed Development Description

The Project site is located approximately 27 kilometres (km) south-west of the Sydney Central Business District (CBD) and approximately 26 km west of Port Botany. The Project 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 Project involves the construction and operation of a multi-purpose intermodal terminal (IMT) facility, Rail link connection, warehousing, freight village, and upgrades to the Moorebank Avenue and Anzac Road intersection. Details on the key components of the Project include:

- Construction and 24/7 operation of an intermodal terminal (IMT) facility to support a container freight throughput volume of 500,000 twenty-foot equivalent units (TEUs) per annum, including:
  - A rail terminal with nine rail sidings and associated locomotive shifter
  - A rail link connection from the sidings to the rail link constructed under MPE Stage 1 (SSD 6766) to the Southern Sydney Freight Line (SSFL)
  - A rail and truck container loading and unloading and container storage areas
  - Truck waiting area and emergency truck storage area
  - Container wash-down facilities and degassing area
  - Mobile locomotive refuelling station
  - Engineer's workshop, administration facility and associated car parking
- Operation of the IMT facility includes operation of the rail link to the SSFL and container freight movements by truck to and from the Moorebank Precinct East (MPE) site
- Construction and 24/7 operation of a warehousing estate on the northern part of the site servicing the IMT facility and including:
  - Six warehouses with a total gross floor area (GFA) of 215,000 m^2 and, for each warehouse, associated offices, staff amenities, hardstands and truck and light vehicle parking

- 800 m2 freight village (operating from 7am to 6pm, 7 days/ week) including staff/ visitor amenities
- Internal roads, noise wall, landscaping, lighting and signage.
- Intersection upgrades on Moorebank Avenue at:
  - Anzac Road providing site access
  - Bapaume Road for left turn only out of the site.

- Construction and operation of on-site detention basins, bioretention/ biofiltration systems and trunk stormwater drainage for the entire site
- Construction works and temporary ancillary facilities, including:
  - Vegetation clearing, topsoil stripping and stockpiling and site earthworks and temporary on-site detention
  - Importation of up to 1,600,000 m^3 of uncompacted fill, temporary stockpiling and placement over the entire site to raise existing ground levels by up to 3 m
  - Materials screening, crushing and washing facilities
  - Importation and placement of engineering fill and rail line ballast
  - Installation and use of a concrete batching plant & crushing facility;

Utilities installation/ connection. The proposed development overview has been defined in the *CEMP Figure 1-2* and is included for reference in this CSWMP as **Figure 2.2**.

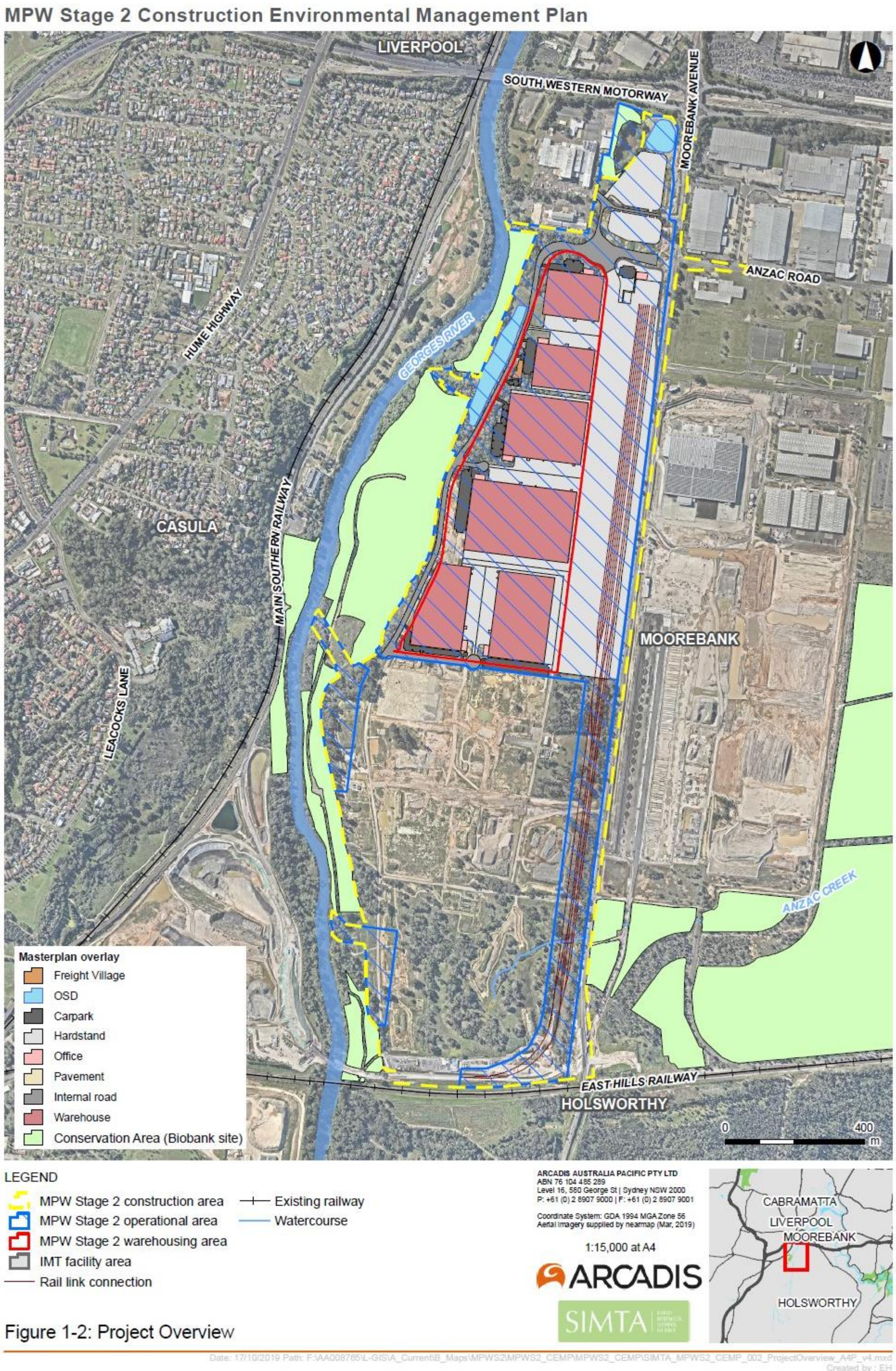


Figure 2.2. MPW Stage 2 Project Overview (Source: *CEMP Figure 1-2, Arcadis*)

Construction of the Project is anticipated to be approximately 36 months. Construction works have been divided into delivery phases which are interrelated and may overlap. The terminology for the Project delivery phases or periods has been developed from the approved EIS and RtS documentation.

The project delivery phases and the equivalent CoC and RtS phases are provided in the CEMP and included in the CSWMP as **Table 2.1**.

Table 2.1. Project Delivery Phase Terminology (Source: CEMP Figure 1-2)

Table 1-2 Project Delivery Phase Terminology

Works Activity	Project Delivery Phase	MPW Stage 2 RtS Equivalent
Pre-Construction	Site Preparation	Works period B – Site preparation activities
Construction	Benching	Works period C – Bulk earthworks, drainage and utilities Works period A - Pre-construction stockpiling and filling
	Roads	Works period D – Moorebank Avenue intersection works and internal road network
	Terminal and Rail	Works period E – IMT facility and Rail link connection construction
	Warehousing	Works period F – Construction and fit-out of warehousing and freight village
		Works period G – Miscellaneous structural construction and finishing works

2.3 Existing Geology & Soils

A number of geotechnical investigations have been completed on the land including assessments by Golders. The subsurface conditions on site can be broadly grouped into four main material types being topsoil, fill material, natural soils and weathered rock.

The 1:100,000 Geological Map for Penrith shows the site is underlain by (Qha) quartz sand, silty sand and clay.

Topsoil typically comprises silty sand, fine grained sand, rootlets and bark to a depth of 0.4m and of loose density.

Natural soils typically comprise medium dense sands, sandy clay and stiff to hard clay with sand to depths between 0 to 3m.

Weathered Rock was found at depths greater in the order of 20m and represents weathered siltstone.

The geotechnical model which provides a generalised rock and soil profile for the MPW Stage 2 site is included in the Golders Geotechnical Investigation prepared for the EIS. This is reproduced for information in **Table 2.2**.

Table 2.2. Geotechnical Model (Source: Golders)

Table 4: Geotechnical Model

Unit		Sub-unit	
1	Surficial Soils	1A	Topsoil
		1B	Anthropogenic Fill
		1C	Granular Fill
		1D	Cohesive Fill
2	Recent Alluvium	2A	Sand
		2B	Clay
3	Older Alluvium	3A	Sand
		3B	Clay
4	Shale	4A	Residual Shale Soil
		4B	Extremely Low to Low Strength Shale
		4C	Shale of medium strength or higher
5	Sandstone	5A	Residual Sandstone Soil
		5B	Very Low to Low Strength Sandstone
		5C	Sandstone of medium strength or higher

The soils throughout the project site, and expected imported soils (crushed sandstone or clay), are generally classed as Soil Texture Type F and Soil Hydrological Group Type D in accordance with *Landcom Blue Book Section 3.2.7* and *Appendix F* respectively.

Refer **Appendix D** for detailed geotechnical information.

2.4 Groundwater

Discussion on groundwater is included in the Golders Geotechnical report *Section 5.3* and reproduced here for completeness:

> *Groundwater beneath the MPW site area was about 8 to 12 m below the existing ground levels at the time of the geotechnical investigation, which is deeper than the expected depth of excavations.*
>
> *However, higher water levels were encountered in the vicinity of established ponds on the site (e.g. 0.8m below surface at GA-BH-3102 and 2.8m below surface at GA-TP-3112). Relatively higher groundwater was also encountered in the vicinity of Anzac Creek at GA-CPT-3116, where groundwater was recorded at approximately 2m below ground level.*
>
> *Groundwater is likely to be encountered within the depth of bored piles, if used (see Chapter 8.3.2).*
>
> *Groundwater monitoring was carried out by PB (PB, 2011) and a monitoring round was completed by Golder (Golder 2015b). The results of the PB groundwater monitoring indicated the groundwater within the alluvial soils generally flows westwards towards the Georges River with groundwater levels recorded in 2011 of between RL6mAHD and RL2mAHD. These results are consistent with the results of the Golder monitoring.*
>
> *As the alluvial soils on the site contain granular horizons, there may be seasonally elevated perched water tables in fill materials and sand*

layers. These perched water systems could impact retaining walls, excavations for slopes and foundations. Elevated or perched groundwater levels are also expected in the vicinity of established ponds on the MPW site. Perched groundwater inflows could potentially lead to softening of natural alluvial clays in footing excavations, so concrete for footings should be placed as soon as practicable. Potential for perched groundwater should be considered in the design of slopes and retaining walls and control measures such as sump pumping may be required during construction.

Based on the geotechnical investigations, groundwater generally should not be encountered or would be limited to localised areas. In the event that groundwater were to be encountered, then the management requirements of the CSWMP and requirements of the NSW EPA EPL, and requirements relevant sub-plans of the CEMP (for example the Acid Sulfate Management Plan, Contamination Management Plan) would need to be applied for dewatering or discharge of water.

2.5 Contamination

Contaminants of concern have been identified within the project area. A *Contamination Management Plan* (CMP) has been prepared by EP Risk (EP1340.002_MPW_CMP.pdf) for MPW Stage 2 .

The CMP includes and requires the appropriate briefing and Specific Work Health and Safety (WHS) induction of site workers who may uncover potential chemical contamination (including potential asbestos containing materials) and/or explosive ordnance. This CMP describes reporting procedures and lines of responsibility relating to contaminants of concern.

Any management measures relating to contaminants of concern should refer to the CMP and measures included in the CMP.

2.6 Acid Sulfate Soils

An *Acid Sulfate Soil Management Plan* (ASSMP) has been prepared by EP Risk (EP1340.001_MPW_ASSMP.pdf) for MPW Stage 2.

The objective of the ASSMP is to ensure a controlled management approach and strategy associated with acid sulfate soil (‘ASS’) and provide guidance on the management of stockpiling and on-site reuse (if suitable) of surplus soil material which is likely to be encountered during the MPW Stage 2. The ASSMP has been prepared in accordance with the Acid Sulfate Soil Manual (ASSMAC 19982).

As set out in *Section 1.4* of the ASSMP, the ASSMP aims to satisfy the following objectives:

1. Review of previous investigations undertaken at the Site.
2. Address the requirements of the relevant environmental legislation and statutory requirements as it applies to the MPW Stage 2.
3. Summarise potential impacts on the environment from the proposed works.
4. Document environmental procedures that must be followed to control potential environmental impacts.

5. Control and minimise the disturbance of ASS.
6. Confirmation of the effectiveness of the adopted control measures by validation testing and documentation.
7. Preservation of engineered structures, water quality, soil quality and the wider environment.
8. Preparation of this ASSMP in accordance with the relevant statutory provisions and guidelines.

Refer to the ASSMP for detailed management requirements associated with ASS.

Where ASS is encountered, additional requirements included in the ASSMP (to those stipulated in this CSWMP) are to be followed in accordance with the ASSMP.

2.7 Climate and Meteorology

The Holsworthy area experiences relatively mild temperatures and moderate rainfall, with a yearly average rainfall of about 880 mm, based on records from the nearest observation site at Bankstown Airport since 1968 (Station 066137).

Typically, the wettest month (mean rainfall) is February, and driest usually August.

The annual mean minimum temperature is 12.0°C and the mean maximum temperature is 23.2°C. The hottest month is usually January (mean maximum of 28.2°C) and the coldest month is usually July (mean minimum of 5.1°C).

Climate statistics and average annual rainfall data and rainfall patterns relevant to this site (Bankstown Airport as sourced from Australian Bureau of Meteorology (BOM)) are included for reference in **Appendix C** of this **CSWMP**.

2.8 Flooding

A flood assessment was completed by Arcadis and formed Appendix R of the EIS (*Moorebank Precinct Intermodal Terminal Facility – MPW Stage 2 Stormwater and Flooding Environmental Assessment*).

Reference to **Figure 2.3** and **Table 2.3** below should be made for flood modelling information and levels.

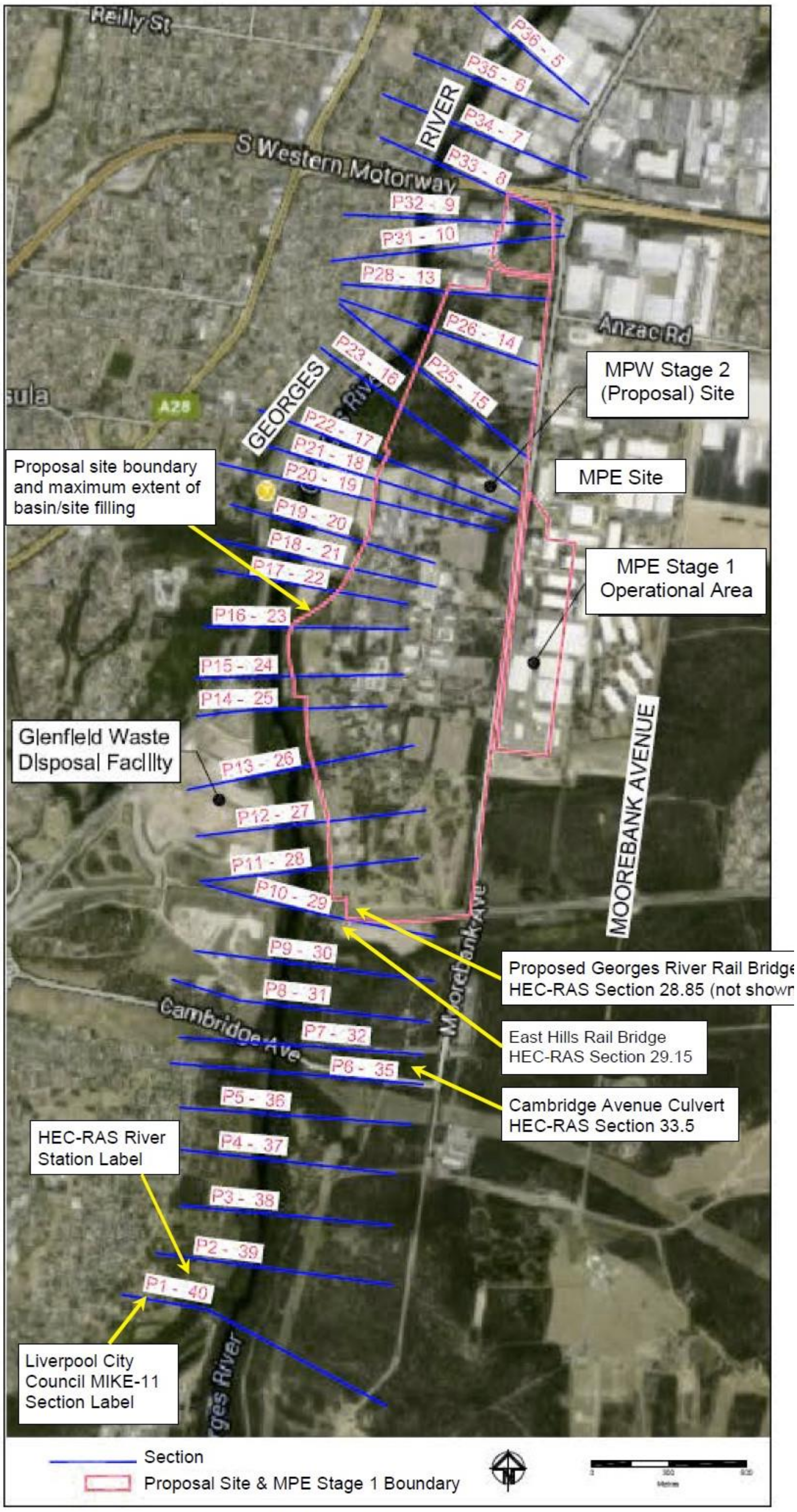


Figure 4-2: Location of HEC-RAS Model Sections

Figure 2.3. Location of HEC-RAS Flood Model Sections (Source: Arcadis Figure 4-2)

Table 2.3. MPW S2 Flood Levels (Source: Arcadis Table 4-1)

Table 4-1: Comparison of 'Base-Case' and 'MPW Stage 2 Proposed Development' Flood Levels

Location	100 year ARI			PMF		
	Flood Level (mAHD)		Flood Impact (mm)	Flood Level (mAHD)		Flood Impact (mm)
	Base-case Condition*	Proposed Condition		Base-case Condition*	Proposed Condition	
36	12.68	12.67	-0.01	16.24	16.24	0.00
35	12.68	12.67	-0.01	15.98	15.99	0.01
34	12.26	12.26	0.00	15.19	15.20	0.01
Cambridge Ave culvert	-	-	-	-	-	-
33	12.16	12.16	0.00	15.26	15.26	0.00
32	12.06	12.06	0.00	14.98	14.98	0.00
31	11.99	11.99	0.00	14.93	14.93	0.00
30	11.88	11.88	0.00	14.80	14.80	0.00
29.3	11.82	11.81	-0.01	14.72	14.72	0.00
29.2	11.76	11.75	-0.01	14.63	14.63	0.00
Existing. Rail Bridge	-	-	-	-	-	-
29.1	11.73	11.73	0.00	14.42	14.43	0.01
29	11.70	11.69	-0.01	14.43	14.43	0.00
28.9	11.72	11.72	0.00	14.43	14.43	0.00
Proposed MPE Stage 1 Rail Bridge	-	-	-	-	-	-
28.8	11.69	11.69	0.00	14.22	14.22	0.00
28.7	11.49	11.49	0.00	13.89	13.89	0.00
28	11.35	11.35	0.00	13.72	13.72	0.00
27	11.35	11.35	0.00	13.83	13.84	0.01
26	11.40	11.40	0.00	13.83	13.83	0.00
25	11.20	11.20	0.00	13.51	13.52	0.01
24	11.11	11.11	0.00	13.36	13.36	0.00
23	10.92	10.92	0.00	12.86	12.86	0.00
22	10.93	10.93	0.00	13.15	13.15	0.00
21	10.99	10.99	0.00	13.25	13.26	0.01
20	10.98	10.98	0.00	13.25	13.25	0.00
19	10.92	10.92	0.00	13.16	13.17	0.01
18	10.82	10.82	0.00	13.00	13.00	0.00
17	10.82	10.82	0.00	12.96	12.96	0.00
16	10.80	10.80	0.00	12.94	12.95	0.01
15	10.73	10.73	0.00	12.85	12.86	0.01
14	10.63	10.63	0.00	12.77	12.77	0.00

* i.e. with MPE Stage 1 Rail link potential flood impact (preliminary only, to be further assessed in MPE Stage 1 design)

The 1% Average Exceedance Probability (AEP) flood line, as defined in the above EIS assessment, has also been shown on ESCP drawings **PIWW-COS-CV-DWG-0210** to **0213** and **0249**. This shows that all ESCP measure are located clear and above the flood affected areas other than items associated with drainage outlets.

It is further noted that generally site levels are all higher than the PMF event, hence the site can be considered flood free in relation to the regional flood conditions.

Local flooding relates to site runoff and contributing catchments relating to the MPW Stage 2 development areas and conveyance of runoff in the east-west culvert only. Local drainage runoff and overland flow is addressed in the ESCP as endorsed by the CPESC.

Given the site is free from regional flooding and local overland flow is managed through ESCP measures, flood liability and risk (CoC B30(a)(ii) is considered low to negligable.

3 GENERAL REQUIREMENTS

3.1 Introduction & Reference Documents

This CSWMP has been prepared with the purpose of providing a set of site management procedures to control the severity and extent of soil erosion and pollutant transport during the earthworks and construction phase of the MPW Stage 2 development.

This document has been completed in accordance with the guidelines in *Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004)*.

An erosion and sediment control plan (ESCP) is shown on drawings **PIWW-COS-CV-DWG-0201, 0211, 0212 & 0213** & **0249** with details of various measures shown on drawings **PIWW-COS-CV-DWG-0250 & 251** (refer **Appendix** A) for works within the project boundaries. Specific plans pertaining to outlets to Georges River are shown on drawings **PIWW-COS-CV-DWG-0246, 0247 & 0248**. This CSWMP is to be read in conjunction with the provided drawings.

Contractors will ensure that all soil and water management is undertaken in accordance with this CSWMP and the guidelines in *Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004)*.

3.2 Roles and Responsibilities

1. All Project Personnel are responsible for the implementation of this CSWMP and have the responsibility to stop works if there is potential for a safety or environmental incident to occur.
2. The key roles and responsibilities for the Project personnel in relation to soil and water management are outlined below in **Table 3.1**.

Table 3.1 Roles and Responsibilities

Role	Responsibilities
Contractor's Project Manager (Contractor's PM)	Manage the delivery of the construction process in relation to soil and water quality management at the site in conjunction with the Contractor's EM. Provide for training in erosion and sediment control for personnel directly involved with the implementation of this plan, as required. Identify and allocate Project resources to implement the requirements of this plan. Oversee the implementation and maintenance of this plan.
Contractor's Construction	Communicate with all workers including sub-contractors regarding compliance with the CSWMP.

Role	Responsibilities
Manager (Contractor's CM)	Record and communicate volume of spoil imported to site to the Principal's Representative on a weekly basis. Coordinate the implementation and maintenance of erosion and sediment controls and provide support for the Contractor's EM.
Contractor Environmental Manager (Contractor's EM)	Co-ordinate CPESC to undertake monthly inspections and report on implementation of this plan (CoC B32). CPESC to recommend any improvements to the plan and site control measures (CoC B32). Develop, implement, monitor and update the progressive CESCPs as required. Direct works to be performed in accordance with this plan. Review works proposed within the riparian zone. Maintain site records confirming achievement of water quality objectives prior to discharge. Maintain relevant waste disposal records Co-ordinate the sampling and assessment of waters and sediments in control structures to enable classification and reuse, discharge or disposal in an appropriate manner on or off site. Maintain the site water quality register (8.2) Record environmentally relevant incidents. Manage and respond to reported incidents.
Site Supervisor	Present toolbox talks that include the requirements of this plan. Inform staff of their obligation to comply with EWMS and CESCPs. Communicate the volume of spoil imported to site on a daily basis to the Contractor's CM. Manage and respond to reported incidents. Approval to make new infrastructure operational. Co-ordinate and report on daily and weekly inspections. Co-ordinate inspection and monitoring of equipment washdowns, waste handling and other construction related activities that influence the site's management of soils and water.
All Personnel	Comply with the requirements of this CSWMP.

Role	Responsibilities
	Report any observed failure of ERSED infrastructure to the Contractor's EM or Site Supervisor. Report all environmental incidents to the Site Supervisor and/or the Contractor's EM.

3.3 Legal and Regulatory Requirements

The below sets out the legislation and planning instruments considered in the preparation of this sub plan. It is noted that the regulatory framework for the project is set out in *Section 2.4* of the *CEMP*.

The Project has been approved under both the *Environmental Planning and Assessment Act* 1979 (EP&A Act) and the EPBC Act.

The CSWMP has been prepared in accordance with the CoC of SSD7709 (as set out in **Section 1.3** of the CSWMP) and forms a subsection of the *CEMP* prepared by Arcadis. This plan is to be read in conjunction with the *CEMP* and any statutory requirements and other management measures included in the *CEMP*.

The plan has been completed in accordance with all relevant approvals and regulatory framework including Australian Government (Department of Environment and Energy) *Concept Approval EPBC 2011/6086* dated 27 September 2019 and *Condition 9(a) to (d)* of this approval.

This CSWMP has been prepared in accordance with the NSW EPA EPL (refer **Appendix** I) and discharge criteria included in **Section 3.6** of the **CSWMP**.

It is further noted that this CSWMP has been completed with consideration to the Arcadis Document included in Appendix 2 of the approved SSD_7709 "*Final Compilation of Management and Mitigation Measures*" submitted 2 November 2018. The items included in the *Applicants Final Management and Mitigation Measures* are consistent with the requirements of *Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004)* as set out in this document. Refer **Appendix J** for FCMMs.

Table 3.2 lists regulatory guidelines and documents relevant to the CSWMP.

Table 3.2. Regulatory Documents and Guidelines

Legislation	Description	Relevance to the CSWMP
Environmental Planning and Assessment Act 1979	This Act establishes a system of environmental planning and assessment of development Projects for the State.	The CoCs and obligations issued under Part 4 of the EP&A Act are addressed in this plan.
Protection of the Environmental Operations Act 1997	The objectives of this Act relate to the protection of the environment through pollution prevention and cleaner production, among others.	Relevant sections of the Act, including duties to report pollution incidents and disposal regulations have been incorporated into this plan and incident response procedures. A key legislative requirement applicable to construction soil and water management is Section 120 of the Protection of the Environment Operations Act 1997 which relates to pollution of waters and the need to implement all reasonable and feasible measures to minimise the risk of pollution of waters. Part 5.7 of the Act requires that a pollution incident causing or threatening material harm to the environment be notified to EPA and other relevant authorities as outlined in the CEMP. Material harm constitutes actual or potential harm to the health or safety of humans and/or ecosystems that is not trivial, or results in actual or potential loss or property damage of amounts in excess of $10,000 in total.
Contaminated Land Management Act 1979	The general object of this Act is to establish a process for investigating and (where appropriate) remediating land that the EPA considers to be contaminated significantly enough to require regulation under Division 2 of Part 3, and to ensure that contaminated land is managed with regard to the principles of ecologically sustainable development.	Contamination on site must be assessed and managed in accordance with this act. Division 2, Part 3, Section 11-17 of this Act details requirements for the Management of Contaminated Land.
Water Management Act 2000	The objects of this Act are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.	Although it is not envisaged that any construction activities would be undertaken on waterfront land, any waterfront activities that do occur would be conducted generally in accordance with the NSW Office of Water's Guidelines for Controlled Activities.
Fisheries Management Act 1994	The objectives of this Act seek to conserve fishery resources, fish stocks and key fish habitats.	This CSWMP has been prepared to maintain existing flow regimes surrounding the site and to contain water onsite within sediment basins until discharged with strict water quality requirements. No impacts to fisheries are envisaged as a result of Project construction.

Legislation	Description	Relevance to the CSWMP
Dangerous Goods Regulation (Road and Rail Transport) 2014	The main objects of this Regulation are to give effect to the standards, requirements and procedures of the Code so far as they apply to the transport of dangerous goods by land transport, and to promote consistency between the standards, requirements and procedures applying to the transport of dangerous goods by land transport and other modes of transport.	Provisions relating to the storage and transport of dangerous good, such as fuelling procedures and fuel storage, are incorporated into this plan.
Commonwealth Environmental Protection and Biodiversity Conservation Act 1999	The objectives of this Act seek to promote environmental protection, ecologically sustainable development, biodiversity conservation and the promotion of heritage, among others.	Requirements under EPBC Approval (No. 2011/6086) have been considered during the preparation of this CSWMP.

Additional guidelines and standards considered in relation to the management of soil and stormwater include:

- Managing Urban Stormwater – Soils and Construction Volume 1, 4th Edition (Landcom 2004);
- Managing Urban Stormwater: Soils and Construction − Installation of Services, Volume 2A (OEH 2008); and
- Australian Rainfall and Runoff – Volume 1 (2001), Engineers Australia.

3.4 General CSWMP Requirements

1. This document is noted to form a sub-plan as part of the *CEMP* as required under **CoC C2** to **C4**.
2. This document and associated drawings are subject to further periodic review throughout the works period to ensure the requirements and measures set out in this CSWMP are fit for purpose and allow for any changes which might occur during construction not envisaged during the initial preparation of the CSWMP and associated ESCP.
3. All erosion and sediment control measures will conform to the standards and specifications contained in:
   (i) This CSWMP;
   (ii) Conditions of Consent;
   (iii) the approved *CEMP* and supporting documentation; and
   (iv) the latest version of *Landcom Blue Book* if the standards and specifications are not contained in the approved ESCP.
4. Any works that may cause significant soil disturbance and are ancillary to any activity for which regulatory body approval/ consent is required, will not commence before the issue of that approval/ consent.

5. Additional and/or alternative ESC measures are to be implemented in the event that site inspections, the site's incident response requirements (refer *CEMP*), or the regulatory authority, identifies that unacceptable off-site sedimentation is occurring as a result of the work activities.
6. Land-disturbing activities shall not cause unnecessary soil disturbance if an alternative construction process is available that achieves the same or equivalent outcomes.
7. It is noted that ongoing inspections and monitoring by the CPESC and ER will be necessary throughout the works period. These inspections shall be undertaken in accordance with project conditions.
8. Appropriate additional erosion and sediment control measures will be implemented as required on site to suit changing site conditions, or other on-site conditions not included in the design documents, such that all reasonable and practicable measures are being taken to ensure acceptable water quality measures are installed. Only those works necessary to minimise or prevent environmental harm shall be conducted on-site prior to approval of the amended Erosion and Sediment Control Plan (ESCP).
9. Only VENM, ENM, or other imported fill material approved in writing by EPA is to be placed on the site, as required of **CoC A7**.
10. The total volume of uncompacted fill to be imported must not exceed 1,600,000m3 as required of **CoC A8**.
11. Importation of imported fill must not exceed a total of 22,000m3 of material per day across this development and MPE Stage 2 (SSD 7628) on the same day as required of **CoC A9**.
12. No construction (including clearing and maintenance access) is permitted within the riparian corridor except for that identified on the revised drawings approved under **Condition B2** and activities associated with vegetation and stormwater management. as required of **CoC A10.**
13. The southern fill area where future warehousing is proposed must be topsoiled and hydroseeded with native grasses as required of **CoC B65**.
14. Perimeter fill batters must be stabilised with vegetation as required of **CoC B66**.

3.5 Erosion and Sediment Control Hazard Assessment

The erosion hazard assessment has been completed per the guidelines of the *Landcom Blue Book.* This assessment identified the proposed development works as posing a high risk to receiving waterways given the proximity of the site to The Georges River. The risks to waterways from site construction activities are:

- Exposure of surface and subsurface soils due to the bulk earthworks activities. At this stage cut and fill to create flat sloping pavements and building envelopes above the Regional 100-year ARI flood level is proposed.
- Exposure of subsurface soils due to bulk earthworks.

- Area of disturbance will be up to a maximum exposed area of 65 Ha in accordance with **CoC B41**.
- As per RUSLE Calculation included in **Section 6.1** and drawing **PIWW-COS-CV-DWG-0201** in **Appendix A.** The assessment results in a soil loss of 68 t/Ha/yr, a Soil Loss Class of 1 and resulting “very low” hazard classification.

In relation to **CoC B30(a)(i) to (v)** refer **Table 3.4** which sets out management measures to mitigate risk items listed in the CoC.

Table 3.4. CoC B30(a)(i) to (v)

Item	Comment	Relevant Reference
(i) Monthly Rainfall Erosivity	Monthly rainfall erosivity assessment has been made per Landcom Blue Book requirements and included in **Appendix G.** The assessment shows that the highest erosivity potential is realised in the months of January to April, with low potential during June to October.	**Appendix G**
(ii) Flooding Liability	Risk of flood affectation or liability is low to negligible. Flood assessments completed as part of the EIS show that the site is clear of the 1% AEP (1 in 100-year ARI) flood extent and also generally above the PMF event.	**Section 2.8**
(iii) Topography	Existing topography is flat with minimal falls over the property as described in **Section 2.1**. Proposed topography (following earthworks and building construction) will generally comprise flat gradients (in the order of 0.5-5%). Risk associated with topography are mitigated through **ESCP** measure outlined in this **CSWMP** and	**Section 2.1** ESCP Drawings in **Appendix A.**

	ESCP drawings in **Appendix A.**	
(iv) Physical and chemical properties of in-situ and imported soils	Physical and chemical properties of in-situ soils are described in Golders Report (appendix D) and Section 2.3 of this CSWMP. Relevant assessments relating to soil and water have been completed as set out in **Section 6.1** pertaining to erosion runoff potential and RUSLE noting a very low hazard classification has been calculated.	**Section 2.3, 2.5, 2.6** and **6.1,** drawings in **Appendix A** and Geotechnical information in **Appendix D**.
(v) Sensitivity of receiving environment	Assessments completed as part of the EIS shows that the receiving environment (Georges River & Anzac Creek) are low quality aquatic environments (refer Section 3.1). Management of discharge to receiving environment and potential of discharge affecting the receiving environment is low based on adherence to this CSWMP and discharge criteria in **Section 3.6**.	**Section 2.1 & 3.6**

3.6 Water Discharge Performance Criteria

The quality of discharge from the site to satisfy the following Water Quality Objectives (WQOs) per Landcom Blue Book requirements:

- Water pH released from a controlled sediment basin outflow shall be within the range 6.5 to 8.5.
- Suspended Solids released from controlled sediment basin outflows will be no greater than 50mg/L, 75 NTU's (Nephelometric Turbidity Units) or other Turbidity measurement based on confirmed laboratory correlation. Correlation should be confirmed through laboratory assessment and in consultation with the CPESC.
- Oils and Grease – no visible films or odour.
- Litter – no visible litter washed or blown from the site.

Requirements set out in the NSW EPA EPL (Number: 21054) (refer **Appendix I**) are included as **Table 3.5** below with discharge points (per the EPL) shown in **Figure 3.1**.

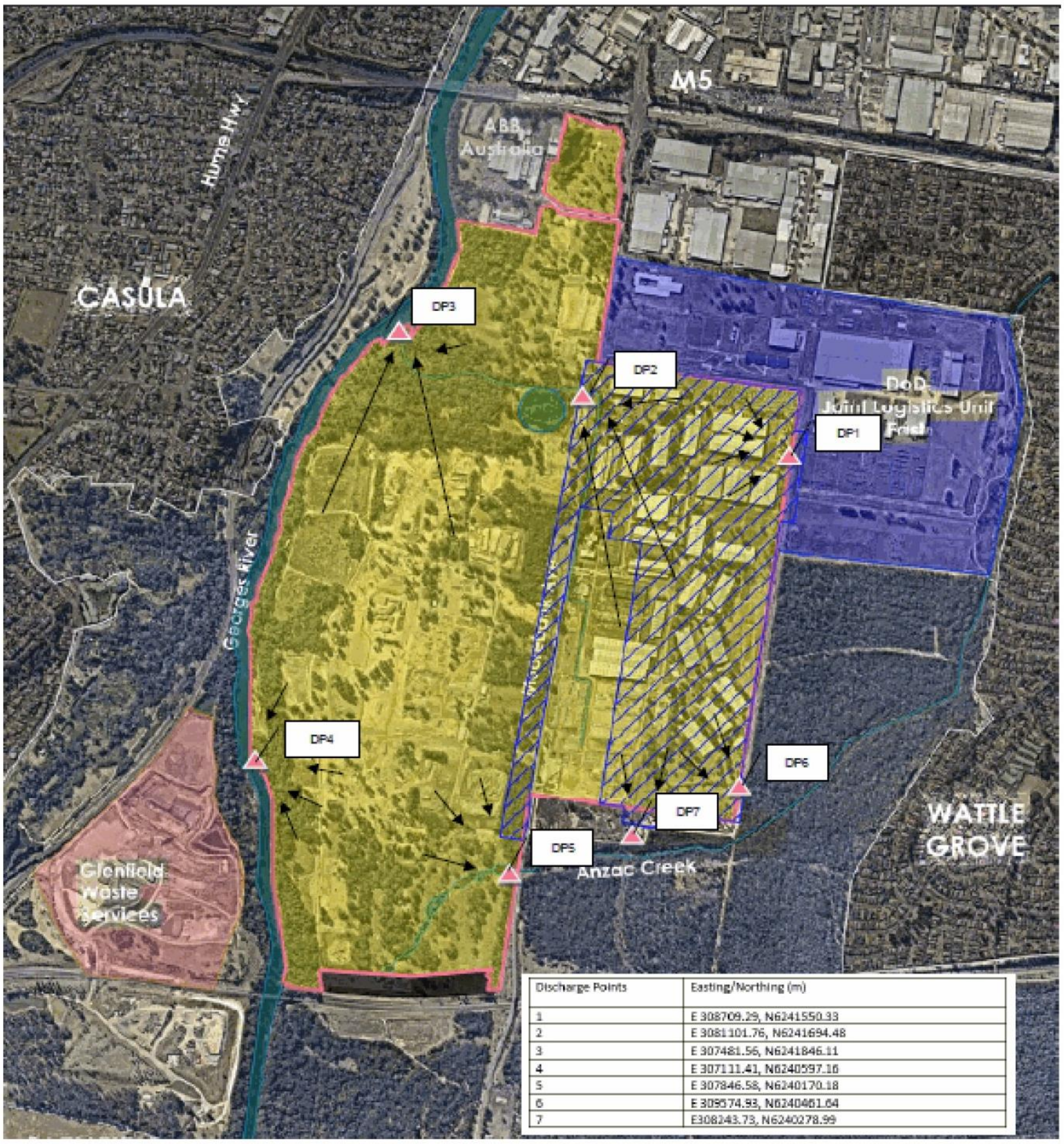


Figure 3.1. NSW EPA EPL Discharge Point Locations

Table 3.5. NSW EPA EPL Discharge Requirements

POINT 1,2,3,4,5,6,7

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	Visible				0
pH	pH				6.5-8.5
TSS	milligrams per litre				50
Turbidity	nephelometric turbidity units				25

POINT 3,4,5

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Perfluorohexane sulphonate (PFHxS)	micrograms per litre				0.7
Perfluorooctane sulphonate (PFOS)	micrograms per litre				0.7
Perfluorooctanoic acid (PFOA)	micrograms per litre				5.6

Additional requirements for discharge set out in the NSW EPA EPL are as follows:

- PFHxS and PFOS must not exceed a total combined concentration limit of 0.7 micrograms per litre
- The total suspended solids and turbidity limits specified under Condition L2.4 for the discharge points identified as EPA licence discharge points 1, 2, 3, 4, 5, 6 and 7 do not apply when the discharge occurs solely as a result of rainfall measured at the premises which exceeds a total of 24.4 millimetre of rainfall over any consecutive 5 day period.
  <u>Note:</u>
  A 24.4mm rainfall depth is defined by the publication Managing Urban Stormwater: Soils and Construction (Landcom 2004) as the rainfall depth in millimetres for a 80th percentile 5 day rainfall events for the Liverpool area.
- The concentration limit for Total Suspended Solids (TSS) and turbidity under condition L2.4 for licence discharge points 1, 2, 3, 4, 5, 6 and 7 is deemed not to have been breached where:
  - the sample complies with the turbidity limit at the time of the discharge; and
  - the EPA is advised within three (3) working days of completion of the TSS testing, of any TSS results above the licence limit.

Records of confirmation of achievement of water quality objectives are to be maintained on site and to be provided on request to the ER and CPESC.

3.7 Contingency Planning

Reference to the unexpected finds protocols within the *CEMP* (Appendix A to D) should be made pertaining to contingency management.

3.8 Incident Classification and Notification

It is the responsibility of all site personnel to report all environmental incidents to the Site Supervisor and/or the Contractor's EM.

Incident response requirements including classification, responses, external notification and incident review protocol are set out in *Section 2.8* of the *CEMP*. Reference to the *CEMP* should be made pertaining to all incident response protocol.

3.9 Environmental Auditing and Reporting

Auditing and reporting will be undertaken in accordance with the CEMP Section 4, refer to the CEMP for details.

3.10 Non-compliance, Non-conformance and Actions

It is the responsibility of all site personnel to report non-compliances and non-conformances to the Site Supervisor and/or the Contractor's EM.

Non-compliances, non-conformances and corrective and preventative actions will be managed in accordance with Section 4.4 of the CEMP.

3.11 Review and Improvement

The effectiveness of sediment and erosion control measures will be confirmed through monthly CPESC inspections, ongoing site inspections by the Construction Contractor, CPESC and the ER. Adjustments as required during the construction period will be made based on confirmed site conditions and effectiveness of the implemented measures.

Review and improvement of this plan (including the CESCP contained in **Appendix A**) will be also be undertaken in accordance with the CoCs and Section 4.5 of the CEMP. Continuous improvement will be achieved by the ongoing evaluation of environmental management performance and effectiveness of this plan against environmental policies, objectives and targets.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure. Construction will be undertaken in accordance with the most recent, approved version of this CSWMP.

4 MANAGEMENT PHASES DURING CONSTRUCTION

4.1 Background

The CSWMP employs an ESCP which will be implemented to minimise water quality impacts in terms of sediment loading. The ESCP drawings are included in **Appendix** A and listed in **Section 3.**1 of this CSWMP. The plan includes measures such as sediment fences, cut-off drains for sediment laden stormwater and diversion channels for clean stormwater run-off.

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

It is expected that the construction period will be more than 6 months.

4.2 Pre-Construction

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

- Sediment fences will be in accordance with *Blue Book Standard drawing SD 6-8* and constructed in locations specified on drawings, and on the upstream edges of the designated buffer strips and at the base of fill embankments.
- Areas for plant and construction material storage will be designated along with associated drains and spillage holding ponds and any contaminated soil management measures required of the CMP. These areas will remain separate to the CSWMP measures and detailed per the CEMP. Refence to the CEMP will be made pertaining to construction specific management measures and spill procedures.
- Diversion banks (and/ or drains) will be created at the upstream boundaries of construction activities to ensure upstream runoff is diverted around any exposed areas. These diversion banks (and/ or drains) will be sufficiently stable to not contribute sediment or sediment laden water off-site. Catch drains will be created at the downstream boundary of construction activities.
- Rock check dams and/or gravel bags or sandbags will be placed along the catch drains to slow flow, reduce scour and capture some sediment from internal site water runoff. Refer to drawings for recommended locations.
- Construction of temporary sediment basins will be completed.
- Site personnel will be educated to the sediment and erosion control measures implemented on site.
- Sediment basins will be flocculated prior to any run off being received. An acceptable method is for water to be treated with gypsum at approximately 32 kg per 100m^3 of collected runoff, or as required to achieve the specified water quality targets.
- All exposed soils should be stabilised within 5 days of completion. Acceptable method would be to use a soil binder such as Ground Control (Complete Water Treatment), Stonewall (Vital Industries) or approved equivalent as noted in **Section 5.8**.

- Concrete crushing plant, washout and other construction related activity to be self-contained and managed through construction specific management measures and spill procedures including in the CEMP and subplans included per **CoC C3**.

- Stockpile management to be completed as set out in ESCP (**Appendix A**) and **Section 5.3**.

4.3 During Construction

The following minimum requirements will be met during construction:

- Progressive re-vegetation of filled areas and filled batters.
- Construction activities will be confined to the necessary construction areas.
- The provision of a stabilised site access to minimise the tracking of debris from tyres of vehicles leaving the site onto public roads. Construction exits will be nominated to manage the movement of construction access to defined locations. Refer to *Blue Book Standard Drawing SD 6-14* on drawing **PIWW-COS-CV-DWG-0250**.
- Topsoil and temporary stockpile location will be nominated to coincide with areas already disturbed. Stockpiles will be sealed with soil binder within 20 days. A sediment fence will be constructed around the downstream side of the stockpile and a diversion drain at the upstream side if required.
- Measures relating to contaminated spoil stockpiles to be implemented in accordance with the CMP by EP Risk. Refer to CMP for management and waste disposal measures.
- Regular inspection and maintenance of sediment fences, sediment basins and other erosion control measures will be made. Following rainfall events greater than 5mm inspection of erosion control measures and removal of collected material will be undertaken. Replacement of any damaged measures will be performed immediately.
- Management measures set out in the FCMM's to be implemented – refer **Appendix J**.
- Spill response to be managed via procedures set out in CEMP and subplans in Appendix G, P and R.

Site shutdowns are conducted in a manner that minimises potential environmental harm:

- Existing ground covers are protected from damage and retained as long as practicable.
- Procedures for initiating a long-term site shutdown (e.g. between completion of earthworks and building works) incorporate appropriate revegetation or approved stabilisation (per **Section 5.8**) of all soil disturbances unless otherwise stipulated within an approved site management plan.
- Stabilisation procedures associated with a programmed site shutdown commence at least 30 days prior to the nominated shutdown time.

- Appropriate stabilisation measure to be undertaken for short-term site shutdown (e.g. long weekend, Christmas, Easter) will be in accordance with measures set out in this CSWMP and in consultation with the CPESC.
- The adopted site stabilisation measures will not rely upon the longevity of non-vegetated erosion control blankets and short-term soil binders.

Soil erosion resulting from rainfall is minimised:

- Soil disturbing activities are programmed to minimise periods of soil exposure.
- Progressive stabilisation will be undertaken following construction and earthworks per **Section 5.8**.
- Appropriate additional measures will be considered and implemented in high risk areas (including batter slopes, temporary work areas, works adjacent to riparian zones, or other sensitive areas) as required during the construction period.

Soil erosion resulting from wind erosion is minimised:

- Erosion control measures used to control wind erosion are commensurate with soil exposure and the expected wind conditions in terms of speed and direction. Refer dust control notes ESCP in **Appendix A**.
- Stockpiles of erodible material (including loosely compacted or granular materials) are covered during periods of strong wind or when strong winds are imminent. Reference to Blue Book Standard drawing SD4-1 will be made pertaining to stockpile requirements including local provisions, covering and stabilisation requirements (refer also *Table 7-1* of *Blue Book*). Specific measures for stockpile stabilisation include wetting of surfaces & application of polymer binders. As a minimum, completed work surfaces should be compacted and free of excessive loose sediment. Refer **Section 5.3** and FCMM's.

4.4 Post Construction

Post construction, maintenance of all erosion and sediment controls are required until permanent stabilisation has occurred.

5 EROSION & SEDIMENT CONTROL

5.1 Land Disturbance

Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in **Table 5.1,** and as defined in **Section 5.8** and stabilisation requirements included in **Table 5.2**.

Table 5.1 Limitations to access

Land Use or Zone	**Limitation**	**Comments**
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the ESC Drawings (**Appendix A**).	All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones on site. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries.
Remaining lands, No Go-Zones, areas outside approved construction or development areas.	Entry prohibited except for essential management works	
Maximum disturbed area of 65Ha as per the requirements of CoC B41.	**CoC B41** requires: Land disturbance and land filling activities must be undertaken: a) In a phased manner, impacting a maximum contiguous area of 65 hectares at any one time b) With no disturbance (including vegetation clearing) of another area (other than the construction of erosion & sediment control measures and associated drainage for the separation of clean and dirty water) until:	Refer stabilisation requirements in **Section 5.8**, and **Table 5.2** of the **CSWMP**.

	(i) A C-Factor of 0.05 has been achieved on the previous phase, and; (ii) At least 75% of the permanent stabilisation works have been implemented for the previous phase, and; (iii) At least 95% of all the permanent stabilisation works on any other previously disturbed area have been implemented.	
Riparian Corridors per **CoC A10**	No construction (including clearing and maintenance access) is permitted within the riparian corridor except for that identified on the revised drawings approved under **Condition B2** and activities associated with vegetation and stormwater management.	Refer **CoC A10** (**Section 1.3**) and **SDDR** by Costin Roe Consulting.

1. Prior to land clearing, areas of protected vegetation, and significant areas of retained vegetation will be clearly identified (e.g. with high-visibility tape, or light fencing) for the purposes of minimising the risk of unnecessary land clearing.
2. All practicable measures will be taken to minimise the removal of, or disturbance to, those trees, shrubs and ground covers (organic or inorganic) that are intended to be retained.
3. All land clearing will be completed in accordance with the Construction Flora and Fauna Management Plan (CFFMP) located in CEMP Appendix K.
4. Land clearing is limited to the minimum practicable during those periods when soil erosion due to wind, rain or surface water is possible.
5. Land clearing will be delayed as long as practicable and will be undertaken in conjunction with development of each stage of works.
6. All appropriate efforts shall be taken to delay the removal of, or disturbance to, existing ground cover (organic or inorganic) prior to land-disturbing activities.
7. Clearing will occur in a manner that minimises disturbance to existing ground cover (organic or inorganic).

8. Grubbing of the site will be immediately followed by temporary stabilisation measures (e.g. mulching), if required, prior to commencement of each stage of construction works.
9. Disturbance to natural watercourses (including bed and banks) and their associated riparian zones will be limited to the minimum practicable.
10. No land clearing will be undertaken unless preceded by the installation of adequate drainage and sediment control measures, unless such clearing is required for the purpose of installing such measures, in which case, only the minimum clearing required to install such measures will occur.
11. Land clearing will not extend beyond that necessary to provide up to eight (8) weeks of site activity, and/ or a maximum area of 65 Ha (per **CoC B41**) - the resultant rainfall erosivity for this cleared area is to be less than 100.

5.2 Site access

1. Prior to the commencement of site works and stages, the site entry and associated stabilised site access will be constructed in the specified location on ESCP drawings in **Appendix A**.
2. Site entry to be constructed in accordance with Blue Book Standard drawing SD 6-14.
3. Site access will be restricted to the minimum practical number of locations – for this project the proposed site access shown on ESCP drawings in **Appendix A**. Further details relating to access are provided in the Construction Traffic and Access Management Plan (CTAMP).
4. Site exit points will be appropriately managed to minimise the risk of sediment being tracked onto sealed, public roadways.
5. Stormwater runoff from access roads and stabilised entry/exit points will drain to sediment controls shown on ESCP drawings in **Appendix A**.

5.3 Soil and stockpile management

1. Stockpiling of topsoil, imported fill and construction materials (sandstone, roadbase, engineering fill) will be necessary on the project.
2. Nominal locations for stockpiles have been shown on the ESCP's which will be subject to adjustment by the contractor during the works period. Reference to Bluebook Standard Drawing SD4-1 should be made for best practice measures relating to both general fill and topsoil stockpiling will be implemented throughout the works period, unless superseded by the requirements of the Consent or FCMM's.
3. As required of **CoC B42**, stockpiling of imported fill is not permitted for longer than 6 months before placement. The Construction Contractor will ensure this condition has been met during construction works.
4. As required of **CoC B43** stockpiles must:
   (i) Not exceed 10m in height.

(ii) Be benched over 4m in height

(iii) Have a maximum slope of 1v:3h slopes; and

(iv) Be stabilised if not worked on form more than 10 days

5. As per the FCMM's Item 5I (refer **Section 1.3**) mitigation measures for stockpile management are presented in Appendix F of the Construction Traffic and Access Management Plan (CTAMP) and the following:

(i) For any stockpile heights greater than 4 m, benching will be implemented.

(ii) Where reasonable and feasible, and to minimise the potential for erosion and sedimentation of stockpile(s), stockpile profiles would typically be at angle of repose (the steepest angle at which a sloping surface formed of loose material is stable or 1v:3h per the CoC) with a slight concave slope to limit the loss of sediments off the slope, or through the profile and the formation of a toe drain.

(iii) The top surface of the stockpile(s) will be slightly sloped to avoid ponding and increase run off.

(iv) Topsoil stockpiles will be vegetated to minimise erosion.

(v) Stockpiles will be protected from upslope stormwater surface flow through the use of catch drains, berms, or similar feature(s) to divert water around the stockpile(s) per Blue Book SD4-1. Stockpiles shall be placed at least 2m away from any channelised/concentrated flow paths. Sediment control measures are to be implemented as noted in item (vi) below;

(vi) A sediment control device, such as a sediment fence, berm, or similar, will be positioned downslope of the stockpile to minimise sediment migration per Blue Book SD4-1.

(vii) Any water seepage from stockpiles will be directed by toe drains at the base of the stockpiles toward the sediment basins or check dams and away from the emplacement or extraction working face.

(viii) Newly formed stockpiles will be compacted (sealed off) using an effective construction method at the end of each working day to minimise water infiltration.

(ix) Haul roads would be located alongside the stockpile to the work/tipping area. As per best practice, the catchment area of haul roads for surface water runoff would be approximate maximum 2530m lengths, facilitated by the provision of spine drains which would convey water from the haul road to toe drains at the base of the stockpile, and then to sediment basins.

(x) Temporary sediment basins would be established in accordance with the **Section 6** of the CSWMP.

(xi) Any imported clean general fill material that would be subject to stockpiling within the Proposal site for more than a 10-day period without being worked on, would be subject to stabilisation works, to minimise the potential for erosion.

(xii) Where the material being stockpiled is less coarse or has a significant component of fines then surface and slope stabilisation would be undertaken. Methods for slope stabilisation may include one or a combination of the following:

– Application of a polymer to bind material together

– Application of hydro-seed or hydromulch

– Covering batters with mulch to provide ground cover.

– Covering batters with geofabric

– Use of a simple sprinkler system for temporary stockpiles, including use of radiating sprinkler nozzles to maintain fine spray over exposed surfaces.

– Other options identified by the Contractor.

(xiii) Topsoil stockpiles would be seeded with a grass/legume or nitrogen fixing species (such as acacia or other approved short-term vegetation) to assist in erosion control and reduce loss of beneficial soil nutrients and micro-organisms.

6. All measures shall be taken to obtain the maximum benefit from existing topsoil and vegetation, including:

(i) Where the proposed area of soil disturbance does not exceed 2500m^2, and the topsoil does not contain undesirable weed seed, the top 100mm of soil located within areas of proposed soil disturbance (including stockpile areas) must be stripped and stockpiled separately from the remaining soil.

(ii) Where the proposed area of soil disturbance exceeds 2500m^2, and the topsoil does not contain undesirable weed seed, the top 50mm of soil must be stripped and stockpiled separately from the remaining topsoil, and spread as a final surface soil.

(iii) In areas where the topsoil contains undesirable weed seed, the affected soil must be suitably buried or removed from the site.

7. Stockpiles of erodible material that has the potential to cause environmental harm if displaced, will be:

(i) Appropriately protected from wind, rain, concentrated surface flow and excessive up-slope stormwater surface flows.

(ii) Located at least 2m from any hazardous area, retained vegetation, or concentrated drainage line, and separated by appropriate controls.

(iii) Located up-slope of an appropriate sediment control measure.

(iv) Provided with an appropriate protective cover (synthetic, mulch, vegetative, or spray on polymer) if the materials are likely to be stockpiled for more than 20 days during construction. Refer **Section 5.8**.

(v) Provided with an appropriate protective cover (synthetic, mulch or vegetative) if the materials are likely to be stockpiled for more than 10 days during those months that have a high erosion risk.

(vi) Provided with an appropriate protective cover (synthetic, mulch or vegetative) if the materials are likely to be stockpiled for more than 5 days during those months that have a extreme erosion risk.

8. A suitable flow diversion system will be established immediately up-slope of a stockpile of erodible material that has the potential to cause environmental harm if displaced, if the up-slope catchment area draining to the stockpile exceeds $1500m^2$ or unless otherwise suggest by the CPESC based on site-specific risk.

5.4 Building Works Management

1. Land-disturbing activities associated with building works will be undertaken in such a manner that allows for measures to be undertaken to:

   (i) allow stormwater to pass through the site in a controlled manner and at non-erosive flow velocities up to the specified design storm discharge;

   (ii) minimise soil erosion resulting from rain, water flow and/or wind;

   (iii) minimise adverse effects of sediment runoff, including safety issues;

   (iv) prevent, or at least minimise, environmental harm resulting from work-related soil erosion and sediment runoff;

   (v) ensure that the value and use of land/properties adjacent to the development (including roads) are not diminished as a result of the adopted ESC measures.

   (vi) All temporary office facilities, compounds and associated activities will be located such that any liquid effluent (e.g. process water, wash-down water, effluent from equipment cleaning, or plant watering), can be totally contained and treated within the site. Refer to CEMP for specific temporary office facility management measures.

2. Sediment (including clay, silt, sand, gravel, soil, mud and other soil-derived waste) deposited off the site as a direct result of an on-site activity, will be collected and the area appropriately cleaned/rehabilitated as part of an environmental incident response. This will be completed immediately following a storm event (or following the incident), in accordance with the *CEMP Appendix G & P* and in a manner that gives appropriate consideration to the safety and environmental risks associated with the sediment deposition.

3. Adequate waste collection bins will be provided on-site and maintained such that potential and actual environmental harm resulting from such material waste is minimised. Refer *CEMP Appendix P* for specific site and waste management requirements.

4. Concrete waste and chemical products, including petroleum and oil-based products, will be prevented from entering an internal water body, or an external drain, stormwater system, or water body. Refer *CEMP Appendix P* for specific site and waste management requirements.

5. All flammable and combustible liquids, including all liquid chemicals if such chemicals could potentially be washed or discharged from the MPW Stage 2 development, are stored and handled on-site in accordance with relevant standards such as AS1940 The storage and handling of flammable and

combustible liquids. Refer *CEMP Appendix P* for specific site and waste management requirements.

6. Trenches not located within roadways shall be backfilled, capped with topsoil, and compacted to a level at least 75mm above adjoining ground level and appropriately stabilised.
7. All stormwater, sewer line and other service trenches, not located within roadways or other construction areas, will be mulched and seeded, other otherwise appropriately stabilised within 7 days after backfill.
8. No more than 150m of a stormwater, sewer line or other service trench will be open at any one time.
9. Site spoil will be lawfully disposed of in accordance with the approved *CEMP Appendix P* in a manner that does not result in ongoing soil erosion or environmental harm.
10. Imported fill material placed on site will comprise VENM or ENM per **CoC A7**, and be placed in accordance with the earthwork's specifications.
11. Construction tracking between finished and unfinished areas is to be restricted to dedicated haul roads and agreed construction pathways. Site construction vehicles entering/exiting the site shall use the dedicated stabilised constructionentry/exit. The existing wheel wash facility shall be utilised throughout theconstruction period in accordance with Section 3.5 of the CTAMP.

5.5 Drainage control

1. Stormwater runoff entering the site from external areas, and non-sediment laden (clean) stormwater runoff entering a work area or area of soil disturbance, will be diverted around or through that area in a manner that minimises soil erosion and the contamination of that water for all discharges up to the specified design storm discharge.
2. During the construction period, all measures will be implemented to control flow velocities in such a manner than prevents soil erosion along drainage paths and at the entrance and exit of all drains and drainage pipes during all storms up to the relevant design storm discharge.
3. All waters discharged during the construction phase will discharge onto stable land, in a non-erosive manner, and at a legal point of discharge.
4. "Clean" surface waters will be diverted away from sediment control devices and any untreated, sediment-laden waters.
5. During the construction period, roof water shall be managed in a manner that minimises soil erosion throughout the site, and site wetness within active work areas. Detailed building CSWMP and ESC's will be prepared for individual buildings and site-specific construction requirements.
6. Proper drainage will be maintained. To this end drains (including inlet and outlet works) will be checked to ensure that they are operating as intended, especially that,
    - No low points exist that can overtop in a large storm event

- Areas of erosion are repaired (e.g. lined with a suitable material) and/or velocity of flow is reduced appropriately through construction of small check dams of installing additional diversion upslope.
- Blockages are cleared (these might occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).
- Refer to **Section 7** for drainage site discharge and outlet requirements including scour protection.

7. Discharge of stormwater from the development to Georges River or Anzac Creek is to be undertaken in sucha a way that ensures that no scour occurs and in accordance with outlet specific ESCP in **Appendix A**.

5.6 Erosion control

1. The application of liquid-based dust suppression measures will be undertaken to ensure that sediment-laden runoff resulting from such measures does not create a traffic or environmental hazard in accordance with **CoC B41** and **Section 5.8**.
2. All temporary earth banks, flow diversion systems, and embankments associated with constructed sediment basins or other flow diversion measures will be machine-compacted and stabilised per details. Bases of diversion drains to be geotextile protected, batters and embankments can be seeded and mulched for the purpose of establishing a temporary vegetative cover within 10 days after grading per **Section 5.8**. Short term drains or embankments should consider other acceptable stabilisation measures to suit construction program.
3. Unprotected slope lengths will not exceed an LS-Factor of 0.27 and nominal values as noted below (per *Blue Book Table A1*):
    a. 300m at 1%
    b. 80m at 1.5%
    c. 30m at 2%
    d. 12m at 3%
    e. 5m at <6%
    f. All slopes >6% to be stabilised.
4. The construction and stabilisation of earth batters steeper than 6:1 (H:V) must be staged such that no more than 3 vertical-metres of any batter is exposed to rainfall at any instant and that upstream water is diverted away from batters. Apply appropriate stabilisation as noted in **Section 5.6(2)** and **5.8**.
5. All upstream catchments to be diverted (or otherwise managed) to that stormwater runoff does not flow directly down or across batter slopes. This could be achieved by diverting water around the batter or past the batter via an appropriately designed drainage chute.

6. Synthetic reinforced erosion control mats and blankets will not be placed within, or adjacent to, riparian zones and watercourses if such materials are likely to cause environmental harm to wildlife or wildlife habitats.
7. A minimum C-factor of 0.05 will be achieved (refer **Section 5.8**) on all non-completed earthworks exposed to accelerated soil erosion if further construction activities or soil disturbances are likely to be suspended for more than 20 days.

5.7 Sediment control

1. Optimum benefit must be made of every opportunity to trap sediment within the work site, and as close as practicable to its source. Sediment controls are to be installed prior to the commencement of work in the contributing catchment area. Sediment control is to be managed using the primary measures as set out in **Sections 5.1-5.7**, with controls to be used as secondary measures to the practices set out in this CSWMP and Landcom Blue Book;
2. Sediment fences and basins will be installed and operated to both collect and retain sediment.
3. The potential safety risk of a proposed sediment trap to site workers and the public will be given appropriate consideration, especially those devices located within publicly accessible areas.
4. All measures will be taken to prevent, or at least minimise, the release of sediment from the site.
5. Suitable all-weather maintenance access will be provided to all sediment control devices.
6. Sediment control devices will be de-silted and made fully operational after a sediment-producing event, whether natural or artificial, if the device's sediment retention capacity falls below 70% of its design retention capacity.
7. Materials, whether liquid or solid, removed from sediment control devices during maintenance or decommissioning, will be disposed of in a manner that does not cause ongoing soil erosion or environmental harm.

8. Refer to **Section 6** for management and operational requirements of sediment basins.

5.8 Site rehabilitation

1. All disturbed areas will be suitably stabilised per **Table 5.2** in the number of days noted, or prior to anticipated rainfall, whichever is the greater, from completion of formation.

Table 5.2. Stabilisation Requirements

Lands	Max. C-factor	Max. No. Days
Waterways and other areas subjected to concentrated flows, post construction	0.05	10 working days
Stockpiles, post construction	0.10	10 workings days

All lands, including waterways and stockpiles, during construction	0.15	20 working days of inactivity
Placed fill must be stabilised if not worked on for more than 10 days (per **CoC B44**)	0.10	10 working days of inactivity

2. A minimum C-factor of 0.05 will be achieved on all non-completed earthworks exposed to accelerated soil erosion if further construction activities or soil disturbances are likely to be suspended for more than 20 days.
3. No completed earthwork surface will remain denuded for longer than 60 days.
4. The type of ground cover or stabilisation applied to completed earthworks will be compatible with the anticipated long-term land use, environmental risk, and site rehabilitation measures.
5. Unless otherwise directed by the Site Supervisor or where directed by the approved revegetation plan, topsoil will be placed at a minimum depth of 75mm on slopes 4:1 (H:V) or flatter, and 50mm on slopes steeper than 4:1.
6. The pH level (soil:water 1:5) of topsoil will be adequate to enable establishment and growth of the specified vegetation.
7. Soil ameliorants will be added to the soil in accordance with the approved landscape/revegetation plans and/or soil analysis.
8. Soil density/compaction will be adjusted prior to seeding/planting in accordance with the approved VMP.
9. Temporary site stabilisation procedures must commence at least 30 days prior to the nominated site shutdown date. At least 70% stable cover (C-factor less than 0.05) of all unstable and/or disturbed soil surfaces will be achieved prior to the start of shutdown. The stabilisation works will not rely upon the longevity of non-vegetated erosion control blankets, or temporary soil binders unless appropriate management measures to ensure the required C-Factor can be achieved throughout the duration of the measure's implementation.
10. All unstable or disturbed soil surfaces will be adequately stabilised against erosion as follows:

    "Land disturbance and land filling activities must be undertaken:

    a) In a phased manner, impacting a maximum contiguous area of 65 hectares at any one time
    b) With no disturbance (including vegetation clearing) of another area (other than the construction of erosion & sediment control measures and associated drainage for the separation of clean and dirty water) until:
        i. A C-Factor of 0.05 has been achieved on the previous phase, and;
        ii. At least 75% of the permanent stabilisation works have been implemented for the previous phase, and;
        iii. At least 95% of all the permanent stabilisation works on any other previously disturbed area have been implemented."

Proposed methods of site stabilisation are set out in *Table A3* of the *Landcom Bluebook* to achieve a C-Factor of less than 0.05. The area of earthworks, or unstabilised works, that can be completed at any one time be limited to 65Ha following a portion of the 65Ha being either stabilised or constructed to the ratios quoted above.

The C-factor, is a ratio which defines soil cover – "*the ratio of soil loss from land under specified plant or mulch condition to the corresponding loss from bare soil*".

Acceptable methods to stabilise per *Landcom Blue Book* and to meet the C-factor less than 0.05 are as follows and shown in **Table 1** drawing **PIWW-COS-VC-DWG-0200,** and *Blue Book Table A3*:

- Where warehousing is proposed, constructed pavements/ buildings more than 75% of area (i.e. 48.75 Ha)
- Where warehousing is not proposed:
  - 70% grass cover over the disturbed area.
  - Wood chip at 27 t/Ha
  - 100mm recycled concrete road base.
  - Jute-matting
  - Hydromulching.
  - In-situ cement stabilisation/ lime stab.
  - soil binder such as Ground Control (Complete Water Treatment), Stonewall (Vital Industries). The use of polymer soil binders will be subject to on-site testing and verification, and confirmation of longevity and suitability of the application and specific location. It is expected that maintenance and ongoing re-application will be required if this method is adopted.
  - Other stabilisation per *Landcom Blue Book Table A3* as shown on drawing **PIWW-COS-VC-DWG-0200**.

11. Construction-stage sediment control basins shall be converted to permanent stormwater quantity and quality management devices (i.e. On-Site-Detention Basins & Bio-filtration Basins) following completion of the civil works within the associated basin sub-catchment. The operational features of the permanent stormwater treatment system will be made fully operational (i.e. maintenance and/or reconstruction as required). Construction details for the permanent outlets are to be completed as per the SDDR and **CoC B33**.

6 SEDIMENT BASIN OPERATION AND MANAGEMENT

6.1 General

1. This section of the report describes the general requirements for Sediment Basin, sizing and operation and management.
2. Sediment basins Type D (Soil Hydrological Group) construction.
3. Basins to operate as wet basins and 5-day cycle. Basins are designed to retain sediment-laden water allowing adequate time for the gravitational settlement of fine sediment particles. Basins are not to be drained until adequate water quality is obtained in the basin as noted in **Section 6.2(4)**.
4. Sediment basins will be constructed prior to site disturbance to ensure that adequate rainfall runoff mitigation during construction has been made.
5. Refer drawing **PIWW-COS-CV-DWG-0201** for basin sizing calculations and drawings **PIWW-COS-CV-DWG-0210, 0211, 0213, 0249, 0250 & 0251** for basin locations, spillway details and basin details.
6. Basins shall be constructed in a manner that facilitates conversion to operational water quantity-and-quality management structures in accordance with **CoC Conditions B33 & B34**. A temporary bio-retention protection detail has been provided on drawing **PIWW-COS-CV-DWG-0251.**
7. Basin sizing based on RUSLE and following parameters.

a.	Soil Texture Group	F
b.	Soil Hydrological Group	D
c.	Design Rainfall Depth	5 days
d.	5-day, 85% percentile Rainfall event	32.2mm
e.	2yr, 6hr storm intensity	10.9mm/ hr
f.	Rainfall Erosivity (R)	2580
g.	Soil erodibility (K-factor)	0.075
h.	Length/ Gradient Factor (LS-factor)	0.27
i.	Erosion Control Practice (P-Factor)	1.3
j.	Ground cover (C-Factor)	1
k.	Soil Loss Class	1
l.	Erosion Hazard	Very Low

8. Constructed sediment basins must be maintained and fully operational throughout the construction period and until each basin's catchment area achieves stabilisation with C-factor of 0.05 or permanent stabilisation per **Section 5.8**.
9. Before starting any clearing or construction, all the necessary materials and components will be on the site to avoid delays in implementing the sediment controls once works begin.

10. Required short-term sediment control measures will be installed downstream of the proposed earthworks to control sediment runoff during construction of the basin.
11. The area to be covered by the embankment, basin borrow pits (if required) and incidental works, together with an area extending beyond the limits of each for a distance not exceeding five (5) metres all around will be cleared of all trees, scrub, stumps, roots, dead timber and rubbish and disposed of in a suitable manner.
12. All holes made by grubbing within the embankment footprint will be filled with sound material, adequately compacted, and finished flush with the natural surface.
13. Spillway sizing has been provided to accommodate capacity for storm flows to the 1 in 10-year ARI storm event per recommendations of the FCMM's.

6.2 Sediment Basin Operation

1. Type D basins will be operated as wet basins with the settled/ treated water decanted from the basin as soon as suitable.
2. Type D basin based on a maximum 5-day cycle. That being the filling, treatment and discharge of the basin is required within a 5-day period following cessation of rainfall.
3. Appropriate coagulation of sediment basins will be undertaken if the contained water does not achieve the specified water quality standard (TSS<50mg/L) within the required 5-day period. Refer notes on drawing **PIWW-COS-CV-DWG-0200.**
4. Recommended coagulant/ flocculant is gypsum at a dose rate between 32-50kg/ 100m3 of sediment water. Dosage rates will be determined on site as required to achieve water quality requirements. Alternate flocculant products can be considered with consultation with the CPESC.
5. Sediment basin water quality samples will be taken at a depth no greater than 200mm above the level of settled sediment.
6. Discharged water will meet the discharge criteria defined in **Section 3.6** of the **CSWMP**. Testing to be completed using acceptable (and appropriately calibrated) field instrument or lab testing. Discharge is noted to meet requirements of the EPL also included in **Section 3.6**.
7. Settled sediment will be removed from sediment basins when the volume of the sediment exceeds the designated sediment storage volume (as nominated on the ESCP drawings), or the design maximum sediment storage elevation. Sediment marker and water level indicators to be provided in accordance with Landcom Blue Book requirements as detailed on drawing **PIWW-COS-CV-DWG-0251 Appendix A.**

6.3 Sediment Basin Maintenance

1. The sediment basin will be inspected during the following periods:

a. During construction to determine whether machinery, falling trees, or construction activity has damaged any components of the sediment basin. If damage has occurred it will be repaired.

b. After each runoff event. Inspect the erosion damage at flow entry and exit points. If damage has occurred the necessary repairs will be made.

c. At least fortnightly in the absence of (b) above.

d. Prior to, and immediately after, periods of "stop work" or site "shutdown".

2. Accumulated sediment will be cleaned out when it reaches the marker board/post, and restore the original storage volume restored. Place sediment in a disposal area or, if appropriate, mix with dry soil on the site.
3. Sediment will not be disposed of in a manner that will create an erosion or pollution hazard.
4. Removed sediment will be moved to a location for moisture conditioning and reuse as engineered site fill. Sediment intended for re-use should be confirmed as acceptable for use as engineered fill following testing and approval from the geotechnical engineer. The geotechnical engineer shall confirm whether the material conforms to the bulk earthworks filling specification. The location for moisture conditioning will be chosen such that it remains within the catchment of a sediment basin and erosion control system. Alternatively, sediment removed from basins shall be disposed of from site in an approved manner. The material shall be tested for any contaminants and be classified ,in accordance with EPA Waste Classification Guidelines, by an environmental consultant prior to disposal.
5. All visible pipe connections will be checked for leaks, and repair as necessary.
6. Fill material in the dam will be checked for excessive settlement, slumping of the slopes or piping between the conduit and the embankment; make all necessary repairs.
7. All trash and other debris will be removed from the basin and riser.
8. Submerged inflow pipes will be inspected and de-silted (as required) after each inflow event.

6.4 Sediment basin rehabilitation

1. Required drainage, erosion and sediment control measures during the decommissioning and rehabilitation or a sediment basin will comply with same standards specified for the normal construction works.
2. Upon decommissioning of a sediment basin, all water and sediment will be removed from the basin prior to removal of the embankment (if any). Any such material, liquid or solid, will be disposed of in a manner that will not create an erosion or pollution hazard.
3. A basin's catchment conditions associated with the staged decommissioning of the basin will comply with the specified sediment control standard.
4. If the permanent outlet structure is constructed prior to stabilisation of the up-slope catchment area, then this outlet structure will not be made operational.

Conversion of construction stage erosion and sediment control infrastructure intopermanent stormwater quality or on-site detention infrastructure will occur once the civilworks (roads and drainage) have been completed.

5. The permanent stormwater treatment features (e.g. vegetation and filtration media) will be appropriately protected from the adverse effects of sediment runoff per the details provided on **PIWW-COS-CV-DWG-0251**.
6. A sediment basin will not be decommissioned until all up-slope site stabilisation measures have been implemented and are appropriately working to control soil erosion and sediment runoff in accordance with the specified ESC standard and minimum permanent stabilisation works per **CoC B41**.
7. Immediately prior to the construction of the permanent stormwater treatment device, appropriate flow bypass conditions will be established to prevent sediment-laden water entering the device.
8. Immediately following the construction of the filter media of the permanent stormwater treatment device, the filter media will be covered by heavy-duty filter cloth (minimum Bidim A44 or equivalent) and a minimum 200mm layer of earth or sacrificial filter media. Such earth and filter cloth will not be removed from the device until suitable surface conditions being achieved within the basin’s catchment area.
9. Immediately following the construction of the bioretention system an appropriate sediment forebay, filter or straw-bale system will be installed in a manner to prevent sediment intrusion into the device.
10. Plant establishment within the permanent stormwater treatment device will be delayed until sediment intrusion into the device is suitably under control.
11. Upon stabilisation of the contributing catchment being achieved, the operational features of the permanent stormwater treatment system will be made fully operational (i.e. maintenance and/or reconstruction as required).
    Construction details for the permanent outlets are to be completed as per the SDDR and **CoC B33**.
12. Upon the approval of the engineer or site supervisor, the newly constructed permanent stormwater treatment features of the basin will be made operational if such actions do not prevent the site from operating at the required sediment control standard.

7 DRAINAGE DISCHARGE OUTLET REQUIREMENTS

7.1 General

The stormwater management for the completed site shall consist of a piped drainage system with on-site detention and pollution control devices as set out in the SDDR and CEMP. Reference to outlet specific ESCP drawings in **Appendix A** is to be made for detailed outlet ESC measures.

The sediment and erosion control methodology for the sediment controls are based on a staged process depending on the level of completed construction activities on the site. The basis of the controls are in accordance with Assessment of Erosion Hazard of LANDCOM, SOILS AND CONSTRUCTION, Volume 1, 4th Edition, March 2004, Managing Urban Stormwater (the Blue Book) and in relation to the outlet controls are generally as follows:

- No works are to be carried out in the Core Riparian Zone (CRZ) other than those specified in this document and the specified plans specifically relating to the stormwater discharge outlets.
- All land disturbance activities are to be minimised to those that are absolutely necessary to complete the works.
- Hay bales are not be used for the control of sediment run-off.
- All sedimentation basins are to be constructed and operational during outlet construction and establishment periods. As per documents all site filling sediment basins built within the proposed development site away from the watercourse and any remnant vegetation.

In relation to the sensitivity of the receiving environment, *Section 5.4.2 of the Arcadis Biodiversity Assessment Report* 2016 (included in the SSD_7709 EIS) defines the Georges River as being a 6th order stream as defined in the Strahler Stream Classification system. As such a dedicated riparian buffer is necessary to be maintained to the Georges River and management measures set out for a *Category 1: Environmental Corridor* included in *Table 5* of the *Landcom Blue Book* are necessary for the works.

There are no direct outlets to Anzac Creek. Discharge from site at the south-east of the development extent (Basin 3) will be made to Moorebank Avenue drainage infrastructure on the western side of Moorebank Avenue.

7.2 Core Riparian Zone (CRZ) Works

The core riparian zone has been delineated on the Outlet Erosion and Sediment Control drawings (refer **Appendix A**) and is based on a 40m setback from the top of The Georges River which has been defined by detail survey.

The construction works within the CRZ will be limited to the three stormwater outlets for OSD’s. The works will involve mechanical excavation and filling, placing of rockwork for energy dissipation and flow spreading, and the removal and replacement of vegetation.

Works located within the CRZ will adhere to the following:

1. Works will be scheduled to be undertaken during forecasted dry weather.

2. Works and any subsequent land disturbance associated with the construction of the energy dissipater and associated outlet pipe or outlet channel will be limited to within 5m either side of the centreline of the outlet system.
3. The works will be consistent with the NSW Office of Water Guidelines for Controlled Activities for works within riparian corridors.
4. Works are to be sufficiently stabilised to meet requirements of **CoC B20** ensuring that no erosion will occur during the works.
5. No construction (including clearing and maintenance access) is permitted within the riparian corridor except for that identified on the revised drawings approved under **Condition B2** and activities associated with vegetation and stormwater management as required of **CoC A10**.

8 SITE INSPECTION AND MAINTENANCE

8.1 Site Inspection and Monitoring Introduction

Monitoring and reviewing of the effectiveness and condition of controls should be completed by the Construction Contractor's EM as set out in **Section 3.2** and as detailed in *Section 4* of the *CEMP*. Auditing - as consistent and detailed within the CEMP. Regular inspections will be performed (daily and weekly – refer **Appendix B** for check sheets) by the Construction Contractor's representative in addition to the regular site inspections of performance of controls by the CPESC (per **CoC B32**). Additionally, the CPESC is to confirm implementation of the measures against the ESCP's.

The minimum inspections to be undertaken on the site will be completed per **Section 7.3(1)**.

8.2 Water Quality Monitoring

1. All water discharge performance to be in accordance with **Section 3.6** of this CSWMP.
2. All water quality data, including dates of rainfall, dates of testing, testing results and dates of water release, must be kept in an on-site register. The register is to be maintained up to date for the duration of the approved works and be available on-site for inspection by environmental representative on request.
3. At nominated water monitoring sites, a minimum of 3 water samples must be taken and analysed, and the average result used to determine quality.
4. All environmentally relevant incidents must be recorded in a field log that must remain accessible to all relevant regulatory authorities.
5. The monitoring requirements of the NSW EPA EPL, included in **Section 3.6** and **Appendix I**, are to be met throughout construction period.

8.3 Site Inspection and Monitoring

1. A self-auditing program (implemented by the Construction Contractor's EM) will be established based on the check sheets shown in **Appendix B**. Surface water monitoring points are indicated on the design drawings. A site inspection using the Check Sheet will be made by the Contractors EM:
    - At least weekly.
    - Immediately before site closure.
    - Immediately following rainfall events in excess of 5mm in any 24-hour period.
2. The self-audit will include:
    - Recording the condition of every sediment control device
    - Recording maintenance requirements (if any) for each sediment control device

- Recording the volumes of sediment removed from sediment retention systems, where applicable
- Recording the site where sediment is disposed
- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their information

3. The CPESC will complete a monthly inspection. The CPESC will oversee the installation and maintenance of all soil and water management works on the site. The CPESC will prepare a monthly written report that will provide recommendations for site implementation of measures. The CPESC monthly report will be provided to the Planning Secretary (the DPIE Post-approvals and Compliance teams respectively) on a monthly basis.
4. The nominated responsible person (Construction Contractor's EM) will need to ensure that:

   - The plan is being implemented correctly
   - Repairs are undertaken as required
   - Essential modifications are made to the plan if and when necessary

   The report will carry a certificate that works have been carried out in accordance with the plan.

Inspection and monitoring of equipment washdowns, waste handling and other construction related activities are to be completed in accordance with *CEMP Appendix P*.

APPENDIX A

COSTIN ROE CONSULTING ESCP DRAWINGS

MOOREBANK PRECINCT WEST EROSION AND SEDIMENT CONTROL PACKAGE

MOOREBANK AVENUE, MOOREBANK, NSW

TABLE 1 – STABILISATION REQUIREMENTS AND TREATMENT METHODS

DURING CONSTRUCTION – TEMPORARY STABILISATION
(DURING PERIODS OF INACTIVITY OR WHEN WORKS ARE ON HOLD)

LANDS	STABILISATION REQUIREMENT	TIMEFRAMES	TREATMENT METHODS – PRODUCTS	REMARKS
ALL LANDS	C-FACTOR = 0.15 (50% EQUIVALENT GROUND COVER[1]	APPLIES AFTER 20 WORKING DAYS OF INACTIVITY (EVEN THOUGH WORKS MIGHT CONTINUE LATER)	SOIL BINDER (I.E VITAL P47/STONEWALL OR EQUIVALENT[1])	- SPRAY ALL SURFACES WITH VITAL P47/STONEWALL OR EQUIVALENT[1]. - VITAL DILUTION RATE = 1:10(VITAL:WATER). -RE-APPLY/MAINTAIN AS NECESSARY (APPROX. EVERY 3-6 MONTHS WITHOUT SUITABLE VEGETATION COVER) TO ENSURE THE REQUIRED COVER IS PROVIDED.
			GEOTEXTILE, JUTE MATTING, BLACK PLASTIC OR EQUIVALENT[1]	- COVER ALL EXPOSED SOILS. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PROVIDED.
WATERWAYS, DRAINAGE LINES AND CONCENTRATED FLOW AREAS	C-FACTOR = 0.05 (70% GRASS COVER OR EQUIVALENT GROUND COVER[1]	APPLIES AFTER 10 WORKING DAYS FROM COMPLETION OF FORMATION AND BEFORE THEY ARE ALLOWED TO CARRY CONCENTRATED FLOWS.	REFER TO THE DRAIN SPECIFICATIONS DETAILED ON THE PLAN FOR SPECIFIC LINING/STABILISATION REQUIREMENTS. EXAMPLE TREATMENT METHODS ARE SHOWN BELOW.	
			TEMPORARY LINING – GEOTEXTILE (I.E. BIDIM A24 OR EQUIVALENT[1])	- COMPLETE ANY SUBSOIL TREATMENT BEFORE LAYING THE MATTING. - INSTALL MATTING IN ACCORDANCE WITH SD 5-7. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PROVIDED.
			JUTE MESH, SEEDING AND SOIL BINDER (I.E. VITAL P47/STONEWALL OR EQUIVALENT[1]) - LOW FLOWS TO MODERATE	- COMPLETE SUBSOIL TREATMENT (I.E. GYPSUM LIGHTLY RIPPED INTO SUBGRADE AT A RATE OF 5 TONNES/Ha). - PLACE TOPSOIL TO A DEPTH OF AT LEAST 75mm. - COMPLETE ANY FERTILISATION AND SEEDING BEFORE LAYING THE MATTING. - INSTALL MATTING IN ACCORDANCE WITH SD 5-7. - SPRAY ALL SURFACES WITH VITAL P47/STONEWALL OR EQUIVALENT[1]. - VITAL DILUTION RATE = 1L / m^2 OF DILUTED VITAL MIXTURE. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PERMANENTLY MAINTAINED.
			JUTE MATTING (~350gsm) AND SEEDING OR EQUIVALENT[1]) - LOW FLOWS TO MODERATE	- COMPLETE SUBSOIL TREATMENT (I.E. GYPSUM LIGHTLY RIPPED INTO SUBGRADE AT A RATE OF 5TONNES/Ha). - PLACE TOPSOIL TO A DEPTH OF AT LEAST 75mm. - COMPLETE ANY FERTILISATION AND SEEDING BEFORE LAYING THE MATTING. - INSTALL MATTING IN ACCORDANCE WITH SD 5-7. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PERMANENTLY MAINTAINED.
			TURF REINFORCEMENT MATTING (TRM) (E.G. TERRAMAT OR EQUIVALENT[1]) - MODERATE FLOWS	- COMPLETE SUBSOIL TREATMENT (I.E. GYPSUM LIGHTLY RIPPED INTO SUBGRADE AT A RATE OF 5TONNES/Ha). - PLACE TOPSOIL TO A DEPTH OF AT LEAST 75mm. - COMPLETE ANY FERTILISATION AND SEEDING BEFORE LAYING THE MATTING. - INSTALL MATTING IN ACCORDANCE WITH SD 5-7. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PERMANENTLY MAINTAINED.
			ROCK LINING - HIGH FLOWS	- COMPLETE SUBSOIL TREATMENT (I.E. GYPSUM LIGHTLY RIPPED INTO SUBGRADE AT A RATE OF 5TONNES/Ha). - INSTALL GEOTEXTILE UNDERLAY (IF SPECIFIED) IN ACCORDANCE WITH SD 5-7. - INSTALL ROCK ARMOURING (TO THE DEPTH AND SIZE AS SPECIFIED ON THE PLAN).
STOCKPILES	C-FACTOR = 0.10 (60% GRASS COVER OR EQUIVALENT GROUND COVER[1]	APPLIES AFTER 10 WORKING DAYS FROM COMPLETION OF FORMATION	SEEDING AND SOIL BINDER (I.E. VITAL P47/STONEWALL OR EQUIVALENT[1])	- APPLY SEED TO ALL STOCKPILE SURFACES (NOTE: SEEDING MAY NOT BE REQUIRED IF EXISTING SEEDBED IS PRESENT). -SPRAY ALL STOCKPILE SURFACES WITH VITAL P47/STONEWALL OR EQUIVALENT[1]. - VITAL DILUTION RATE = 1:10 (VITAL:WATER). - APPLICATION RATE = 1L / m2 OF DILUTED VITAL MIXTURE. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PERMANENTLY MAINTAINED.
			GEOTEXTILE, JUTE MATTING, BLACK PLASTIC OR EQUIVALENT[1]	- COVER ALL EXPOSED SOILS. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PROVIDED.
GENERAL SURFACES	C-FACTOR = 0.10 / 0.05 (60% / 70% GRASS COVER OR EQUIVALENT GROUND COVER[1]	C-FACTOR = 0.1 APPLIES AFTER 10 WORKING DAYS FROM COMPLETION OF FORMATION AND C-FACTOR = 0.05 APPLIES WITHIN A FURTHER 60 DAYS	TOPSOIL, SEEDING AND SOIL BINDER (I.E. VITAL P47/STONEWALL OR EQUIVALENT[1])	- REFER TO SD 7-1 - COMPLETE SUBSOIL TREATMENT (I.E. GYPSUM LIGHTLY RIPPED INTO SUBGRADE AT A RATE OF 5TONNES/Ha). - PLACE GYPSUM TREATED TOPSOIL TO A DEPTH OF AT LEAST 75mm. - APPLY ANY FERTILISERS REQUIRED. - APPLY SEED TO ALL SURFACES. - SPRAY ALL SURFACES WITH VITAL P47/STONEWALL OR EQUIVALENT[1]. - VITAL DILUTION RATE = 1:10 (VITAL:WATER). - APPLICATION RATE = 1L / m2 OF DILUTED VITAL MIXTURE. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PERMANENTLY MAINTAINED.
			HYDROMULCH OR EQUIVALENT[1]	- REFER TO SD 7-1 - COMPLETE SUBSOIL TREATMENT (I.E. GYPSUM LIGHTLY RIPPED INTO SUBGRADE AT A RATE OF 5TONNES/Ha). - PLACE GYPSUM TREATED TOPSOIL TO A DEPTH OF AT LEAST 75mm. - APPLY HYDROMULCH WITH APPROVED SEED MIX TO SOIL SURFACE. - RE-APPLY/MAINTAIN AS NECESSARY TO ENSURE THE REQUIRED COVER IS PERMANENTLY MAINTAINED.

[1] – EQUIVALENT COVER/PRODUCT MUST ACHIEVE THE EQUIVALENT C-FACTOR WITH PROVEN RESEARCH/DOCUMENTATION TO VERIFY THIS.
STANDARD DRAWINGS REFERENCED CAN BE LOCATED IN THE 'SOILS & CONSTRUCTION, MANAGING URBAN STORMWATER – VOLUME 1' BOOK BY LANDCOM. ALTERNATIVE DETAILS MAY BE SOUGHT IN CONSULTATION WITH THE ENGINEER

TABLE 2 – LIMITATIONS TO ACCESS DURING CONSTRUCTION

LAND USE	LIMITATION	REMARKS
CONSTRUCTION AREAS	LIMITED TO 5 (PREFERABLE 2) METRES FROM THE EDGE OF ANY ESSENTIAL CONSTRUCTION ACTIVITY AS SHOWN ON ENGINEERING PLANS.	ALL SITE WORKERS SHOULD CLEARLY RECOGNISE THESE AREAS THAT, WHERE APPROPRIATE, ARE IDENTIFIED WITH BARRIER FENCING (UPSLOPE) AND SEDIMENT FENCE (DOWNSLOPE) OR SIMILAR MATERIALS.
ACCESS CORRIDORS	LIMITED TO A MAXIMUM WIDTH OF 7 METERS	THE SITE MANAGER WILL DETERMINE AND MARK THE LOCATION OF THESE ZONES ON SITE, THEY CAN VARY IN POSITION SO AS TO BEST CONSERVE EXISTING VEGETATION AND PROTECT DOWNSTREAM AREAS WHILE BEING CONSIDERATE OF THE NEEDS EFFICIENT WORKS ACTIVITIES. ALL SITE WORKERS WILL CLEARLY RECOGNISE THESE BOUNDARIES.
REMAINING LANDS, INCLUDING REVEGETATION AREA	ENTRY PROHIBITED EXCEPT FOR ESSENTIAL MANAGEMENT WORKS	THINNING OF GROWTH MIGHT BE NECESSARY, FOR EXAMPLE, FOR FIRE REDUCTION OR WEED REMOVAL.

DUST CONTROL NOTES:

1. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE DUST CONTROL MEASURES ARE APPLIED AND MAINTAINED IN ACCORDANCE WITH THE GOVERNING AUTHORITIES REQUIREMENTS.
2. THE APPLICATION OF LIQUID BASED DUST SUPPRESSION MEASURES MUST BE SUCH THAT SEDIMENT LADEN RUNOFF RESULTING FROM SUCH MEASURES DOES NOT CREATE A TRAFFIC OR ENVIRONMENTAL HAZARD. (EG UTILISING SEDIMENT CONTROLS)
3. DUST GENERATION ASSOCIATED WITH WIND EROSION TO BE CONTROLLED USING WATER TRUCKS, DUST SUPPRESSING FOG, MIST GENERATORS, SEALANT PLACED OVER THE SOIL, SURFACE ROUGHENING OR RE-VEGETATION.
4. THE FOLLOWING ACTIVITIES SHALL BE ADOPTED, IF NECESSARY, TO MANAGE DUST CONTROL ON SITE:
   - LIMITING THE AREA OF SOIL DISTURBANCE AT ANY GIVEN TIME
   - REPLACING TOPSOIL AFTER COMPLETION OF EARTHWORKS.
   - PROGRAMMING WORK TO MINIMISE THE LIFE OF STOCKPILES.
   - TEMPORARILY STABILISING LONG-TERM STOCKPILES.
   - GRAVELLING UNSEALED ACCESS AND HAUL ROADS.
   - MINIMISING TRAFFIC MOVEMENT ON EXPOSED SURFACES.
   - LIMITING VEHICULAR TRAFFIC TO 15km/h.
   - RETAINING EXISTING VEGETATION AS WIND BREAKS.
   - UTILISING A WATER CART WITH POTABLE WATER ONLY
5. OIL, LANDFILL GAS CONDENSATE OR ANY CONTAMINATED LEACHATE IS NOT TO BE USED FOR DUST SUPPRESSION.

EROSION CONTROL NOTES

ALL SEDIMENT CONTROL WORK INCLUDING DIVERSION BANKS, CATCH DRAINS, V-DRAINS AND SEDIMENT FENCES SHALL BE COMPLETED IN ACCORDANCE WITH THE STAGED PLANS PRESENTED AND SHALL FACILITATE A STAGED CONSTRUCTION METHODOLOGY.

1. ALL EROSION & SEDIMENT CONTROLS SHALL BE COMPLETED IN ACCORDANCE WITH THE 'SOILS AND CONSTRUCTION, MANAGING URBAN STORMWATER – THE BLUE BOOK' BY LANDCOM.
2. SEDIMENT FENCES AND SEDIMENT FENCE RETURNS SHALL BE ERECTED CONVEX TO THE CONTOUR TO POND WATER.
3. STRAW BALE BARRIERS & GEOFABRIC FENCES OR SEDIMENT FANCNES ARE TO BE CONSTRUCTED TO TOE OF BATTER, PRIOR TO COMMENCEMENT OF EARTHWORKS, IMMEDIATELY AFTER CLEARING OF VEGETATION AND BEFORE REMOVAL OF TOP SOIL.
4. ALL TEMPORARY EARTH BERMS, DIVERSION AND SEDIMENT BASIN EMBANKMENTS ARE TO BE MACHINE COMPACTED, SEEDED AND MULCHED FOR TEMPORARY VEGETATION COVER AS SOON AS THEY HAVE BEEN FORMED. REFER TO TABLE 1 FOR APPROVED STABILISATION METHODS.
5. CLEAN OR NON-SITE WATER IS TO BE DIVERTED AWAY FROM DISTURBED GROUND AND INTO THE DRAINAGE SYSTEM OVER STABLE SURFACES.
6. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING AND PROVIDING ON GOING ADJUSTMENT TO EROSION CONTROL MEASURES AS REQUIRED DURING CONSTRUCTION.
7. ALL SEDIMENT TRAPPING STRUCTURES AND DEVICES ARE TO BE INSPECTED AFTER STORMS OF 5mm OR GREATER WITHIN A 24 HOUR PERIOD FOR STRUCTURAL DAMAGE OR CLOGGING, TRAPPED MATERIAL IS TO BE REMOVED TO A SAFE, APPROVED LOCATION.
8. THE SITE IS TO BE INSPECTED FOLLOWING A RAINFALL EVENT OF 5mm OR GREATER WITHIN A 24 HOUR PERIOD FOR EVIDENCE OF EROSION AND RESPOND WITH INCREASED CONTROL IF REQUIRED.
9. ALL FINAL EROSION PREVENTION MEASURES INCLUDING THE ESTABLISHMENT OF GRASSING ARE TO BE MAINTAINED UNTIL THE END OF THE DEFECTS LIABILITY PERIOD.
10. ALL EARTHWORKS AREAS SHALL BE ROLLED ON A REGULAR BASIS TO SEAL THE EARTHWORKS.
11. ALL FILL AREAS ARE TO BE LEFT WITH A BUND AT THE TOP OF THE SLOPE AT THE END OF EACH DAY'S EARTHWORKS TO DIRECT WATER TO A STABLE OUTLET OVER THE BATTER OR INTERNALLY TOWARDS SEDIMENT CONTROL. THE HEIGHT OF THE BUND SHALL BE A MINIMUM OF 200mm.
12. ALL CUT AND FILL SLOPES ARE TO BE SEEDED AND HYDROMULCHED WITHIN 10 DAYS OF COMPLETION OF FORMATION.
13. AFTER PERMANENT STABILISATION OF THE SITE IS COMPLETE (I.E. BY TOPSOILING, PAVING ETC.) AND THE SITE IS DEEMED TO BE STABLE IN THE OPINION OF A SUITABLY QUALIFIED PERSON ALL TEMPORARY WORK SUCH AS SEDIMENT FENCE, DIVERSION DRAINS ETC SHALL BE REMOVED.
14. ALL STOCKPILES ARE TO BE SUITABLY COVERED AND STABILIZED TO THE SATISFACTION OF THE SITE MANAGER TO PREVENT WIND AND WATER EROSION.
15. ANY AREA THAT IS NOT APPROVED BY THE CONTRACT ADMINISTRATOR FOR CLEARING OR DISTURBANCE BY THE CONTRACTOR'S ACTIVITIES SHALL BE CLEARLY MARKED AND SIGN POSTED, FENCED OFF OR OTHERWISE APPROPRIATELY PROTECTED AGAINST ANY SUCH DISTURBANCE.
16. ALL STOCKPILE SITES SHALL BE SITUATED IN AREAS INDICATED ON THE APPROVED EROSION AND SEDIMENTATION CONTROL PLAN OR APPROVED FOR SUCH USE BY THE SITE MANAGER. A 6m BUFFER ZONE SHALL EXIST BETWEEN STOCKPILE SITES AND ANY STREAM OR FLOW PATH. ALL STOCKPILES SHALL BE ADEQUATELY PROTECTED FROM EROSION AND CONTAMINATION OF THE SURROUNDING AREA BY USE OF THE MEASURES IN THE APPROVED ESCP.
17. ACCESS AND EXIT AREAS SHALL INCLUDE TRUCK SHAKER GRID OR OTHER METHODS APPROVED BY THE SITE MANAGER FOR THE REMOVAL OF SOIL MATERIALS FORM MOTOR VEHICLES.
18. THE CONTRACTOR IS TO ENSURE RUNOFF FROM ALL AREAS WHERE THE NATURAL SURFACE IS DISTURBED BY CONSTRUCTION, INCLUDING ACCESS ROADS, DEPOT AND STOCKPILE SITES, SHALL BE FREE OF SEDIMENTS BEFORE IT IS EITHER DISPERSED TO STABLE AREAS OR DIRECTED TO NATURAL WATERCOURSES.
19. THE CONTRACTOR SHALL PROVIDE AND MAINTAIN SLOPES, CROWNS AND DRAINS ON ALL EXCAVATIONS AND EMBANKMENTS TO ENSURE SATISFACTORY DRAINAGE AT ALL TIMES WATER SHALL NOT BE ALLOWED TO POND ON THE WORKS UNLESS SUCH PONDING IS PART OF AN APPROVED ESCP / SWMP.

SEDIMENT CONTROL BASIN NOTES

1. TYPE D BASIN IS REQUIRED.
2. VOLUME OF THE BASINS SHALL BE AS NOMINATED ON DRAWING. NOMINAL POND LOCATIONS AND NOMINAL DIMENSIONS.
3. SEDIMENT BUILD UP TO NOT EXCEED 33% TOTAL CAPACITY OF BASIN.
4. DEWATERING OF BASIN TO BE PERFORMED TO THE BOTTOM OF THE SEDIMENT SETTLING ZONE FOLLOWING ACHIEVEMENT OF WQO's. MANAGEMENT OF DOSAGE AND DISCHARGE TO BE ACHIEVED WITHIN 5 DAYS OF THE INITIAL RAINFALL EVENT.
5. FOLLOWING DEWATERING PER NOTE 4, WATER LEVEL TO BE MAINTAINED AT 20% CAPACITY AFTER A FOUR DAY SETTLING PERIOD FOLLOWING A STORM EVENT SUCH THAT THE BASIN HAS SUFFICIENT CAPACITY TO CONTAIN RUNOFF AND SEDIMENT FROM SUBSEQUENT RAINFALL EVENTS.
6. WATER TO BE DOSED WITH GYPSUM TO ACCELERATE SETTLEMENT OF SUSPENDED SOLIDS AS REQUIRED.
7. GYPSUM DOSAGE RATE TO BE APPLIED AT APPROX. 32kg PER 100 CUBIC METRE OF COLLECTED RUNOFF.
8. THE USE OF ALUM (OR ANY OTHER ALTERNATIVE) AS A FLOCCULANT IS NOT RECOMMENDED. ALUM OR ANY OTHER FLOCCULANT IS TO BE USED ONLY FOLLOWING CONSULTATION WITH AND ACCEPTANCE FROM COUNCIL ESC OFFICERS.
9. DISCHARGE FROM POND IS PERMISSIBLE WHEN THE WATER PH IS 6.5-8.5 AND IS CLARIFIED TO AT OR BELOW A TSS OF 50mg/L. CLARIFICATION WOULD GENERALLY BE ACHIEVED IN 36-72 HOURS WITH THE USE OF GYPSUM PLUS NO VISIBLE OIL OR GREASE. CORRELATION TESTS MUST BE UNDERTAKEN ON SITE TO ENSURE THIS IS ACHIEVED.
10. DEWATERING SHALL BE DONE IN SUCH A MANNER AS TO REMOVE THE CLEAN WATER (BEING WATER WITHIN THE ADOPTED CRITERIA) WITHOUT REMOVING OR DISTURBING THE SEDIMENT THAT HAS SETTLED. THE PUMP INTAKE PIPE IS NOT TO REST ON THE SETTLED SEDIMENT LAYER.
11. IF WATER EXCEEDS TSS OF 50mg/L DURING DEWATERING, PUMPING IS TO CEASE. RECORDS ARE TO BE KEPT (ON-SITE AT ALL TIMES) OF ALL MEASUREMENT PRIOR TO, DURING AND AFTER DISCHARGE. RECORDS TO BE MADE AVAILABLE TO COUNCIL OFFICERS UPON REQUEST.
12. PROVIDE SECURITY FENCE TO BASIN FOR SAFETY.

INSTREAM WORKS:

1. SEDIMENT FENCES AND SEDIMENT FENCE RETURNS TO BE ERECTED PRIOR TO THE COMMENCEMENT OF ANY WORK. SEDIMENT FENCES TO REMAIN UNTIL COMPLETION OF INSTREAM WORK IN THESE LOCATION TO PROTECT EXISTING DOWNSTREAM PROPERTIES AND ROAD PAVEMENT. (REFER TO DRG-0250 FOR DETAILS).
2. UNDERTAKE WORK DURING A PERIOD OF DRY FORECASTED WEATHER.
3. PROTECT DISTURBED AREA WITH COFFERDAMS AS REQUIRED.
4. TEMPORARY LOW FLOW DIVERSION PIPE OR PUMPED SYSTEM MAY BE INSTALLED AT THE BASE OF CHANNEL TO DIVERT CLEAN WATER FROM UPSTREAM BASEFLOW.
5. UNDERTAKE ALL INSTREAM WORK IN THE SPECIFIED SECTION OF THE CHANNEL IN ACCORDANCE WITH APPROVED PLANS AND IMMEDIATELY PLANT TO STABLISE THE WORKS.
6. PLANT WITH APPROPRIATE SPECIES, AT A DENSITY THAT WOULD NATURALLY OCCUR. REFER TO DURS-COS-CV-DWG-0040 FOR THE LIST OF APPROPRIATE WETLAND SPECIES.

INSPECTION & MAINTENANCE NOTES:

IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE ADEQUATE INSPECTIONS AND MAINTENANCE ARE CARRIED OUT DURING SITE WORKS. DAILY AND WEEKLY INSPECTION CHECKLISTS HAVE BEEN PROVIDED IN THE COSTIN ROE SOIL AND WATER MANAGEMENT PLAN (SWMP) Co13455.07-03.rpt DATED NOVEMBER 2019.

AS NOTED, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE ADEQUATE MAINTENANCE OF EROSION & SEDIMENT CONTROL MEASURES ARE UNDERTAKEN DURING THE WORKS PERIOD. DAMAGED, DISLODGED OR FAULTY ESC MEASURES ARE TO BE IMMEDIATELY RECTIFIED AND THE SURROUNDING AREA IS TO BE REMEDIATED AS PER NOTES ON THIS DRAWING, THE SWMP AND THE LANDCOM 'BLUE BOOK'.

SITE STABILITY NOTE:

LAND DISTURBANCE & LAND FILLING ACTIVITIES MUST BE UNDERTAKEN IN A PHASED MANNER, IMPACTING A MAXIMUM AREA OF 65Ha AT ANY ONE TIME PER CONDITION B41(a). DISTURBED AREAS MUST BE STABILISED TO A C-FACTOR OF 0.05 PRIOR TO THE COMPLETION OF ANY OTHER WORKS PER CONDITION B41(b). REFER TO TABLE 1 ABOVE FOR APPROVED STABILISATION METHODS

SOIL & WATER MANAGEMENT PLAN NOTE:

ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SOIL AND WATER MANAGEMENT PLAN BY COSTIN ROE CONSULTING, REF 13455.07-03.rpt & CONDITIONS OF CONSENT B29-B35

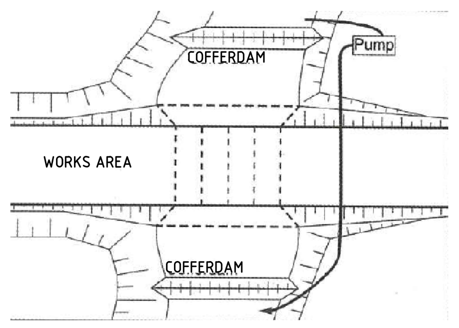
SEDIMENTATION BASIN NOTE:

REFER TO SEDIMENT & EROSION CONTROL NOTES.

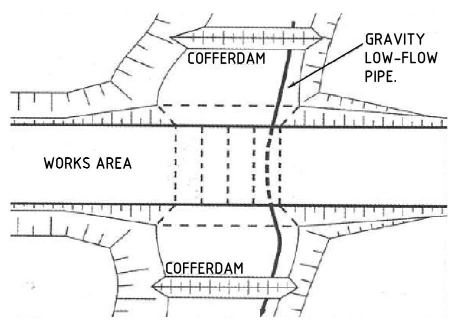
FOR SEDIMENT AND EROSION CONTROL DETAILS, REFER TO THE LANDCOM 'BLUE BOOK' AND EXTRACTS ON DRAWING PIWW-COS-CV-DWG-0250.

SEDIMENTATION BASIN SIZING BASED ON RECOMMENDATIONS OF 'SOILS AND CONSTRUCTION, MANAGING URBAN STORMWAER-THE BLUE BOOK'. CAPACITY BASED ON 5-DAY RAINFALL DEPTHS AT 85th PERCENTILE INTENSITY (32.2mm) IN THE LIVERPOOL CATCHMENT AREA.

NOTES:
1. ASSUME TYPE D SOIL (CLAY/SILTY CLAY)
2. ASSUME GROUP D SOIL (HIGH PLASTICITY AND SHRINK/SWELL PROPERTIES)
3. REFER TO DRAWING PIWW-COS-CV-DWG-0200 FOR SEDIMENTATION BASIN CALCULATIONS

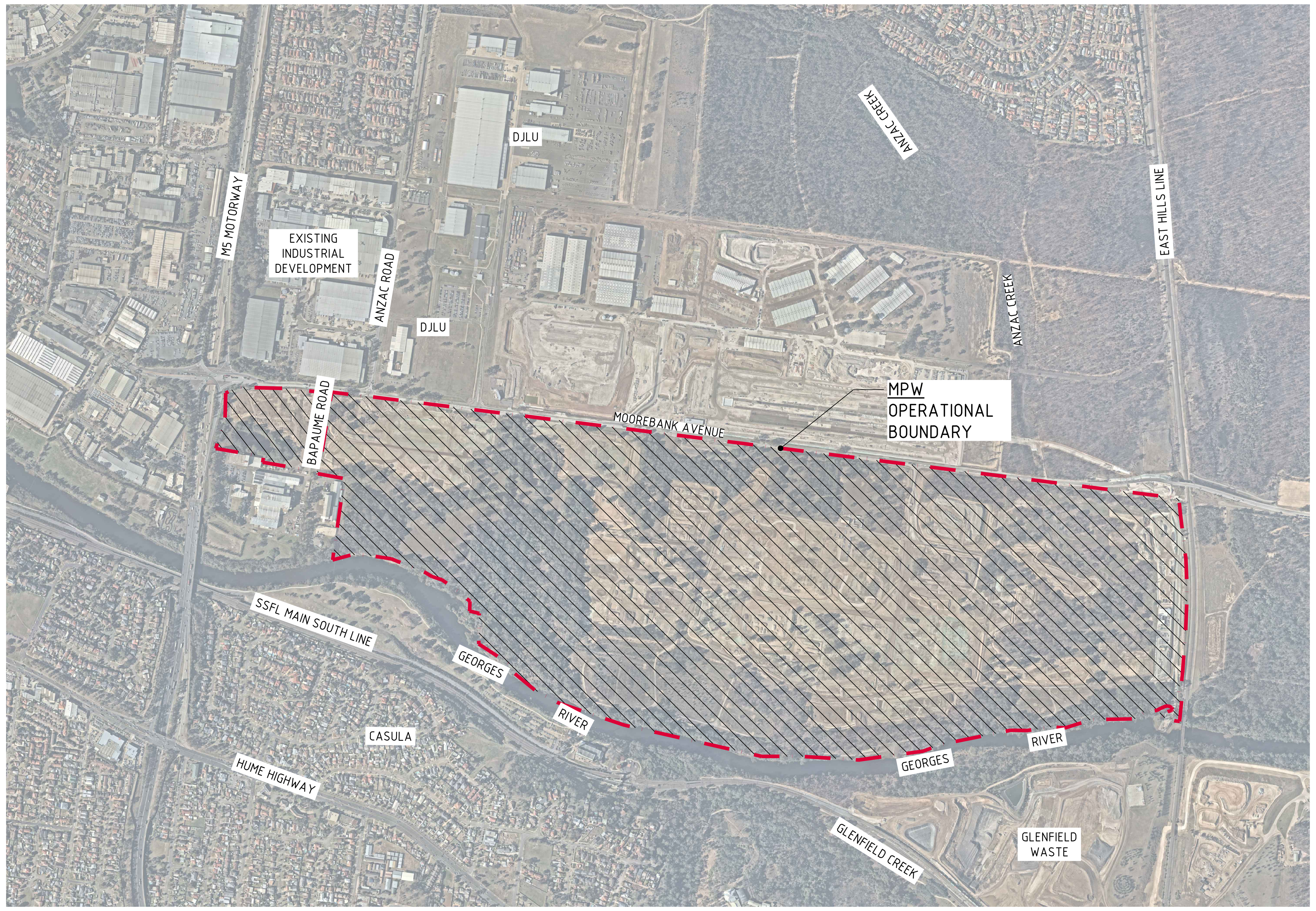


PUMPED SYSTEM OPTION



GRAVITY PIPE OPTION

INSTREAM WORKS COFFERDAM ARRANGEMENT



LOCALITY PLAN
NOT TO SCALE

DRAWING LIST

DRAWING NO.	DRAWING TITLE
PIWW-COS-CV-DWG-0200	EROSION & SED CONTROL LOCALITY PLAN, DRAWING LIST & ENGINEERING NOTES
PIWW-COS-CV-DWG-0201	EROSION & SED CONTROL RUSLE CALCULATIONS
PIWW-COS-CV-DWG-0210	EROSION & SEDIMENT CONTROL PLAN - PHASE 1
PIWW-COS-CV-DWG-0211	EROSION & SEDIMENT CONTROL PLAN - PHASE 2
PIWW-COS-CV-DWG-0212	EROSION & SEDIMENT CONTROL PLAN - PHASE 3
PIWW-COS-CV-DWG-0213	EROSION & SEDIMENT CONTROL PLAN - PHASE 4
PIWW-COS-CV-DWG-0246	BASIN 5 OUTLET STRUCTURE EROSION & SEDIMENT CONTROL PLAN
PIWW-COS-CV-DWG-0247	BASIN 6 OUTLET STRUCTURE EROSION & SEDIMENT CONTROL PLAN
PIWW-COS-CV-DWG-0248	BASIN 8 OUTLET STRUCTURE EROSION & SEDIMENT CONTROL PLAN
PIWW-COS-CV-DWG-0249	EROSION & SEDIMENT CONTROL PLAN - FINAL PHASE
PIWW-COS-CV-DWG-0250	EROSION & SEDIMENT CONTROL DETAILS - SHEET 1
PIWW-COS-CV-DWG-0251	EROSION & SEDIMENT CONTROL DETAILS - SHEET 2

FOR INFORMATION

AMENDMENTS	DATE	ISSUE	AMENDMENTS	DATE	ISSUE
ISSUED FOR POST APPROVALS	27.11.19	F			
PRELIMINARY ISSUE ONLY	22.11.19	E			
PRELIMINARY ISSUE ONLY	08.11.19	D	ISSUED FOR INFORMATION	04.02.20	j
PRELIMINARY ISSUE ONLY	12.09.19	C	ISSUED FOR INFORMATION	30.01.20	I
PRELIMINARY ISSUE ONLY	11.09.19	B	ISSUED FOR INFORMATION	20.12.19	H
PRELIMINARY ISSUE ONLY	06.09.19	A	REVISED FOR CPESC COMMENTS	12.12.19	G

DEVELOPER MOOREBANK QUBE

ARCHITECT REIDCAMPBELL Architecture, Interiors, Project Management

PROJECT MANAGER TACTICAL GROUP

PROJECT
PRECINCT INFRASTRUCTURE WORKS WEST
MOOREBANK AVENUE, MOOREBANK

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0200

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DRAWING TITLE
EROSION AND SEDIMIENT CONTROL LOCALITY PLAN, DRAWING LIST & ENGINEERING NOTES

DRAWING No PIWW-COS-CV-DWG-0200 ISSUE J

1. Erosion Hazard and Sediment Basins

Site Name: MPW

Site Location: MOOREBANK

Precinct/Stage: PRECINCT INFRASTRUCTURE WORKS

Other Details: STAGE 1 EROSION & SEDIMENT CONTROLS

Site area	Sub-catchment or Name of Structure						Notes
	1	2	3	4	5	6	
Total catchment area (ha)	16.95	18.26	25.92	11.1	8.56	4.32	
Disturbed catchment area (ha)	16.95	18.26	25.92	11.1	8.56	4.32	

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D	D	D	D	From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D	D	D	D	Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5	5	5	See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85	85	85	85	85	85	
x-day, y-percentile rainfall event (mm)	32.2	32.2	32.2	32.2	32.2	32.2	
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	10.9	10.9	10.9	10.9	10.9	10.9	

RUSLE Factors

Rainfall erosivity (*R*-factor)	2580	2580	2580	2580	2580	2580	Auto-filled from above
Soil erodibility (*K*-factor)	0.075	0.075	0.075	0.075	0.075	0.075	RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	300	300	300	300	300	300	
Slope gradient (%)	1	1	1	1	1	1	
Length/gradient (*LS*-factor)	0.27	0.27	0.27	0.27	0.27	0.27	
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64	0.64	0.64	0.64	0.64	0.64	See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	68	68	68	68	68	68	
Soil Loss Class	1	1	1	1	1	1	See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	53	53	53	53	53	53	Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	149	160	227	97	75	38	See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	3493	3763	5342	2287	1764	890	See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	3642	3923	5569	2384	1839	928	

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

2. Flow Calculations

Peak flow is given by the Rational Formula: $Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$

where: Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years.
F_y is a frequency factor for "Y" years.
A is the catchment area in hectares (ha)
$I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent. Place an x in the appropriate row below to automatically halve the time of concentration for that sub-catchment.

Structure Details

									Notes
Name	1	2	3	4	5	6			
Catchment Area (ha)	16.95	18.26	25.92	11.1	8.56	4.32			
Place an x here to halve tc	X	X	X	X	X	X			Place an x if disturbed catchment
Time of concentration (tc)	12	12	14	10	9	7			minutes

Rainfall Intensities

1-year, tc	52.51	52.51	48.99	56.81	59.34	65.54			Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2-year, tc	68.08	68.08	63.5	73.67	76.97	85.03			
5-year, tc	89.03	89.03	83.02	96.36	100.69	111.27			
10-year, tc	101.56	101.56	94.68	109.97	114.94	127.06			
20-year, tc	117.91	117.91	109.9	127.7	133.49	147.59			
50-year, tc	139.5	139.5	130.01	151.11	157.98	174.66			
100-year, tc	156.1	156.1	145.45	169.12	176.82	195.54			

C10 runoff coefficient	0.9	0.9	0.9	0.9	0.9	0.9			Use AR&R or Table F3, pg F-6

Frequency Factors

FF, 1-year	0.8	0.8	0.8	0.8	0.8	0.8			Can use 0.8 for a construction site
FF, 2-year	0.85	0.85	0.85	0.85	0.85	0.85			Can use 0.85 for a construction site
FF, 5-year	0.95	0.95	0.95	0.95	0.95	0.95			Can use 0.95 for a construction site
FF, 10-year	1	1	1	1	1	1			Generally always 1
FF, 20-year	1.05	1.05	1.05	1.05	1.05	1.05			Can use 1.05 for a construction site
FF, 50-year	1.15	1.15	1.15	1.15	1.15	1.15			Can use 1.15 for a construction site
FF, 100-year	1.2	1.2	1.2	1.2	1.2	1.2			Can use 1.2 for a construction site

Flow Calculations

									Notes
1-year, tc (m^3/s)	1.782	1.919	2.542	1.262	1.017	0.567			
2-year, tc (m^3/s)	2.454	2.644	3.5	1.739	1.401	0.781			
5-year, tc (m^3/s)	3.587	3.864	5.115	2.542	2.049	1.143			
10-year, tc (m^3/s)	4.307	4.64	6.14	3.054	2.462	1.373			
20-year, tc (m^3/s)	5.25	5.656	7.484	3.724	3.002	1.675			
50-year, tc (m^3/s)	6.803	7.329	9.696	4.826	3.891	2.171			
100-year, tc (m^3/s)	7.944	8.558	11.319	5.636	4.544	2.536			

NB for flow calculations on sediment basin spillways, see Worksheet 3 (if required).

3. Sediment Basin Spillway Design

Structure Details

Structure Name	1	2	3	4	5	6	Auto-filled from Worksheet 1
Catchment Area (ha)	16.95	18.26	25.92	11.1	8.56	4.32	Auto-filled from Worksheet 1
Time of concentration (tc)	12	12	14	10	9	7	Auto-calculated assuming tc is halved

Rainfall Intensities (IFD Values)

1 year, tc	52.51	52.51	48.99	56.81	59.34	65.54	Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2 year, tc	68.08	68.08	63.5	73.67	76.97	85.03	
5 year, tc	89.03	89.03	83.02	96.36	100.69	111.27	
10 year, tc	101.56	101.56	94.68	109.97	114.94	127.06	
20 year, tc	117.91	117.91	109.9	127.7	133.49	147.59	
50 year, tc	139.5	139.5	130.01	151.11	157.98	174.66	
100 year, tc	156.1	156.1	145.45	169.12	176.82	195.54	

C_{10} runoff coefficient	0.9	0.9	0.9	0.9	0.9	0.9	Use AR&R or Table F3, pg F-6
Design ARI event (select):	100	100	100	100	100	100	Select design ARI (years) from dropdown
Frequency Factor	1.2	1.2	1.2	1.2	1.2	1.2	Auto-filled based on selected ARI
Flow Calculation	7.944	8.558	11.319	5.636	4.544	2.536	Auto-calculated based on selected ARI

STAGE 1 BASIN CALCULATIONS - REFER DRAWING PIWW-COS-CV-DWG-0210

1. Erosion Hazard and Sediment Basins

Site Name: MPW

Site Location: MOOREBANK

Precinct/Stage: PRECINCT INFRASTRUCTURE WORKS

Other Details: STAGE 2 EROSION & SEDIMENT CONTROLS

Site area	Sub-catchment or Name of Structure						Notes
	4	5A	5B				
Total catchment area (ha)	3.28	20.19	18.74				
Disturbed catchment area (ha)	3.28	20.19	18.74				

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D				From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D				Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5				See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85	85	85				
x-day, y-percentile rainfall event (mm)	32.2	32.2	32.2				
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	10.9	10.9	10.9				

RUSLE Factors

Rainfall erosivity (*R*-factor)	2580	2580	2580				Auto-filled from above
Soil erodibility (*K*-factor)	0.075	0.075	0.075				RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	300	300	300				
Slope gradient (%)	1	1	1				
Length/gradient (*LS*-factor)	0.27	0.27	0.27				
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2				Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64	0.64	0.64				See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	68	68	68				
Soil Loss Class	1	1	1				See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	53	53	53				Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	29	177	164				See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	676	4161	3862				See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	705	4338	4026				

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

2. Flow Calculations

Peak flow is given by the Rational Formula: $Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$

where: Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years.
F_y is a frequency factor for "Y" years.
A is the catchment area in hectares (ha)
$I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent. Place an x in the appropriate row below to automatically halve the time of concentration for that sub-catchment.

Structure Details

									Notes
Name	4	5A	5B						
Catchment Area (ha)	3.28	20.19	18.74						
Place an x here to halve tc	X	X	X						Place an x if disturbed catchment
Time of concentration (tc)	6	12	12						minutes

Rainfall Intensities

1-year, tc	69.44	52.51	52.51						Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2-year, tc	90.11	68.08	68.08						
5-year, tc	117.9	89.03	89.03						
10-year, tc	134.63	101.56	101.56						
20-year, tc	156.37	117.91	117.91						
50-year, tc	185	139.5	139.5						
100-year, tc	207.11	156.1	156.1						

C10 runoff coefficient	0.9	0.9	0.9						Use AR&R or Table F3, pg F-6

Frequency Factors

FF, 1-year	0.8	0.8	0.8						Can use 0.8 for a construction site
FF, 2-year	0.85	0.85	0.85						Can use 0.85 for a construction site
FF, 5-year	0.95	0.95	0.95						Can use 0.95 for a construction site
FF, 10-year	1	1	1						Generally always 1
FF, 20-year	1.05	1.05	1.05						Can use 1.05 for a construction site
FF, 50-year	1.15	1.15	1.15						Can use 1.15 for a construction site
FF, 100-year	1.2	1.2	1.2						Can use 1.2 for a construction site

Flow Calculations

									Notes
1-year, tc (m^3/s)	0.456	2.122	1.97						
2-year, tc (m^3/s)	0.629	2.923	2.713						
5-year, tc (m^3/s)	0.919	4.273	3.966						
10-year, tc (m^3/s)	1.105	5.13	4.762						
20-year, tc (m^3/s)	1.347	6.254	5.805						
50-year, tc (m^3/s)	1.746	8.104	7.522						
100-year, tc (m^3/s)	2.04	9.463	8.783						

NB for flow calculations on sediment basin spillways, see Worksheet 3 (if required).

3. Sediment Basin Spillway Design

Structure Details

Structure Name	4	5A	5B				Auto-filled from Worksheet 1
Catchment Area (ha)	3.28	20.19	18.74				Auto-filled from Worksheet 1
Time of concentration (tc)	6	12	12				Auto-calculated assuming tc is halved

Rainfall Intensities (IFD Values)

1 year, tc	69.44	52.51	52.51				Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2 year, tc	90.11	68.08	68.08				
5 year, tc	117.9	89.03	89.03				
10 year, tc	134.63	101.56	101.56				
20 year, tc	156.37	117.91	117.91				
50 year, tc	185	139.5	139.5				
100 year, tc	207.11	156.1	156.1				

C_{10} runoff coefficient	0.9	0.9	0.9				Use AR&R or Table F3, pg F-6
Design ARI event (select):	100	100	100	100	100	100	Select design ARI (years) from dropdown
Frequency Factor	1.2	1.2	1.2	1.2	1.2	1.2	Auto-filled based on selected ARI
Flow Calculation	2.04	9.463	8.783				Auto-calculated based on selected ARI

STAGE 2 BASIN CALCULATIONS - REFER DRAWING PIWW-COS-CV-DWG-0211

1. Erosion Hazard and Sediment Basins

Site Name: MPW

Site Location: MOOREBANK

Precinct/Stage: PRECINCT INFRASTRUCTURE WORKS

Other Details: STAGE 3 EROSION & SEDIMENT CONTROLS

Site area	Sub-catchment or Name of Structure						Notes
	6						
Total catchment area (ha)	59.1						
Disturbed catchment area (ha)	59.1						

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D						From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D						Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5						See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85						
x-day, y-percentile rainfall event (mm)	32.2						
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	10.9						

RUSLE Factors

Rainfall erosivity (*R*-factor)	2580						Auto-filled from above
Soil erodibility (*K*-factor)	0.075						RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	300						
Slope gradient (%)	1						
Length/gradient (*LS*-factor)	0.27						
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2						Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64						See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	68						
Soil Loss Class	1						See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	53						Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	518						See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	12179						See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	12697						

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

2. Flow Calculations

Peak flow is given by the Rational Formula: $Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$

where: Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years.
F_y is a frequency factor for "Y" years.
A is the catchment area in hectares (ha)
$I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent. Place an x in the appropriate row below to automatically halve the time of concentration for that sub-catchment.

Structure Details

									Notes
Name	6								
Catchment Area (ha)	59.1								
Place an x here to halve tc	X								Place an x if disturbed catchment
Time of concentration (tc)	19								minutes

Rainfall Intensities

1-year, tc	42.35								Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2-year, tc	54.88								
5-year, tc	71.74								
10-year, tc	81.79								
20-year, tc	94.91								
50-year, tc	112.25								
100-year, tc	125.57								

C10 runoff coefficient	0.9								Use AR&R or Table F3, pg F-6

Frequency Factors

FF, 1-year	0.8								Can use 0.8 for a construction site
FF, 2-year	0.85								Can use 0.85 for a construction site
FF, 5-year	0.95								Can use 0.95 for a construction site
FF, 10-year	1								Generally always 1
FF, 20-year	1.05								Can use 1.05 for a construction site
FF, 50-year	1.15								Can use 1.15 for a construction site
FF, 100-year	1.2								Can use 1.2 for a construction site

Flow Calculations

									Notes
1-year, tc (m^3/s)	5.01								
2-year, tc (m^3/s)	6.898								
5-year, tc (m^3/s)	10.078								
10-year, tc (m^3/s)	12.094								
20-year, tc (m^3/s)	14.736								
50-year, tc (m^3/s)	19.088								
100-year, tc (m^3/s)	22.281								

NB for flow calculations on sediment basin spillways, see Worksheet 3 (if required).

3. Sediment Basin Spillway Design

Structure Details

Structure Name	6						Auto-filled from Worksheet 1
Catchment Area (ha)	59.1						Auto-filled from Worksheet 1
Time of concentration (tc)	19						Auto-calculated assuming tc is halved

Rainfall Intensities (IFD Values)

1 year, tc	42.35						Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2 year, tc	54.88						
5 year, tc	71.74						
10 year, tc	81.79						
20 year, tc	94.91						
50 year, tc	112.25						
100 year, tc	125.57						

C_{10} runoff coefficient	0.9						Use AR&R or Table F3, pg F-6
Design ARI event (select):	100	100	100	100	100	100	Select design ARI (years) from dropdown
Frequency Factor	1.2	1.2	1.2	1.2	1.2	1.2	Auto-filled based on selected ARI
Flow Calculation	22.281						Auto-calculated based on selected ARI

STAGE 3 BASIN CALCULATIONS - REFER DRAWING PIWW-COS-CV-DWG-0212

1. Erosion Hazard and Sediment Basins

Site Name: MPW

Site Location: MOOREBANK

Precinct/Stage: PRECINCT INFRASTRUCTURE WORKS

Other Details: STAGE 4 EROSION & SEDIMENT CONTROLS

Site area	Sub-catchment or Name of Structure						Notes
	3	8					
Total catchment area (ha)	10.46	26.91					
Disturbed catchment area (ha)	10.46	26.91					

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D					From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D					Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5					See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85	85					
x-day, y-percentile rainfall event (mm)	32.2	32.2					
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	10.9	10.9					

RUSLE Factors

Rainfall erosivity (*R*-factor)	2580	2580					Auto-filled from above
Soil erodibility (*K*-factor)	0.075	0.075					RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	300	300					
Slope gradient (%)	1	1					
Length/gradient (*LS*-factor)	0.27	0.27					
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2					Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64	0.64					See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	68	68					
Soil Loss Class	1	1					See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	53	53					Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	92	236					See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	2156	5546					See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	2248	5782					

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

2. Flow Calculations

Peak flow is given by the Rational Formula: $Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$

where: Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years.
F_y is a frequency factor for "Y" years.
A is the catchment area in hectares (ha)
$I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent. Place an x in the appropriate row below to automatically halve the time of concentration for that sub-catchment.

Structure Details

									Notes
Name	3	8							
Catchment Area (ha)	10.46	26.91							
Place an x here to halve tc	X	X							Place an x if disturbed catchment
Time of concentration (tc)	10	14							minutes

Rainfall Intensities

1-year, tc	56.81	69.44							Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2-year, tc	73.67	90.11							
5-year, tc	96.36	117.9							
10-year, tc	109.97	134.63							
20-year, tc	127.7	156.37							
50-year, tc	151.11	185							
100-year, tc	169.12	207.11							

C10 runoff coefficient	0.9	0.9							Use AR&R or Table F3, pg F-6

Frequency Factors

FF, 1-year	0.8	0.8							Can use 0.8 for a construction site
FF, 2-year	0.85	0.85							Can use 0.85 for a construction site
FF, 5-year	0.95	0.95							Can use 0.95 for a construction site
FF, 10-year	1	1							Generally always 1
FF, 20-year	1.05	1.05							Can use 1.05 for a construction site
FF, 50-year	1.15	1.15							Can use 1.15 for a construction site
FF, 100-year	1.2	1.2							Can use 1.2 for a construction site

Flow Calculations

									Notes
1-year, tc (m^3/s)	1.189	3.74							
2-year, tc (m^3/s)	1.639	5.157							
5-year, tc (m^3/s)	2.396	7.541							
10-year, tc (m^3/s)	2.878	9.064							
20-year, tc (m^3/s)	3.509	11.055							
50-year, tc (m^3/s)	4.548	14.324							
100-year, tc (m^3/s)	5.311	16.733							

NB for flow calculations on sediment basin spillways, see Worksheet 3 (if required).

3. Sediment Basin Spillway Design

Structure Details

Structure Name	3	8					Auto-filled from Worksheet 1
Catchment Area (ha)	10.46	26.91					Auto-filled from Worksheet 1
Time of concentration (tc)	10	14					Auto-calculated assuming tc is halved

Rainfall Intensities (IFD Values)

1 year, tc	56.81	69.44					Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2 year, tc	73.67	90.11					
5 year, tc	96.36	117.9					
10 year, tc	109.97	134.63					
20 year, tc	127.7	156.37					
50 year, tc	151.11	185					
100 year, tc	169.12	207.11					

C_{10} runoff coefficient	0.9	0.9					Use AR&R or Table F3, pg F-6
Design ARI event (select):	100	100	100	100	100	100	Select design ARI (years) from dropdown
Frequency Factor	1.2	1.2	1.2	1.2	1.2	1.2	Auto-filled based on selected ARI
Flow Calculation	5.311	16.733					Auto-calculated based on selected ARI

STAGE 4 BASIN CALCULATIONS - REFER DRAWING PIWW-COS-CV-DWG-0213

FOR POST-APPROVALS

AMENDMENTS	DATE	ISSUE	AMENDMENTS	DATE	ISSUE
ISSUED FOR POST APPROVALS	27.11.19	B			
PRELIMINARY ISSUE ONLY	06.09.19	A			

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PROJECT MANAGER: TACTICAL GROUP

PROJECT: PRECINCT INFRASTRUCTURE WORKS WEST
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DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0201

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DRAWING TITLE: EROSION AND SEDIMENT CONTROL SEDIMENTATION BASIN RUSLE CALCULATIONS

DRAWING No: PIWW-COS-CV-DWG-0201 ISSUE: B

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY CARDNO TITLED 115804548 DATED 05/08/19.

SHEET-FLOW DIRECTION	SEDIMENT BASIN (REFER TO PLAN)
SITE BOUNDARY	STABILISED SOIL
CATCHMENT BOUNDARY	SITE WATER SUMP (LOW POINT)
DIRTY WATER DIVERSION DRAIN	STABILISED EARTH DIVERSION BUND
CLEAN WATER DIVERSION DRAIN	WHEEL WASH STATION
PUMP DIVERSION	HAUL ROAD
PIPED DRAINAGE LINE	PIPE CROSSING
SEDIMENT FENCING	
1 IN 100 YEAR ARI FLOOD EXTENT	

50% DESIGN COMPLETION

AMENDMENTS	DATE	ISSUE
REVISED FOR CPESC COMMENTS	12.12.19	F
ISSUED FOR POST APPROVALS	27.11.19	E
PRELIMINARY ISSUE ONLY	08.11.19	D
PRELIMINARY ISSUE ONLY	12.09.19	C
PRELIMINARY ISSUE ONLY	11.09.19	B
PRELIMINARY ISSUE ONLY	06.09.19	A
50% DESIGN COMPLETION	17.02.20	H
REVISED FOR ER COMMENTS	30.01.20	G

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PROJECT: PRECINCT INFRASTRUCTURE WORKS WEST — MOOREBANK AVENUE, MOOREBANK

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0210

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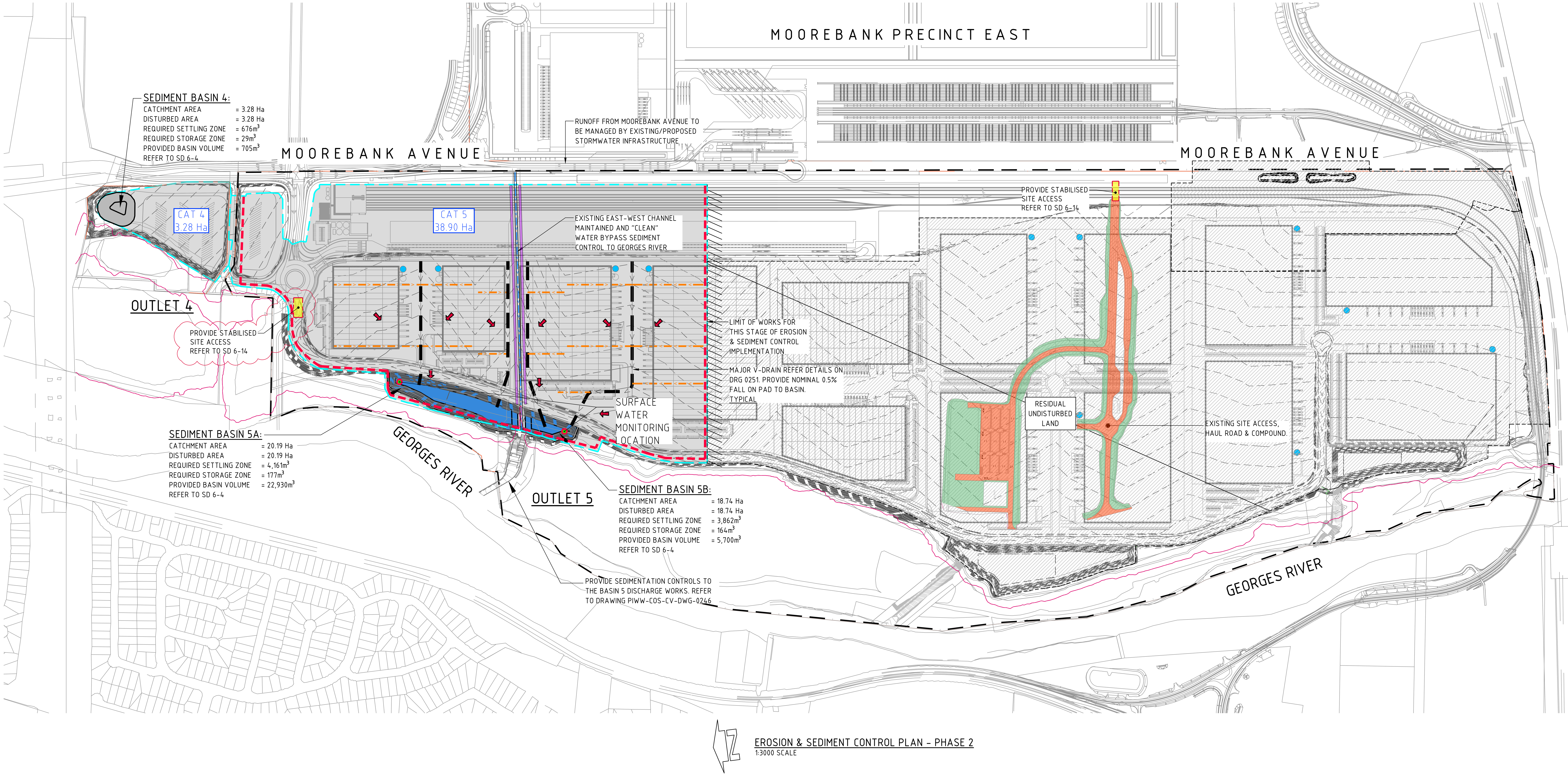
DRAWING TITLE: EROSION AND SEDIMIENT CONTROL PLAN - PHASE 1

DRAWING No: PIWW-COS-CV-DWG-0210 ISSUE: H



EROSION & SEDIMENT CONTROL PLAN - PHASE 2
1:3000 SCALE

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY CARDNO TITLED 115804548 DATED 05/08/19.

(red arrow)	SHEET-FLOW DIRECTION
(black dashed line)	SITE BOUNDARY
(cyan dashed line)	CATCHMENT BOUNDARY
(orange dashed line)	DIRTY WATER DIVERSION DRAIN - MINOR
(black dashed line)	DIRTY WATER DIVERSION DRAIN - MAJOR
(blue dashed line)	CLEAN WATER DIVERSION DRAIN
(purple dashed line)	PUMP DIVERSION
(red dashed line)	SEDIMENT FENCING
(pink line)	1 IN 100 YEAR ARI FLOOD EXTENT
(blue fill)	SEDIMENT BASIN (REFER TO PLAN)
(green fill)	STABILISED SOIL
(purple fill)	STABILISED EARTH DIVERSION BUND
(orange fill)	HAUL ROAD
(grey fill)	DISTURBED LAND (<65Ha AT ANY ONE TIME)
(hatched)	UNDISTURBED LAND

SITE STABILITY NOTE:

LAND DISTURBANCE & LAND FILLING ACTIVITIES MUST BE UNDERTAKEN IN A PHASED MANNER, IMPACTING A MAXIMUM AREA OF 65Ha AT ANY ONE TIME PER CONDITION B41(a).
DISTURBED AREAS MUST BE STABILISED TO A C-FACTOR OF 0.05 PRIOR TO THE COMPLETION OF ANY OTHER WORKS PER CONDITION B41(b). REFER TO TABLE 1 ON DRAWING 0200 FOR APPROVED STABILISATION METHODS

EROSION & SEDIMENT CONTROL NOTES:

REFER TO DRAWING 0200 FOR EROSION & SEDIMENT CONTROL NOTES

SEDIMENT BASIN NOTES

REFER TO DRAWING 0201 FOR SEDIMENT BASIN SIZING CALCULATIONS

30m 0 50 100 150 200 250 300m
1:3000 SCALE AT A0 SHEET SIZE

50% DESIGN COMPLETION

AMENDMENTS	DATE	ISSUE
REVISED AS CLOUDED	16.03.20	F
50% DESIGN COMPLETION	17.02.20	E
REVISED FOR ER COMMENTS	30.01.20	D
ISSUED FOR INFORMATION	20.12.19	C
REVISED FOR CPESC COMMENTS	12.12.19	B
ISSUED FOR POST APPROVALS	27.11.19	A

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PROJECT MANAGER: TACTICAL GROUP

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D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0211

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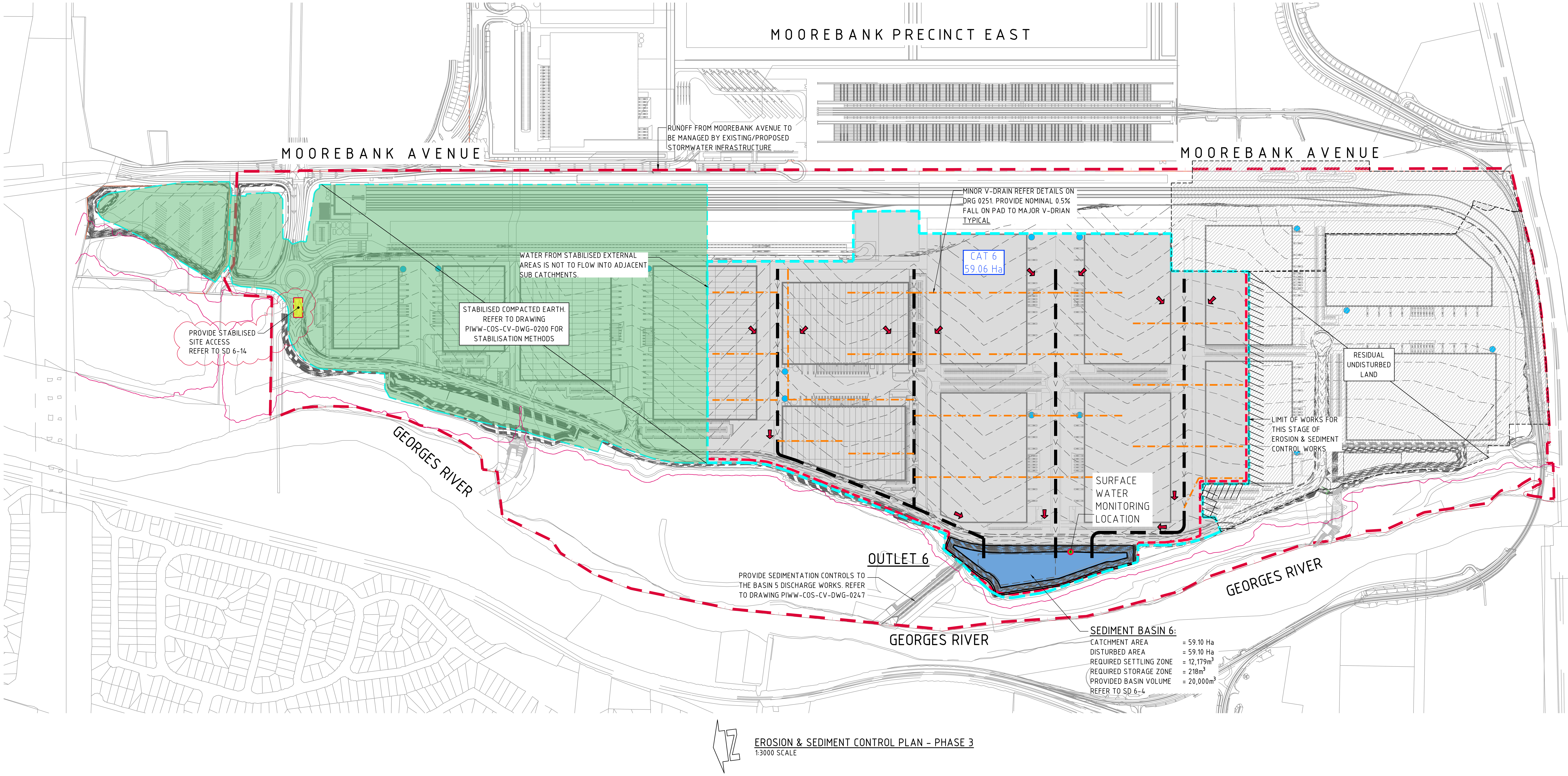
DRAWING TITLE: EROSION & SEDIMENT CONTROL PLAN - PHASE 2
DRAWING No: PIWW-COS-CV-DWG-0211
ISSUE: F



EROSION & SEDIMENT CONTROL PLAN – PHASE 3
1:3000 SCALE

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY CARDNO TITLED 115804548 DATED 05/08/19.

– SHEET-FLOW DIRECTION	– 1 IN 100 YEAR ARI FLOOD EXTENT
– SITE BOUNDARY	– SEDIMENT BASIN (REFER TO PLAN)
– CATCHMENT BOUNDARY	– STABILISED SOIL
– DIRTY WATER DIVERSION DRAIN – MINOR	– STABILISED EARTH DIVERSION BUND
– DIRTY WATER DIVERSION DRAIN – MAJOR	– HAUL ROAD
– CLEAN WATER DIVERSION DRAIN	– DISTURBED LAND (<65Ha AT ANY ONE TIME)
– PUMP DIVERSION	– UNDISTURBED LAND
– SEDIMENT FENCING	

SITE STABILITY NOTE:

LAND DISTURBANCE & LAND FILLING ACTIVITIES MUST BE UNDERTAKEN IN A PHASED MANNER, IMPACTING A MAXIMUM AREA OF 65Ha AT ANY ONE TIME PER CONDITION B41(a).
DISTURBED AREAS MUST BE STABILISED TO A C-FACTOR OF 0.05 PRIOR TO THE COMPLETION OF ANY OTHER WORKS PER CONDITION B41(b). REFER TO TABLE 1 ON DRAWING 0200 FOR APPROVED STABILISATION METHODS

EROSION & SEDIMENT CONTROL NOTES:

REFER TO DRAWING 0200 FOR EROSION & SEDIMENT CONTROL NOTES

SEDIMENT BASIN NOTES

REFER TO DRAWING 0201 FOR SEDIMENT BASIN SIZING CALCULATIONS

30m 0 50 100 150 200 250 300m
1:3000 SCALE AT A0 SHEET SIZE

50% DESIGN COMPLETION

AMENDMENTS	DATE	ISSUE	AMENDMENTS	DATE	ISSUE
REVISED AS CLOUDED	16.03.20	F			
50% DESIGN COMPLETION	17.02.20	E			
REVISED FOR ER COMMENTS	30.01.20	D			
ISSUED FOR INFORMATION	20.12.19	C			
REVISED FOR CPESC COMMENTS	12.12.19	B			
PRELIMINARY ISSUE ONLY	27.11.19	A			

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PROJECT MANAGER: TACTICAL GROUP

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DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0212

CONSULT AUSTRALIA

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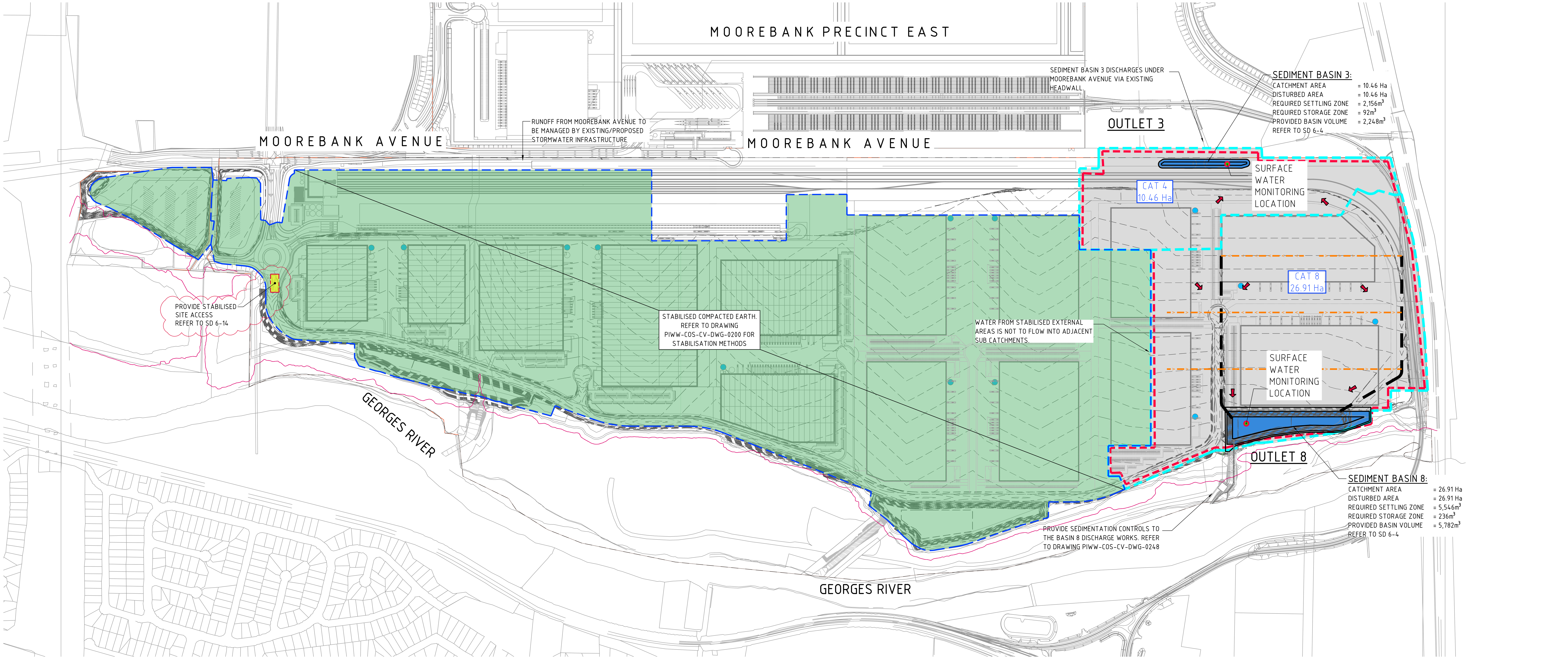
DRAWING TITLE: EROSION & SEDIMENT CONTROL PLAN – PHASE 3
DRAWING No: PIWW-COS-CV-DWG-0212
ISSUE: F



EROSION & SEDIMENT CONTROL PLAN - PHASE 4
1:3000 SCALE

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY CARDNO TITLED 115804548 DATED 05/08/19.

(red arrow)	- SHEET-FLOW DIRECTION	(red line)	- 1 IN 100 YEAR ARI FLOOD EXTENT
(black dashed)	- SITE BOUNDARY	(blue fill)	- SEDIMENT BASIN (REFER TO PLAN)
(cyan dashed)	- CATCHMENT BOUNDARY	(green fill)	- STABILISED SOIL
(orange >)	- DIRTY WATER DIVERSION DRAIN - MINOR	(purple fill)	- EARTH DIVERSION BUND
(black >)	- DIRTY WATER DIVERSION DRAIN - MAJOR	(orange fill)	- HAUL ROAD
(blue >)	- CLEAN WATER DIVERSION DRAIN	(grey fill)	- DISTURBED LAND (<65Ha AT ANY ONE TIME)
(purple >)	- PUMP DIVERSION		
(red dashed)	- SEDIMENT FENCING		

SITE STABILITY NOTE:

LAND DISTURBANCE & LAND FILLING ACTIVITIES MUST BE UNDERTAKEN IN A PHASED MANNER, IMPACTING A MAXIMUM AREA OF 65Ha AT ANY ONE TIME PER CONDITION B41(a).
DISTURBED AREAS MUST BE STABILISED TO A C-FACTOR OF 0.05 PRIOR TO THE COMPLETION OF ANY OTHER WORKS PER CONDITION B41(b). REFER TO TABLE 1 ON DRAWING 0200 FOR APPROVED STABILISATION METHODS

EROSION & SEDIMENT CONTROL NOTES:

REFER TO DRAWING 0200 FOR EROSION & SEDIMENT CONTROL NOTES

SEDIMENT BASIN NOTES

REFER TO DRAWING 0201 FOR SEDIMENT BASIN SIZING CALCULATIONS

30m 0 50 100 150 200 250 300m
1:3000 SCALE AT A0 SHEET SIZE

50% DESIGN COMPLETION

AMENDMENTS	DATE	ISSUE
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PROJECT MANAGER: TACTICAL GROUP

PROJECT: PRECINCT INFRASTRUCTURE WORKS WEST
MOOREBANK AVENUE, MOOREBANK

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0213

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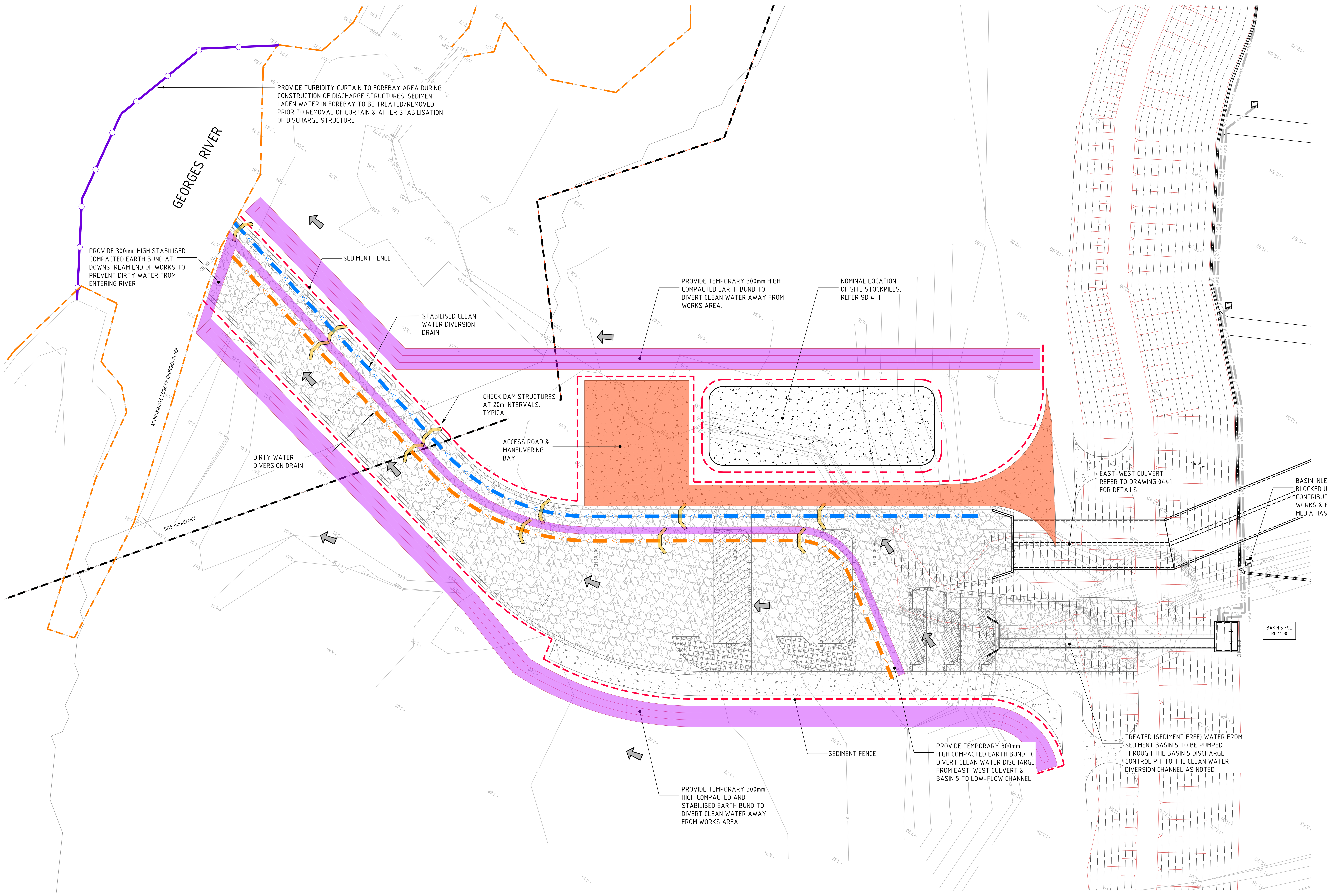
DRAWING TITLE: EROSION & SEDIMENT CONTROL PLAN - PHASE 4
DRAWING No: PIWW-COS-CV-DWG-0213
ISSUE: F



LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY CARDNO TITLED 115804548 DATED 05/08/19.

- SHEET-FLOW DIRECTION
- SITE BOUNDARY
- DIRTY WATER DIVERSION DRAIN
- CLEAN WATER DIVERSION DRAIN
- TURBIDITY CURTAIN
- SEDIMENT FENCING
- STABILISED SOIL
- STABILISED EARTH DIVERSION BUND
- ACCESS ROAD

BASIN 5 OUTLET EROSION & SEDIMENT CONTROL PLAN
1:200 SCALE

2m 0 5 10 15 20m
1:200 SCALE AT A0 SHEET SIZE

FOR POST-APPROVALS

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DEVELOPER: MOOREBANK LOGISTICS PARK, QUBE

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DRAWING TITLE: BASIN 5 OUTLET STRUCTURE EROSION & SEDIMENT CONTROL PLAN
DRAWING No: PIWW-COS-CV-DWG-0246
ISSUE: C

BASIN 6 OUTLET EROSION & SEDIMENT CONTROL PLAN

1:200 SCALE

LEGEND:

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EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY CARDNO TITLED 115804548 DATED 05/08/19.

- SHEET-FLOW DIRECTION
- SITE BOUNDARY
- DIRTY WATER DIVERSION DRAIN
- CLEAN WATER DIVERSION DRAIN
- TURBIDITY CURTAIN
- SEDIMENT FENCING
- STABILISED SOIL
- STABILISED EARTH DIVERSION BUND
- ACCESS ROAD

2m 0 5 10 15 20m

1:200 SCALE AT A0 SHEET SIZE

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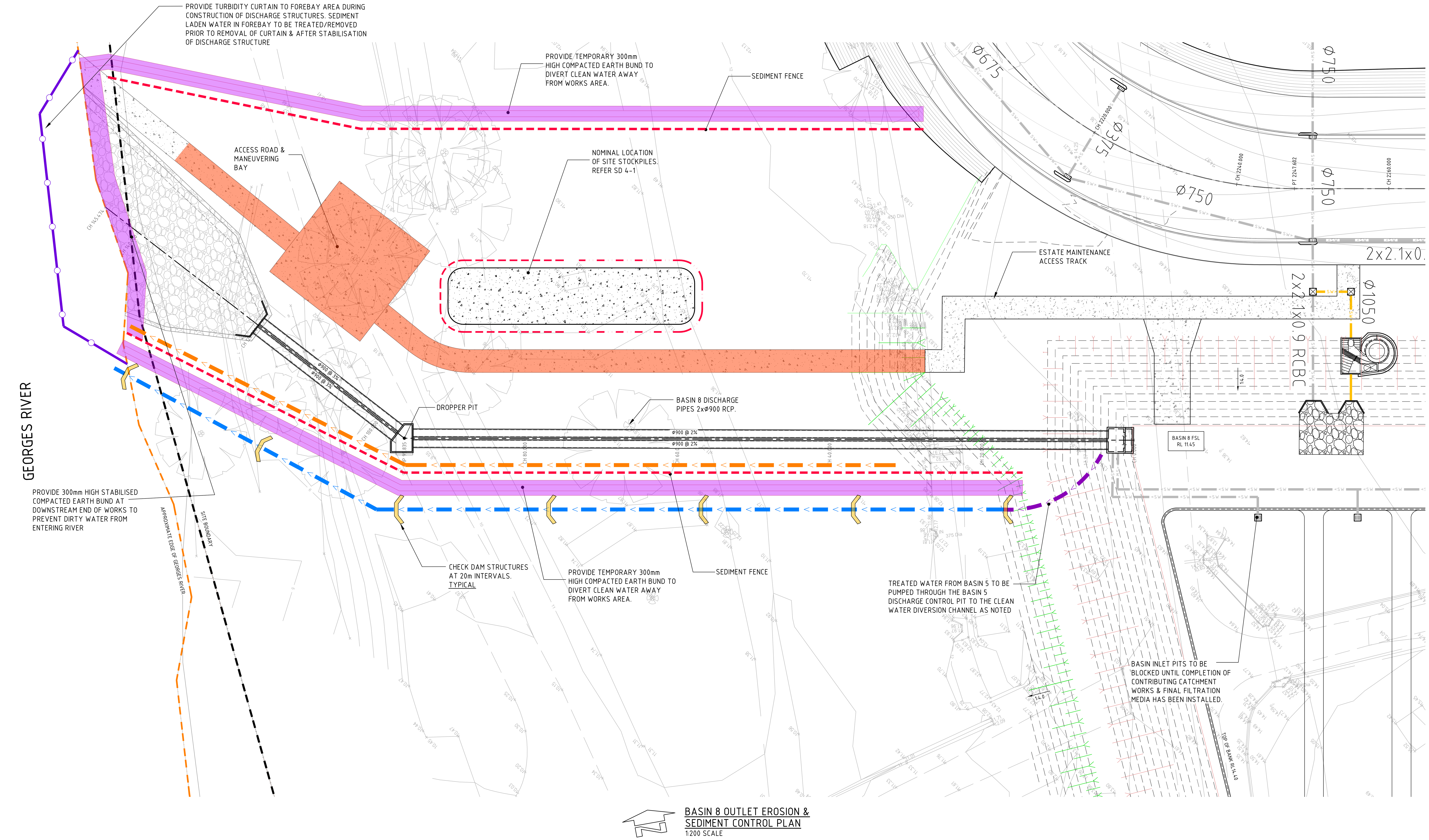
DRAWING TITLE: BASIN 6 OUTLET STRUCTURE EROSION & SEDIMENT CONTROL PLAN

DRAWING No: PIWW-COS-CV-DWG-0247 ISSUE: C



BASIN 8 OUTLET EROSION & SEDIMENT CONTROL PLAN
1:200 SCALE

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY CARDNO TITLED 115804548 DATED 05/08/19.

- SHEET-FLOW DIRECTION
- SITE BOUNDARY
- DIRTY WATER DIVERSION DRAIN
- CLEAN WATER DIVERSION DRAIN
- TURBIDITY CURTAIN
- SEDIMENT FENCING
- STABILISED SOIL
- STABILISED EARTH DIVERSION BUND
- ACCESS ROAD

2m 0 5 10 15 20m
1:200 SCALE AT A0 SHEET SIZE

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DRAWING TITLE: BASIN 8 OUTLET STRUCTURE EROSION & SEDIMENT CONTROL PLAN
DRAWING No: PIWW-COS-CV-DWG-0248
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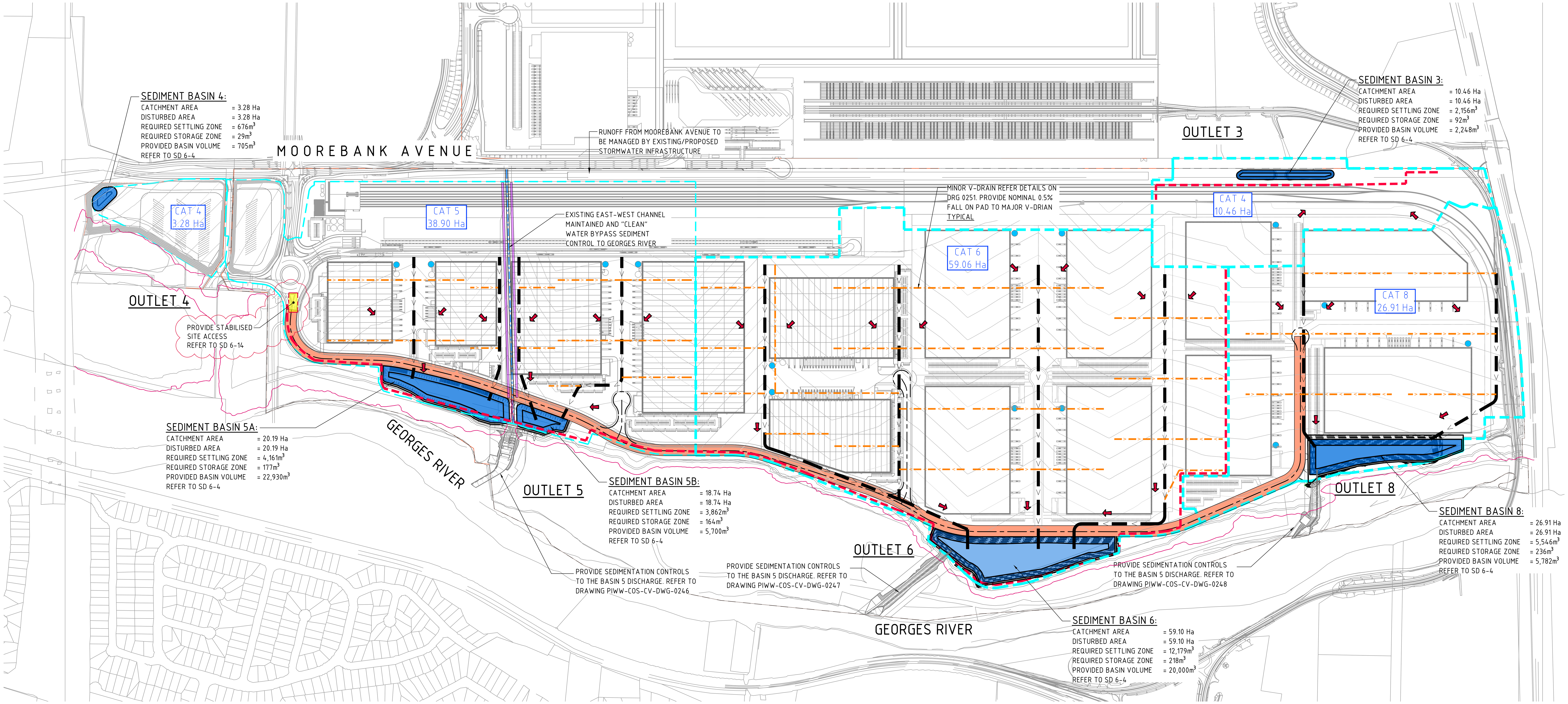

EROSION & SEDIMENT CONTROL PLAN - FINAL PHASE
1:3000 SCALE

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY CARDNO TITLED 115804548 DATED 05/08/19.

- SHEET-FLOW DIRECTION
- SITE BOUNDARY
- CATCHMENT BOUNDARY
- DIRTY WATER DIVERSION DRAIN - MINOR
- DIRTY WATER DIVERSION DRAIN - MAJOR
- CLEAN WATER DIVERSION DRAIN
- PUMP DIVERSION
- SEDIMENT FENCING
- 1 IN 100 YEAR ARI FLOOD EXTENT
- SEDIMENT BASIN (REFER TO PLAN)
- STABILISED EARTH DIVERSION BUND
- HAUL ROAD

SITE STABILITY NOTE:

LAND DISTURBANCE & LAND FILLING ACTIVITIES MUST BE UNDERTAKEN IN A PHASED MANNER, IMPACTING A MAXIMUM AREA OF 65Ha AT ANY ONE TIME PER CONDITION B41(a).
DISTURBED AREAS MUST BE STABILISED TO A C-FACTOR OF 0.05 PRIOR TO THE COMPLETION OF ANY OTHER WORKS PER CONDITION B41(b). REFER TO TABLE 1 ON DRAWING 0200 FOR APPROVED STABILISATION METHODS

EROSION & SEDIMENT CONTROL NOTES:

REFER TO DRAWING 0200 FOR EROSION & SEDIMENT CONTROL NOTES

SEDIMENT BASIN NOTES

REFER TO DRAWING 0201 FOR SEDIMENT BASIN SIZING CALCULATIONS

30m 0 50 100 150 200 250 300m
1:3000 SCALE AT A0 SHEET SIZE

50% DESIGN COMPLETION

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PROJECT MANAGER
TACTICAL GROUP

PROJECT
PRECINCT INFRASTRUCTURE WORKS WEST
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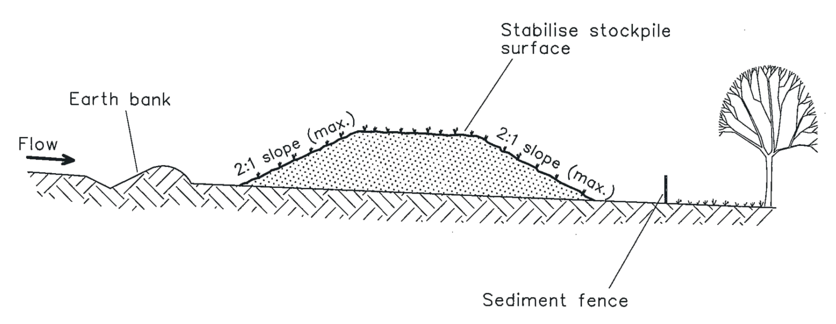
DRAWING TITLE
EROSION & SEDIMENT CONTROL PLAN - FINAL PHASE

DRAWING No PIWW-COS-CV-DWG-0249
ISSUE I

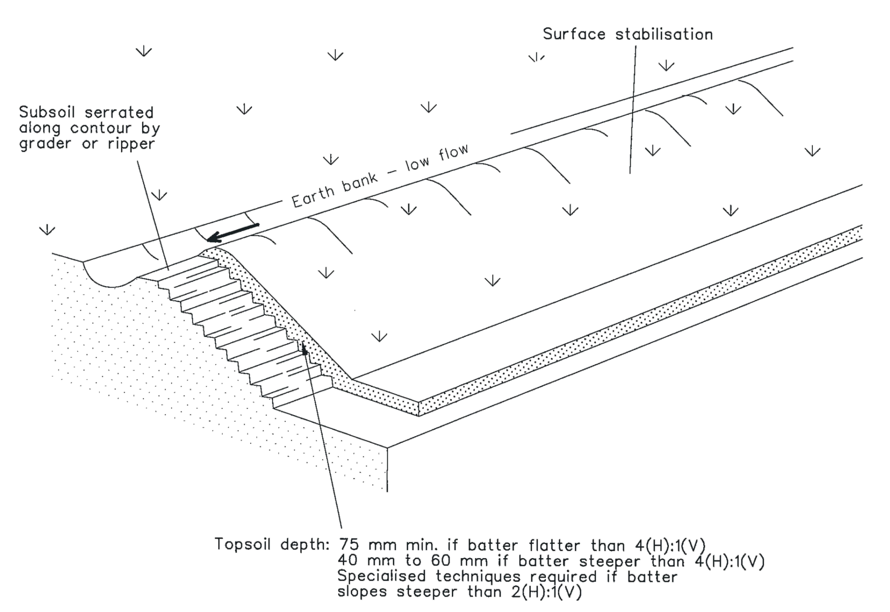


Construction Notes

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

STOCKPILES **SD 4-1**

4-5

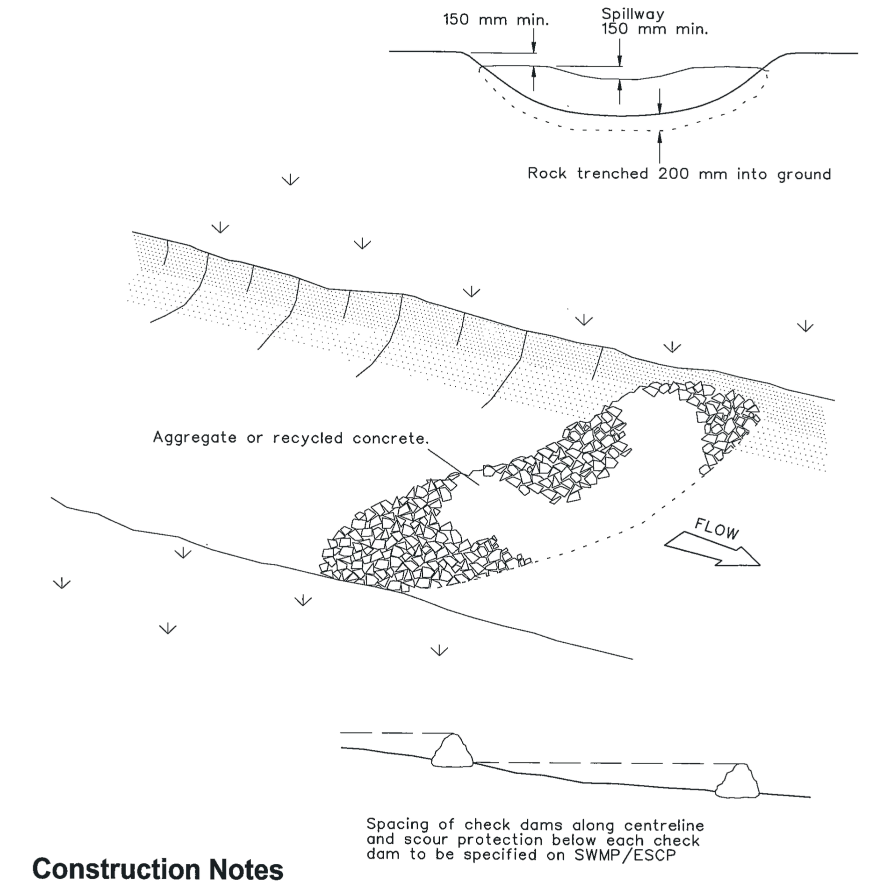


Construction Notes

1. Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any hardsetting surfaces and to provide a good bond between the respread material and subsoil.
2. Add soil ameliorants as required by the ESCP or SWMP.
3. Rip to a depth of 300 mm if compacted layers occur.
4. Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

REPLACING TOPSOIL **SD 4-2**

4-6

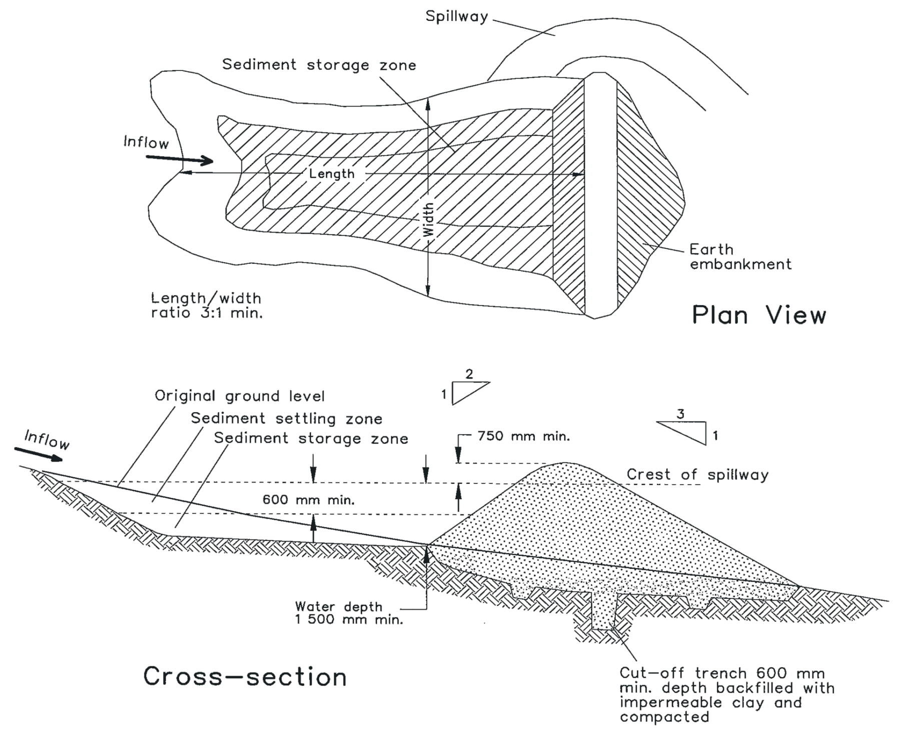


Construction Notes

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

ROCK CHECK DAM **SD 5-4**

5-22

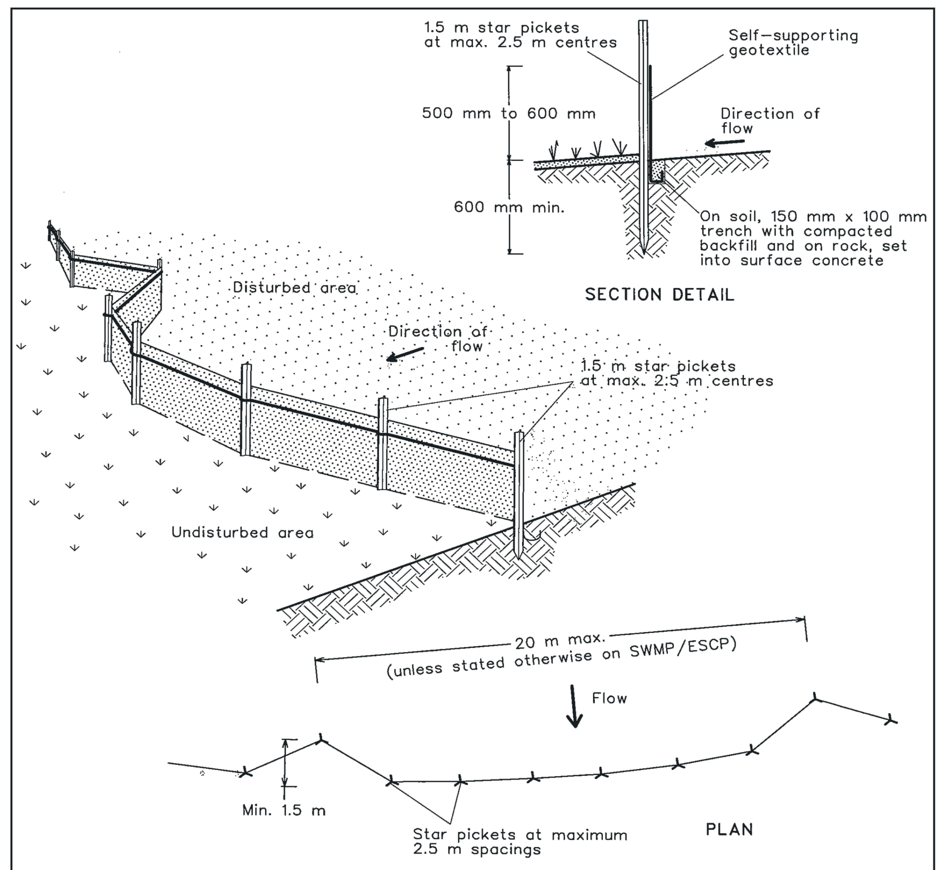


Construction Notes

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

EARTH BASIN - WET **SD 6-4**
(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)

6-19

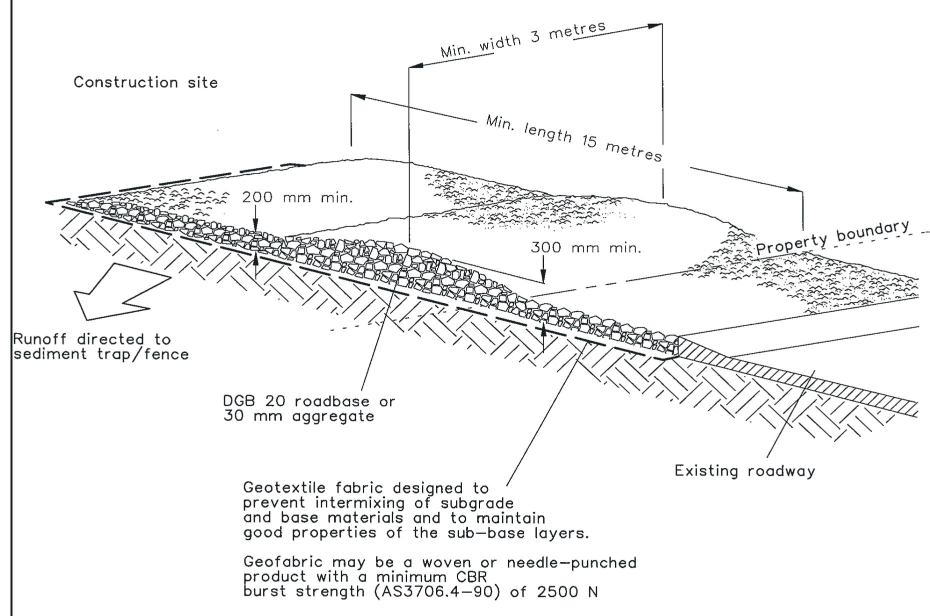


Construction Notes

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

SEDIMENT FENCE **SD 6-8**

6-36

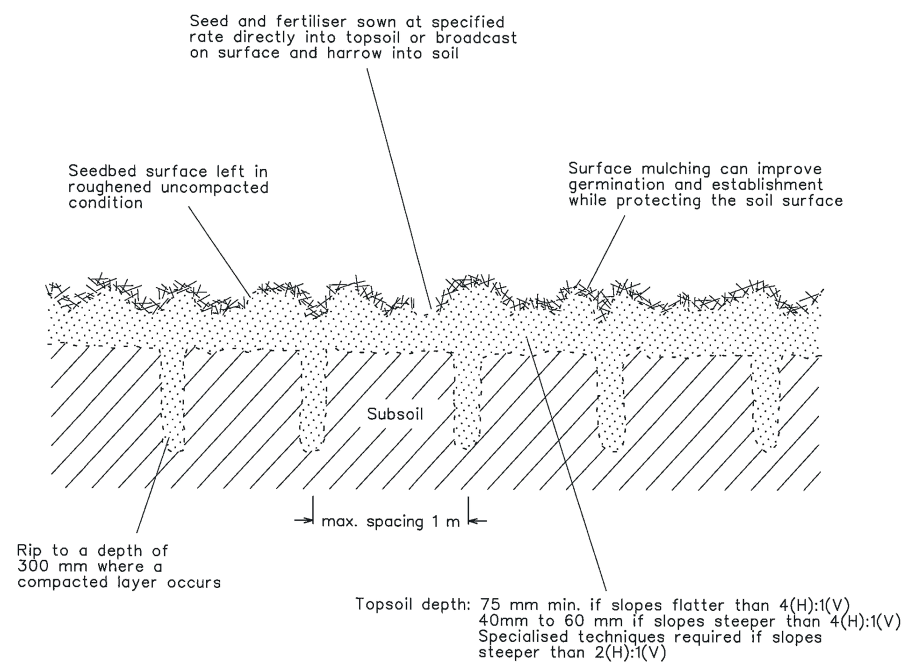


Construction Notes

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

STABILISED SITE ACCESS **SD 6-14**

6-48



Construction Notes

1. Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
2. Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
3. Avoid cultivation in very wet or very dry conditions.
4. Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION **SD 7-1**

7-7

EROSION & SEDIMENT CONTROL NOTES:
REFER TO DRAWING 0201 FOR EROSION & SEDIMENT CONTROL NOTES

FOR POST-APPROVALS

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DEVELOPER: MOOREBANK, QUBE
ARCHITECT: REIDCAMPBELL Architecture, Interiors, Project Management
PROJECT MANAGER: TACTICAL GROUP

PROJECT: PRECINCT INFRASTRUCTURE WORKS WEST
MOOREBANK AVENUE, MOOREBANK

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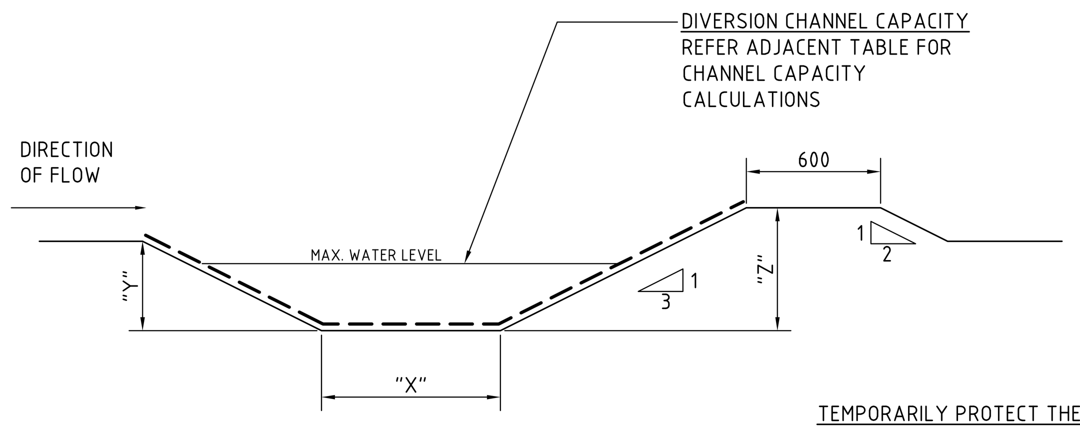
DRAWING TITLE: EROSION & SEDIMENT CONTROL DETAILS - SHEET 1
DRAWING No: PIWW-COS-CV-DWG-0250 ISSUE: B

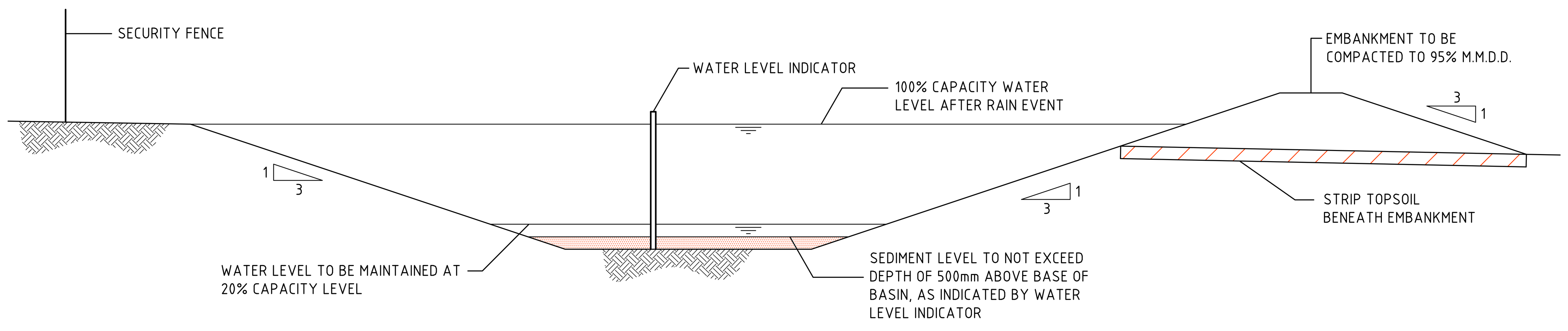
DIVERSION CHANNEL CAPACITY
Q_2 = XXX l/s (A=XX Ha MAX.)
MANNINGS n=XXX, MIN. SLOPE = 0.5%
CHANNEL CAPACITY (d=250mm) = XXX l/s + 20% FREEBOARD
VELOCITY = XXX m/s THEREFORE SCOUR PROTECTION REQ'D.



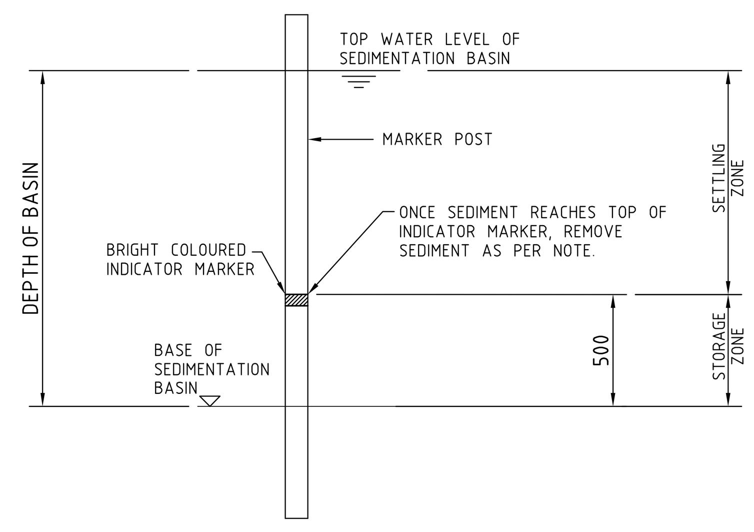
DIVERSION DRAIN SECTION
SCALE 1:20

TEMPORARILY PROTECT THE SWALE FROM EROSION DURING CONSTRUCTION.

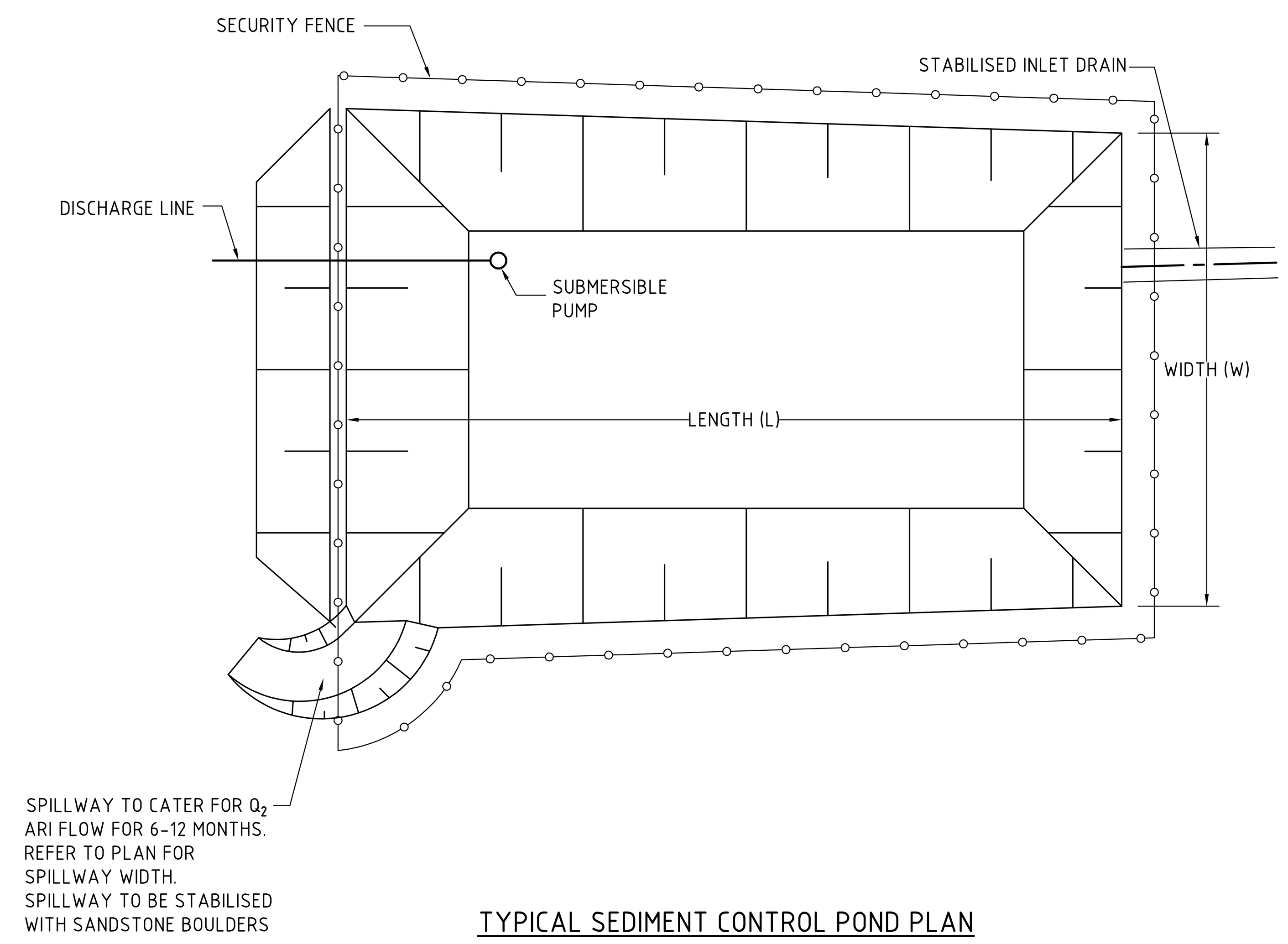
1. TEMPORARY DIVERSION DRAINS SHALL BE STABILISED BY A 3000mm WIDE SECTION OF BIODEGRADABLE JUTE OPEN WEAVE MESH. JUTE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATION
2. EARTHEN CLEAN WATER DIVERSION DRAINS SHALL BE STABILISED BY:
   a. TURF REINFORCEMENT; OR
   b. GEOFABRIC LINER; OR
   c. POLYMER HYDRAULIC SOIL STABILISER. DOSAGE TO BE TO MANUFACTURER'S SPECIFICATION FOR FLOW RATES NOMINATED. DOSAGE SHALL BE SUCH THAT C=0.05.



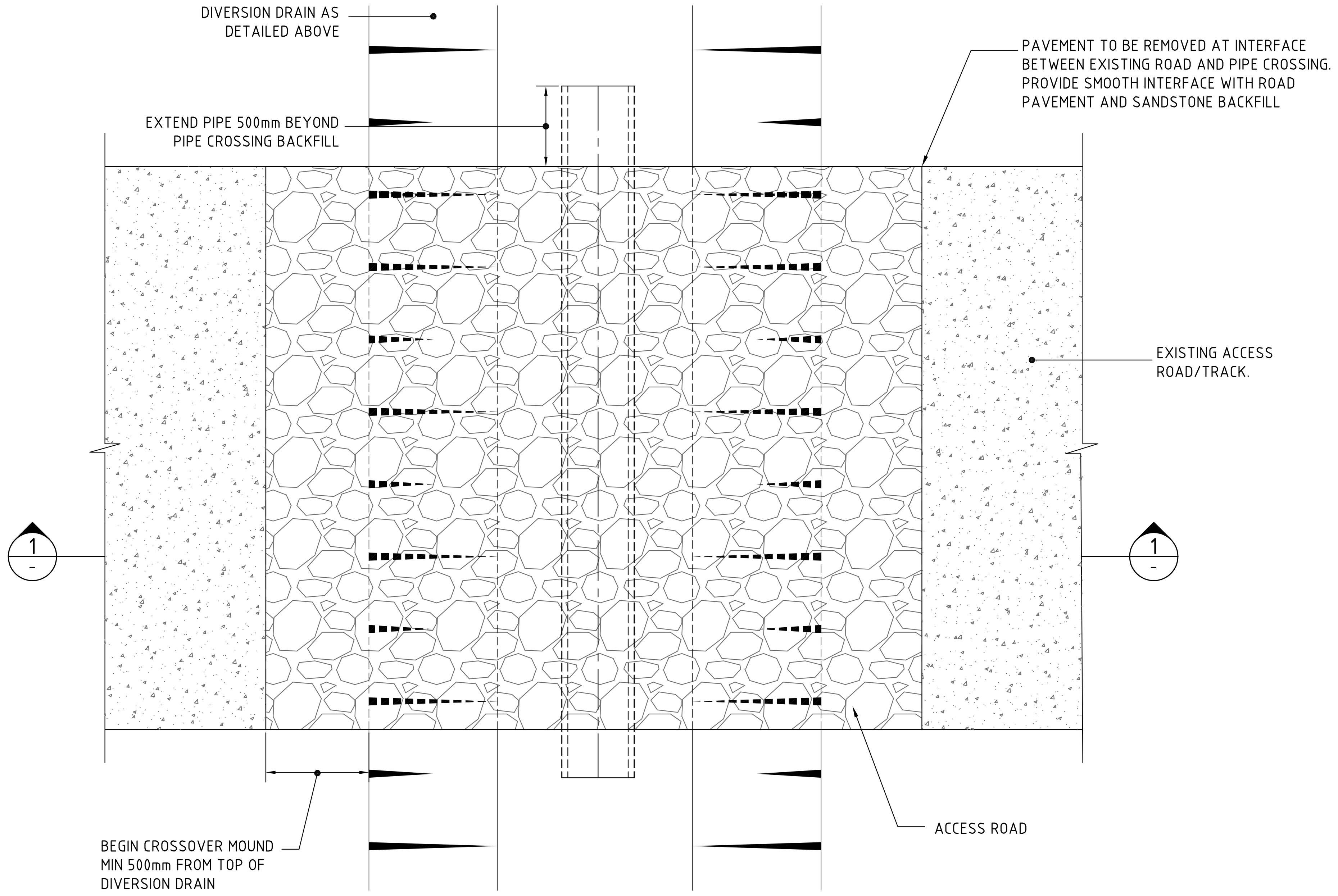
TYPICAL SEDIMENT CONTROL BASIN SECTION
SCALE 1:50



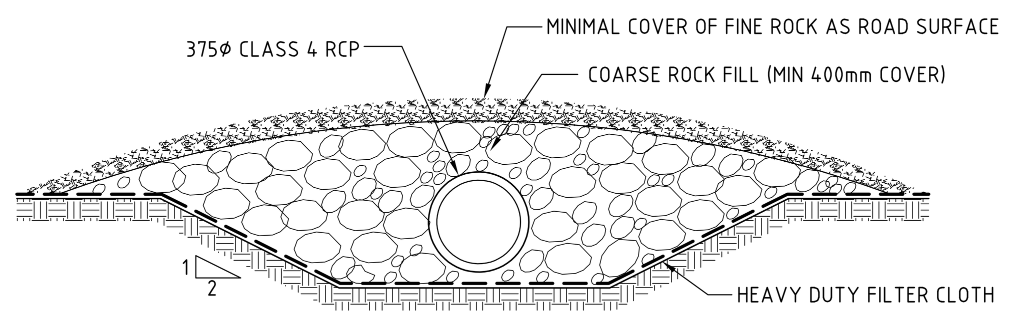
SEDIMENT STORAGE MARKER
SCALE 1:20



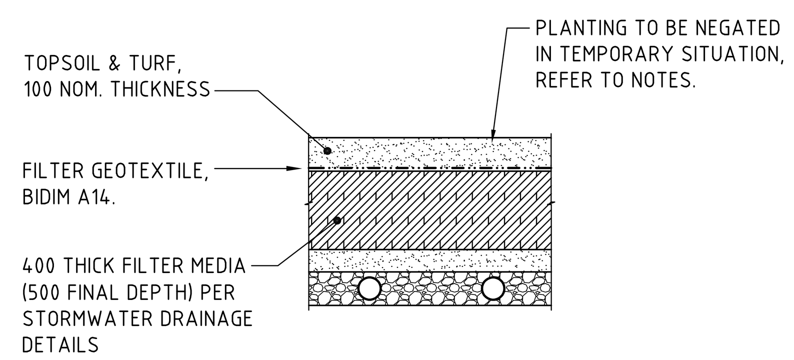
TYPICAL SEDIMENT CONTROL POND PLAN
SCALE 1:250



TYPICAL CROSSING OVER DIVERSION CHANNEL - PLAN
SCALE 1:20



SECTION 1:20 1
TYPICAL CROSSING OVER
DIVERSION CHANNEL



TEMPORARY BIO-RETENTION PROTECTION DETAIL
SCALE 1:20

TEMPORARY CONSTRUCTION REQUIREMENT DETAIL - PROVIDE 100mm TOPSOIL AND TEMPORARY EROSION PROTECTION (JUTEMASTER OR EQUIV) TO SWALE BATTER SLOPES AND ADJACENT LANDSCAPED AREAS. NOTE THAT NO TOPSOIL IS TO BE PLACED OVER FILTRATION MEDIA. PROVIDE SILT FENCE TO TOP OF BANK UNTIL SUCH TIME AS THIS STABILISING AND VEGETATION HAS BEEN COMPLETED.

BIO-RETENTION TO BE PARTIALLY INSTALLED, FOLLOWING COMPLETION OF ROADWORKS, WITH THE TOP 75-100mm OF FILTER MEDIA REPLACED WITH A FINE TO COARSE SAND UNDERLAIN WITH A GEOTEXTILE LAYER (PER ABOVE DETAIL). FOLLOWING COMPLETION OF THE UPSTREAM DEVELOPMENT AND SITE STABILISATION, THE SAND IS TO BE REMOVED, REPLACED WITH FILTER MATERIAL AND PLANTED OUT. REFER TO BIO-RETENTION NOTES ON DRAWING PIWW-COS-CV-DWG-0453

TEMPORARY BIO-RETENTION BASIN PROTECTION DETAILS

NOTES:
ALL EROSION & SEDIMENT CONTROL MEASURES TO BE INSPECTED & MAINTAINED DAILY BY SITE MANAGER.

MINIMISE DISTURBED AREAS.

ROADS & FOOTPATHS TO BE SWEPT DAILY.

1.2m TURF TO BE PLACED BEHIND KERBS.

DUST MINIMISATION CONTROL BY WATERING TO BE IMPLEMENTED BY SITE MANAGER AS REQUIRED OR AS DIRECTED BY THE EPA.

EROSION & SEDIMENT CONTROL NOTES:
REFER TO DRAWING 0200 FOR EROSION & SEDIMENT CONTROL NOTES

2m 0 5 10 15 20 25m
SCALE 1:250 AT A0 SHEET SIZE

500mm 0 1 2 3 4 5m
SCALE 1:50 AT A0 SHEET SIZE

200mm 0 500 1000 1500 2000mm
SCALE 1:20 AT A0 SHEET SIZE

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ARCHITECT: REIDCAMPBELL Architecture, Interiors, Project Management
PROJECT MANAGER: TACTICAL GROUP

PROJECT: PRECINCT INFRASTRUCTURE WORKS WEST
MOOREBANK AVENUE, MOOREBANK

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0251

Costin Roe Consulting Pty Ltd.
Consulting Engineers
Level 1, 8 Windmill Street
Walsh Bay, Sydney NSW 2000
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Costin Roe Consulting
PRECISION | COMMUNICATION | ACCOUNTABILITY

DRAWING TITLE: EROSION & SEDIMENT CONTROL DETAILS - SHEET 2
DRAWING No: PIWW-COS-CV-DWG-0251 ISSUE: C

APPENDIX B

Daily and Weekly Site Inspection Forms

Daily Site Inspection

LOCATION . . . .

SITE SUPERVISOR . . . . **DATE** . . . .

SIGNATURE . . . .

Legend: OK Not OK N/A Not applicable

Item	Consideration	Assessment
1	All tradespeople working on the site have been informed of the erosion and sediment control requirements of the site.	. . . .
2	All required builder identification, safety notices, and pollution (e.g. litter and sediment control) management signs are visible.	. . . .
3	The work site and all erosion and sediment control measures do not represent a safety risk to tradespeople or the public.	. . . .
4	Public roadways are clear of sediment.	. . . .
5	Turfing on the footpath area is clear of sediment, sand and mud.	. . . .
6	Entry/exit pads are clear of excessive sediment deposition.	. . . .
7	Entry/exit pads have adequate available void spacing to trap sediment.	. . . .
8	The construction site is clear of litter and unconfined rubbish.	. . . .
9	Long-term (> 24 hours) soil/sand stockpiles are protected from wind, rain, and stormwater flow.	. . . .
10	At end of day, all short-term soil/sand stockpiles located outside the sediment control zone have been removed and cleaned.	. . . .
11	No dust problems exist on the site.	. . . .
12	Up-slope "clean" water is being appropriately diverted through the site in a non-erosive manner.	. . . .
13	Drainage lines are free of soil scour and sediment deposition.	. . . .
14	Stormwater flow down exposed earth batters does not cause erosion.	. . . .
15	Appropriate erosion controls of all finished soil disturbances have been discussed with the client.	. . . .
16	Sediment fences have been correctly installed (e.g. fabric buried and standing up-slope of stakes) and are free of damage.	. . . .
17	Sediment fences have been installed in a manner that will allow sediment-laden stormwater to temporarily pond and settle behind the fence rather than flow around the fence.	. . . .
18	Appropriate sediment controls have been placed adjacent to, or around, stormwater inlets—as appropriate for the type of inlet.	. . . .
19	All sediment traps are free of excessive sediment deposition.	. . . .

20	Finished service trenches have been appropriately backfilled, compacted and stabilised.	. . . .
21	All reasonable and practicable measures are being taken to control sediment runoff from the site.	. . . .
22	The site is adequately prepared for potential storms.	. . . .
23	Adequate stockpiles exist of ESC materials, such as extra sediment fence fabric.	. . . .
24	Temporary downpipes have been correctly connected to any installed roof gutters.	. . . .

Weekly Site Inspection

LOCATION . . . .

INSPECTION OFFICER . . . . **DATE** . . . .

SIGNATURE . . . .

Legend: ☐ OK ☐ Not OK N/A Not applicable

Item	**Consideration**	**Assessment**
1	Public roadways clear of sediment.	. . . .
2	Entry/exit pads clear of excessive sediment deposition.	. . . .
3	Entry/exit pads have adequate void spacing to trap sediment.	. . . .
4	The construction site is clear of litter and unconfined rubbish.	. . . .
5	Adequate stockpiles of emergency ESC materials exist on site.	. . . .
6	Site dust is being adequately controlled.	. . . .
7	Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.	. . . .
8	Up-slope "clean" water is being appropriately diverted around/through the site.	. . . .
9	Drainage lines are free of soil scour and sediment deposition.	. . . .
10	No areas of exposed soil are in need of erosion control.	. . . .
11	Earth batters are free of "rill" erosion.	. . . .
12	Erosion control mulch is not being displaced by wind or water.	. . . .
13	Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.	. . . .
14	Sediment fences are free from damage.	. . . .
15	Sediment-laden stormwater is not simply flowing "around" the sediment fences or other sediment traps.	. . . .
16	Sediment controls placed up-slope/around stormwater inlets are appropriate for the type of inlet structure.	. . . .
17	All sediment traps are free of excessive sediment deposition.	. . . .
18	The settled sediment layer within a sediment basin is clearly visible through the supernatant prior to discharge such water.	. . . .
19	All reasonable and practicable measures are being taken to control sediment runoff from the site.	. . . .
20	All soil surfaces are being appropriately prepared (i.e. pH, nutrients, roughness and density) prior to revegetation.	. . . .
21	Stabilised surfaces have a minimum 70% soil coverage.	. . . .
22	The site is adequately prepared for imminent storms.	. . . .
23	All ESC measures are in proper working order.	. . . .

APPENDIX C

Monthly Rainfall Data & Climate Statisitics

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years		Plot	Map
Temperature																	
Mean maximum temperature (°C)	28.5	27.9	26.4	23.8	20.6	17.8	17.4	19.0	21.7	24.0	25.5	27.6	23.3	51	1968 2019		
Mean minimum temperature (°C)	18.3	18.2	16.3	12.8	9.4	6.8	5.1	6.0	8.7	11.9	14.4	16.7	12.0	51	1968 2019		
Rainfall																	
Mean rainfall (mm)	91.9	101.0	100.5	83.0	63.5	80.3	42.7	49.2	44.6	60.1	75.4	67.2	862.8	51	1968 2019		
Decile 5 (median) rainfall (mm)	74.6	75.0	78.6	57.5	51.4	57.2	29.6	24.6	37.0	39.2	67.8	55.4	884.6	52	1968 2019		
Mean number of days of rain ≥ 1 mm	8.1	7.9	8.5	6.6	6.5	6.8	5.2	4.5	5.3	6.7	7.9	7.0	81.0	51	1968 2020		
Other daily elements																	
Mean daily sunshine (hours)																	
Mean number of clear days	5.0	4.2	5.0	6.9	5.4	6.5	9.3	10.0	6.7	5.6	4.4	5.0	74.0	25	1968 2010		
Mean number of cloudy days	12.1	10.7	10.1	7.8	8.4	8.4	6.1	5.2	6.3	9.4	9.5	9.7	103.7	25	1968 2010		
9 am conditions																	
Mean 9am temperature (°C)	22.2	21.6	20.2	17.4	13.8	10.7	9.6	11.6	15.1	18.2	19.3	21.4	16.8	42	1968 2010		
Mean 9am relative humidity (%)	72	77	77	75	79	80	78	70	64	62	67	67	72	42	1968 2010		
Mean 9am wind speed (km/h)	8.2	7.4	6.6	6.7	6.7	6.6	6.6	9.0	10.3	10.6	9.7	9.1	8.1	42	1968 2010		
9am wind speed vs direction plot																	
3 pm conditions																	
Mean 3pm temperature (°C)	26.8	26.4	25.0	22.6	19.5	17.0	16.4	18.0	20.2	22.1	23.5	25.9	22.0	42	1968 2010		
Mean 3pm relative humidity (%)	54	57	55	54	55	55	50	44	45	48	52	51	52	42	1968 2010		
Mean 3pm wind speed (km/h)	20.9	19.0	17.6	15.3	12.9	13.6	14.1	17.6	19.9	20.9	21.6	22.6	18.0	37	1968 2010		
3pm wind speed vs direction plot																	

red = highest value blue = lowest value

Product IDCJCM0028 Prepared at Thu 23 Jan 2020 03:16:07 AM EST

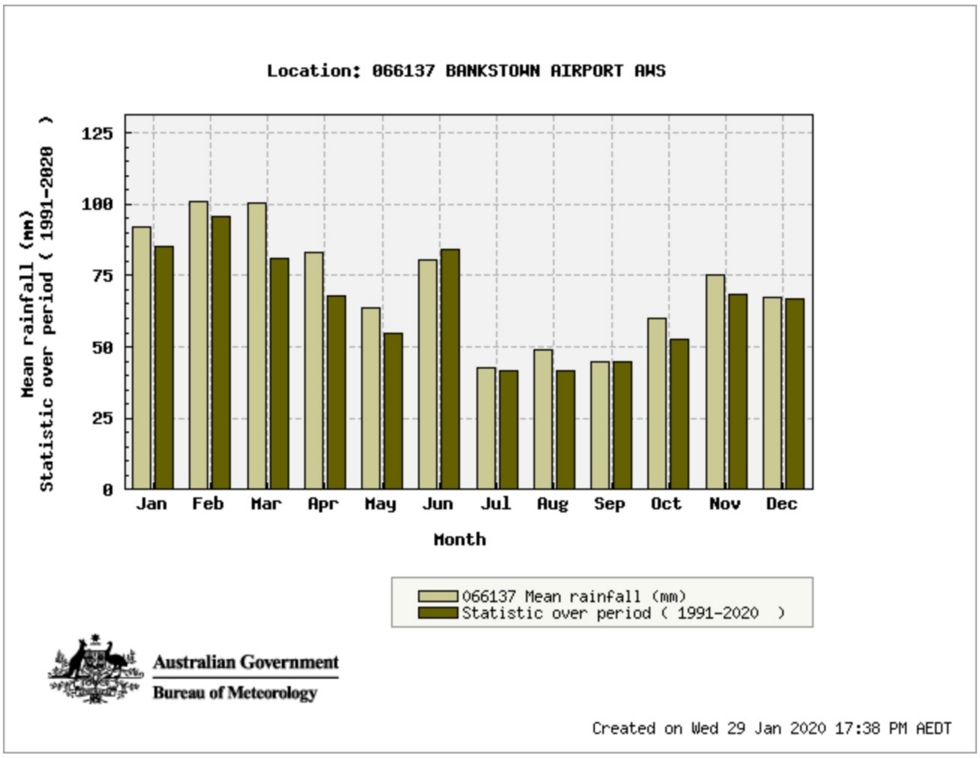
Site details

Site name: BANKSTOWN AIRPORT AWS | **Site number:** 066137 | **Commenced:** 1968
Latitude: 33.92 °S | **Longitude:** 150.99 °E | **Elevation:** 6 m | **Operational status:** Still Open

Yearly data | 30 year statistics | Comparison site | First statistic | Second statistic

Note: Only one option can be redrawn at a time

Compare with statistics for the 30 year period: 1991-2020 ▼ Redraw



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 1968 to 2019	91.9	101.0	100.5	83.0	63.5	80.3	42.7	49.2	44.6	60.1	75.4	67.2	857.9	52
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean rainfall (mm) for years 1991 to 2019	85.4	95.9	80.9	67.7	54.7	84.4	41.8	41.8	44.6	52.7	68.5	66.6	785.1	29

APPENDIX D

Geotechnical Information

ARCADIS Design & Consultancy for natural and built assets

Moorebank Precinct West (MPW) – Stage 2 Proposal

Geotechnical Interpretive Report

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

October 2016

07 September 2016

MOOREBANK PRECINCT WEST (MPW) - STAGE 2

Geotechnical Interpretive Report

Submitted to:
Sydney Intermodal Terminal Alliance c/o Tactical Group
Level 15, 124 Walker Street
North Sydney
NSW 2060

REPORT

Report Number. 1416224-016-R-Rev 3

Distribution:

Tactical Group - 1 electronic

Record of Issue

Company	Client Contact	Version	Date Issued	Method of Delivery	Golder Report Reference
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Tactical Group	Nathan Cairney	Rev 1	01st August 2016	Electronic	1416224-016-R-Rev 1
Tactical Group	Nathan Cairney	Rev 2	2nd September 2016	Electronic	1416224-016-R-Rev 2
Tactical Group	Nathan Cairney	Rev 3	7th September 2016	Electronic	1416224-016-R-Rev 3

Executive Summary

This report provides geotechnical advice for the Moorebank Precinct West (MPW) Stage 2 Proposal of the Moorebank Precinct (MP), which involves redevelopment of approximately 220 hectares of land for an intermodal terminal, associated infrastructure facilities, and warehousing. The results of a geotechnical investigation, completed by Golder in 2014 and 2016, have been used to develop a geotechnical model for the site. Analysis of the geotechnical model has been used to provide recommendations for the redevelopment of the site and forms the basis of this Geotechnical Interpretive Report. This report will provide the basis of the submission for the MPW Stage 2 State Significant Development (SSD) application.

The geology of the site generally comprises a thin layer of fill material at the existing ground surface, generally 0.5 m thick (but up to 2 m or more locally) over alluvium comprising stiff to very stiff clays or dense to very dense sands. The site is generally underlain by shale bedrock at depths between 5 m to 24 m below existing ground level. Sandstone rock was located in some boreholes at the southern end of the site. Groundwater is expected between about 9 m to 12 m depth below the existing ground surface, however perched water is likely to be encountered at higher levels in the vicinity of established ponds and Anzac Creek.

Most aspects of the development will involve relatively routine geotechnical design and construction procedures. An aspect that will require particular attention is the treatment of the existing fill (including the topsoil layer, where present), which is of variable compaction and composition. In the report we present alternative techniques for managing the risks associated with the potential for adverse settlement of the fill under the weight of new fill, pavements, floor slabs and structural footings.

Excavations are expected to be relatively shallow and typically above the water table. Where space permits, the sides of excavations can be battered and recommended batter slopes are provided in the report. If space is limited, excavations may need to be laterally supported and recommendations are provided for the design of retaining systems. We would expect that conventional earthworks equipment could be used for excavations, with a provision for breaking-out occasional ironstone layers.

Fill materials will need to be imported onto the site to raise site levels, particularly over the lower lying western portion of the site, in close proximity to Georges River. Importation of good quality fill (e.g. VENM ripped rock, such as sandstone tunnel excavation spoil) will present less risk than the reuse of existing site fill. This is due to portions of the existing fill being contaminated and/or having been placed as uncontrolled fill of potentially variable and deleterious composition. Notwithstanding this, existing fill on site may be suitable for reuse as general fill provided it is treated to remove unsuitable materials and re-compacted to meet the requirements of AS3798. There are areas of existing fill within the site that will need contamination remediation in accordance with the Remediation Action Plan (RAP).

In the report we have provided indicative pavement designs based on different assumed subgrade conditions. A fully flexible pavement with thin asphalt surfacing (non-structural wearing course) and granular base and sub-base is expected to have lower capital cost but higher maintenance costs for the wearing surface. A thick asphaltic concrete pavement with cement stabilised base and granular sub-base typically has higher capital cost but lower maintenance costs. Indicative pavement thicknesses based on a 20 years design life are 450 millimetres (mm) (flexible) and 590 mm (rigid) with an assumed subgrade CBR of 10% and 750 mm (flexible) to 1,050 mm (rigid) for a subgrade CBR of 3%.

We expect that conventional shallow level foundations would be suitable to support lightly loaded structures on the site, such as single-storey buildings and possibly some warehouse columns. Deep foundation options will likely be required for heavily loaded structures or structures sensitive to differential settlement.

Settlements under warehouse floor slab loads, for the current cut/fill strategy (Arcadis, 2016a), are about 5 mm to 35 mm, which is within the typical tolerance limits for industrial structures.

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FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 The Project

On the 3 June 2016 Concept Plan Approval (SSD 5066) was granted, under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to develop the Moorebank Precinct West Project (MPW Project) on the western side of Moorebank Avenue, Moorebank, in south-western Sydney (the MPW site).

The MPW Project involves the development of intermodal freight terminal facilities (IMT), linked to Port Botany, the interstate and intrastate freight rail network. The MPW Project includes associated commercial infrastructure (i.e. warehousing), a rail link connecting the MPW site to the Southern Sydney Freight Line (SSFL), and a road entry and exit point from Moorebank Avenue.

Under the Concept Plan Approval, the MPW Project is to be developed in four phases, being:

1) Early Works development phase, comprising:

   - The demolition of existing buildings and structures
   - Service utility terminations and diversion/relocation
   - Removal of existing hardstand/roads/pavements and infrastructure associated with existing buildings
   - Rehabilitation of the excavation/earthmoving training area (i.e. 'dust bowl')
   - Remediation of contaminated land and hotspots, including areas known to contain asbestos, and the removal of:
     - Underground storage tanks (USTs)
     - Unexploded ordnance (UXO) and explosive ordnance waste (EOW) if found
     - Asbestos contaminated buildings
   - Archaeological salvage of Aboriginal and European sites
   - Establishment of a conservation area along the Georges River
   - Establishment of construction facilities (which may include a construction laydown area, site offices, hygiene units, kitchen facilities, wheel wash and staff parking) and access, including site security
   - Vegetation removal, including the relocation of hollow-bearing trees, as required for remediation and demolition purposes

2) Development of the intermodal terminal (IMT) facility and initial warehousing facilities

3) 'Ramp up' of the IMT capacity and warehousing

4) Development of further warehousing.

Approval for the Early Works phase (MPW Concept Plan Approval) was granted as the first stage of the MPW Project within the Concept Plan Approval. Works, approved as part of this stage are anticipated to commence in the third quarter of 2016.

Commonwealth Approval (No. 2011/6086), under the *Environmental Protection Biodiversity Conservation Act 1999* (EPBC Act), was also granted in mid-2016 (soon after the Concept Plan Approval) for the MPW Project. In addition to this, the Planning Proposal (PP_2012_LPOOL_004_00) which provided a rezoning of part of the MPW site, and surrounds, was gazetted on 24 June 2016 into the *Liverpool Local Environmental Plan 2008* (Amendment No. 62).

On 5 December 2014, Moorebank Intermodal Terminal Company (MIC) and SIMTA announced their in-principle agreement to develop the Moorebank IMT Precinct on a whole of precinct basis. This agreement is subject to satisfying several conditions which both parties are currently working towards. SIMTA is therefore seeking approval to build and operate the IMT facility and warehousing under the MPW Project Concept Approval, known as the MPW Stage 2 Proposal (the Proposal).

Key terms used within this report are defined in Table 1 below. Table 1 includes Key Terms as applied in the Environmental Impact Statement (EIS) for the MPW Stage 2 Proposal.

Table 1: Key Terms Table

Moorebank Precinct West (MPW) Concept Plan Approval (Concept approval and Early Works)	MPW Concept Plan and Stage 1 Approval (SSD 5066) granted on 3 June 2016 for the development of the MPW Intermodal terminal facility at Moorebank and the undertaking of the Early Works. Granted under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979*. This reference also includes associated Conditions of Approval and Revised Environmental Management Measures, which form part of the documentation for the approval. N.B. Previously the MIC Concept Plan Approval
Moorebank Precinct West (MPW) Planning Proposal	Planning Proposal (PP_2012_LPOOL_004_00) to rezone the MPW site from 'SP2- Defence to 'IN1- Light Industrial' and 'E3- Management', as part of an amendment to the *Liverpool Local Environmental Plan 2008* (as amended) gazetted on 24 June 2016.
Moorebank Precinct West (MPW) Project	The MPW Intermodal Terminal Facility as approved under the MPW Concept Plan Approval (5066) and the MPW EPBC Approval (2011/6086). N.B. Previously the MIC Project
Moorebank Precinct West (MPW) site	The site which is the subject of the MPW Concept Plan Approval, MPW EPBC Proposal and MPW Planning Proposal (comprising Lot 1 DP1197707 and Lots 100, 101 DP1049508 and Lot 2 DP 1197707). The MPW site does not include the rail link as referenced in the MPW Concept Plan Approval or MPE Concept Plan Approval. N.B. Previously the MIC site.
Early Works	Works approved under Stage 1 of the MPW Concept Plan Approval (SSD 5066), within the MPW site, including: establishment of construction compounds, building demolition, remediation, heritage impact mitigation works and establishment of the conservation area.
Early Works Approval	Approval for the Early Works (Stage 1) component of the MPW Project under the MPW Concept Plan Approval (SSD 5066) and the MPW EPBC Approval. Largely contained in Schedule 3 of the MPW Concept Plan Approval.
Early Works area	Includes the area of the MPW site subject to the Early works approved under the MPW Concept Plan Approval (SSD 5066).
Proposal	MPW Stage 2 Proposal (the subject of the EIS), namely Stage 2 of the MPW Concept Plan Approval (SSD 5066) including construction and operation of an IMT facility, warehouses, a Rail link connection and Moorebank Avenue/Anzac Road intersection works.
Proposal site	The subject of the EIS, the part of the MPW site which includes all areas to be disturbed by the MPW Stage 2 Proposal (including the operational area and construction area).
IMT facility	The Intermodal terminal facility on the Proposal site, including truck processing, holding and loading areas, rail loading and container storage areas, nine rail sidings, loco shifter and an administration facility and workshop.
internal road	Main internal road through the Proposal site which generally travels along the western perimeter of the site. Provides access between Moorebank Avenue and the IMT and warehouses.
Rail link connection	Rail connection located within the Proposal site which connects to the Rail link included in the MPE Stage 1 Proposal (SSD 14-6766).
Proposal operational rail line	The section of the Rail link connection and Rail link between the SSFL and the Rail link connection (included in the MPE Stage 1 Proposal) to be utilised for the operation of the Proposal.

construction area	Extent of construction works, namely areas to be disturbed during the construction of the Proposal.
operational area	Extent of operational activities for the operation of the Proposal.
Moorebank conservation area/conservation area	Vegetated area to remain to the west of the Georges River, to be subject to biodiversity offset, as part of the MPW Project.
Moorebank Precinct (MP)	Refers to the whole Moorebank intermodal precinct, i.e. the MPE site and the MPW site.
Moorebank Precinct East (MPE) Project	The Intermodal terminal facility on the MPE site as approved by the MPE Concept Plan Approval (MP 10_0913) and including the MPE Stage 1 Proposal (14-6766). N.B. Previously the SIMTA Concept Plan Approval
Moorebank Precinct East (MPE) site	The site which is the subject of the MPE Concept Plan Approval, and includes the site which is the subject of the MPE Stage 1 Approval. N.B. Previously the SIMTA site
Moorebank Precinct East (MPE) Stage 1 Proposal	MPE Stage 1 Proposal (14-6766) for the development of the Intermodal terminal facility at Moorebank. This reference also includes associated conditions of approval and environmental management measures which form part of the documentation for the approval. N.B. Previously the SIMTA Stage 1 Proposal
Rail link	Part of the MPE Stage 1 Proposal (14-6766), connecting the MPE site to the SSFL. The Rail link (as discussed above) is to be utilised for the operation of the Proposal.

1.2 Objective of Geotechnical Investigations

Golder has undertaken geotechnical investigation across the Moorebank Precinct (MP) under a number of campaigns, at various stages during the planning and concept design development.

Two campaigns of geotechnical investigation have been undertaken within the MPW site, as follows:

- Stage 1 – 2014/2015 Campaign (factual results contained within Golder 2015a)
- Stage 2 – 2016 Campaign (factual results contained within Golder 2016a)

The overall objective of the geotechnical investigations was to collect subsurface information to inform detailed design of key features of the project, including earthworks, structural foundations, major drainage structures, internal road pavements and rail subgrade preparation and container handling and storage areas.

Due to the current conceptual nature of design layout and design features, additional geotechnical investigation and geotechnical advice is likely to be required to finalise detail design of specific individual design elements.

1.3 This Report

The report has been prepared to support the Environmental Impact Statement (EIS) for approval of the Proposal and provide geotechnical advice to inform:

- The Proposal;
- Planning and design, so that the requirements for engineering, management and geotechnical requirements can be better defined during further stages of the development;
- Concept and detail designs for earthworks, foundations, engineered fill, pavement and rail subgrade, and other structures;
- Development of an Earthworks Specification for the Proposal Site;

- Geotechnical solutions that will allow approval of the site to be used for commercial and industrial uses; and
- Contractors and developers during a tendering and construction process.

This report has been updated to its current (Rev 1) form in consideration of the results of the Stage 2 – 2016 geotechnical investigation campaign referred to in Chapter 1.2 above.

1.4 Scope of Work

The scopes of work for the two stages of geotechnical investigation are discussed in Golder Associates' Geotechnical Data Reports (GDR, Golder, 2015a and 2016a) and summarised below. The locations of geotechnical site investigations completed are shown in Figure A003.

- Hand-auger boreholes to 1.2 m depth at proposed exploratory locations;
- Hand dug test pits to 0.5 m target depth;
- Borehole drilling and sampling including recovery of rock core;
- Machine excavated test pits;
- Cone penetration tests (CPT) and dilatometer tests (DMT);
- Seismic refraction profiling;
- Survey of all borehole locations using GPS equipment;
- Laboratory testing of soil and rock samples for geotechnical, contamination and acid sulphate soil purposes.

This geotechnical interpretive report includes:

- Geological and geotechnical interpretation and assessment of site investigation results;
- A geological site model, including a description of the ground conditions and cross-sections illustrating the ground conditions beneath the site;
- Recommended geotechnical engineering design parameters;
- Recommendations for earthworks, foundations, engineered fill, pavement and rail subgrade, other structures; and
- Assessment of geotechnical conditions that will be encountered that affect the design, construction and ongoing performance of the MPW Project.

2.0 REVIEW OF EXISTING INFORMATION

2.1 Topography and Terrain

The Proposal site is generally bounded by the Georges River to the west, Moorebank Avenue to the east, the East Hills Railway Line to the south and the M5 Motorway to the north. It is located on Moorebank Avenue, Moorebank (which runs approximately north-south along the Proposal site's eastern boundary) and forms Lot 1 in Deposited Plan (DP) 1197707[1]. The Proposal site also contains Lots 100 and 101 DP1049508, which are located north of Bapaume Road and west of Moorebank Avenue.

The Proposal site is located wholly within Commonwealth Land. The site is approximately rectangular in plan, occupying an area of about 220 hectares, and about 2,950 m from north to south and 960 m from east to west at its widest point.

Key existing features of the site include:

- Relatively flat topography, with a slight decline towards the Georges River along the western boundary to the MPW site. The majority of the site is situated on a terrace above the Georges River at an elevation of approximately RL+15m AHD;
- A number of linked ponds in the south-west corner of the Proposal site, within the existing golf course, that link to Anzac Creek, which is an ephemeral tributary of the Georges River;
- An existing stormwater system comprising pits, pipes and open channels ;
- Direct frontage to Moorebank Avenue, which is a publicly used private road, south of Anzac Road and a publicly owned and used road north of Anzac Road;
- The majority of the site has been developed and comprises low-rise buildings (including warehouses, administrative offices, operative buildings and residential buildings), access roads, open areas and landscaped fields for the former School of Military Engineering (SME) and the Royal Australian Engineers (RAE) Golf Course and Club. Defence has since vacated and all buildings on the site are currently unoccupied and will be removed during the Early Works;
- Native and exotic vegetation is scattered across the Proposal site;
- The riparian area of the Georges River lies to the west of the Proposal site and contains a substantial corridor of native and introduced vegetation. The riparian vegetation corridor provides a wildlife corridor and a buffer for the protection of soil stability, water quality and aquatic habitats. This area has been defined as a conservation area as part of the MPW Concept Plan Approval;
- As stated above, the majority of the Proposal site has been developed, however heritage and biodiversity values still remain on the site; and
- A strip of land (up to approximately 250 metres wide) along the western edge of the MPW site lies below the 1% annual exceedance probability (AEP) flood level.

The ground surface levels of the Proposal site are shown on Figure A004. The area adjacent to the Georges River is terraced. Some modification of the natural ground surface may have occurred in this area as part of the development of training facilities. These training facilities included an area where earthmoving plant driver training was completed, known as "The Dust Bowl", where soils were reworked and fill may have been imported.

Asbestos was found within localised contamination 'hot spots' and areas of anthropogenic fill, for further discussion of this refer to the ESAR (Golder, 2015b) and the AMP (Golder 2016b).

[1] Previously legally described as "Lot 3001, DP 1125930" in the MPW Concept Plan Approval (SSD 5066), however has since been subdivided.

The sides of the Georges River valley are relatively steep and heavily vegetated. Rock outcrops were locally observed on the western bank of the river, which generally lies at higher elevations than the eastern bank.

Within the site there is a small creek (Anzac Creek) which runs through the golf course to the northeast. There are also some small dams in the northern part of the site, some of which have had their sides steepened and retained with sheet piles. With the exception of Anzac Creek, the drainage systems drain west towards Georges River.

2.2 Land Use

This section of the report presents a general overview of the historic development of the site and changes in land use. For more detailed discussion refer to the ESAR (Golder, 2015b), the UXO Risk and Management Plan (G-Tek, 2016a) and the AMP (Golder 2016b). Changes in land use of the site can be assessed using historical aerial photographs (Refer to Figures A005 to A015).

The earliest available aerial photographs are from 1930 and these show the land to be cleared bushland and fields. There are small tracks and paths across the site area and meandering streams cross the site. The area appears to have been cleared of trees and bush up to the edge of the Georges River. Sand banks and bars are visible within the Georges River. Moorebank Avenue is present on this photograph.

By 1956, the military facility had been developed on the site, comprising Steele Barracks. The Defence National Storage Distribution Centre (DNSDC) is present on the eastern side of Moorebank Avenue. A road bridge is present, which crosses the Georges River immediately to the south of the Casula Power Station.

The 1965 aerial photograph shows additional development of the site area, the bridge adjacent to the power station is not present and there is a sand quarry on the site of the current day Glenfield Waste Facility. From the aerial photographs it is apparent that from the 1970's dredging methods were in use on the Glenfield site, as it is flooded. The golf course is present on the MPW site in the 1978 aerial photograph.

By 1986 the road bridge on the current M5 alignment had been constructed to the north of the site. The overall site arrangement appears to be similar to that of the present day. The Glenfield Waste site does not have flooded areas on it, and possible shale and sandstone outcrops are visible in the base of some excavations.

Current aerial photographs show the site in its present arrangement. As of December 2014, military units on the MPW site were relocating to new facilities at Holsworthy and the DNSDC was being gradually relocated in preparation for the proposed change in land use from a military facility to an intermodal terminal.

However, due to training activities involving blank small arms ammunition (SAA) and bomb disposal training activities, Inert Ammunition (IA), Unexploded Ordnance (UXO) and Exploded Ordnance Waste (EOW) risks require management on the Proposal Site (G-Tek 2016a).

2.3 Drainage and Ponds

The dominant water feature of the area is the Georges River which is not locally tidal. Other water systems in the area include ponds and creeks, some of which run towards the Georges River. Anzac Creek is notable in that it runs away from the Georges River in a north easterly direction, re-joining the river at Lake Moore. Drainage systems are shown on Figure A016, attached.

The natural state of the Georges River has been modified since the early 1800s, and the weir constructed at Liverpool marks the present upstream tidal limit (Navin, 2014).

2.4 Climate and Meteorology

2.4.1 Overview

The Holsworthy area experiences relatively mild temperatures and moderate rainfall, with a yearly average rainfall of about 880 mm, based on records from the nearest observation site at Bankstown Airport since 1968 (Refer to Figure 1). Typically, the wettest month (mean rainfall) is February, and driest usually August. The annual mean minimum temperature is 12.0°C and the mean maximum temperature is 23.2°C. The hottest month is usually January (mean maximum of 28.2°C) and the coldest month is usually July (mean minimum of 5.1°C).

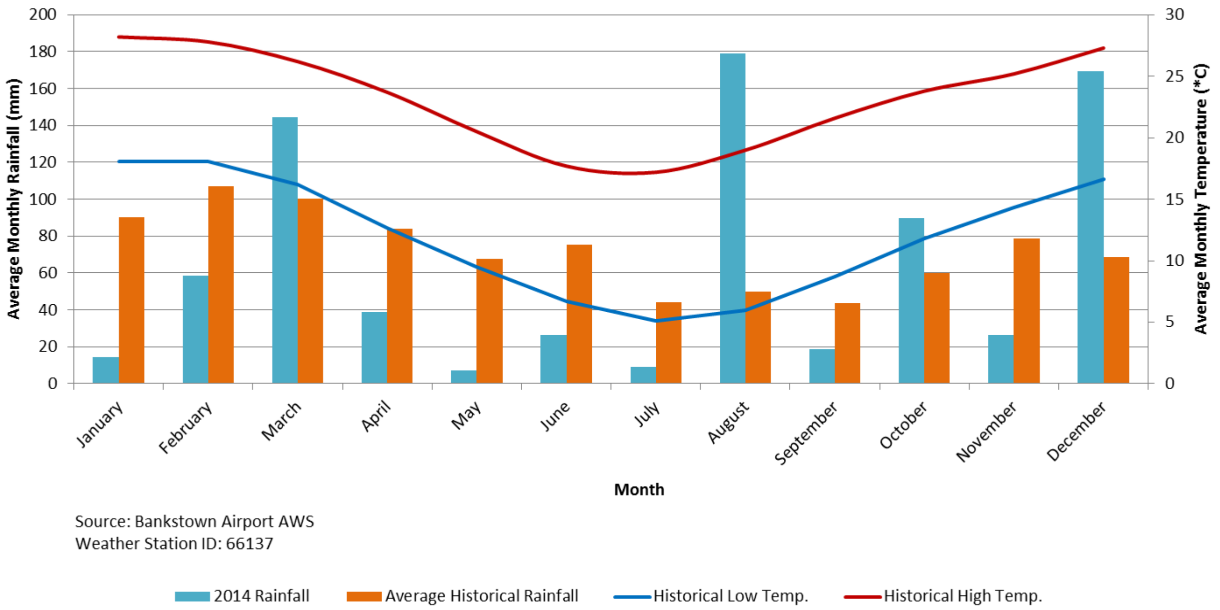


Figure 1: Monthly Rainfall and Temperature Records from Bankstown Airport (7.1 km from MPW Site)

2.4.2 Rainfall Records

Plots showing daily rainfall data over the duration of the Stage 1 and Stage 2 geotechnical fieldwork campaigns are presented as Figure 2 and Figure 3, below. The rainfall conditions around the time of the site investigation may impact groundwater levels measured during that time. Based on the rainfall records, the rainfall during the MPW Stage 1 investigation was less than average during November but more than average during December. For the MPW Stage 2 investigation, the combined rainfall over the preceding 3 months was approximately equal to historical averages for that period. Over the period of the MPW Stage investigation rainfall experienced was slightly lower than historical averages for that period.

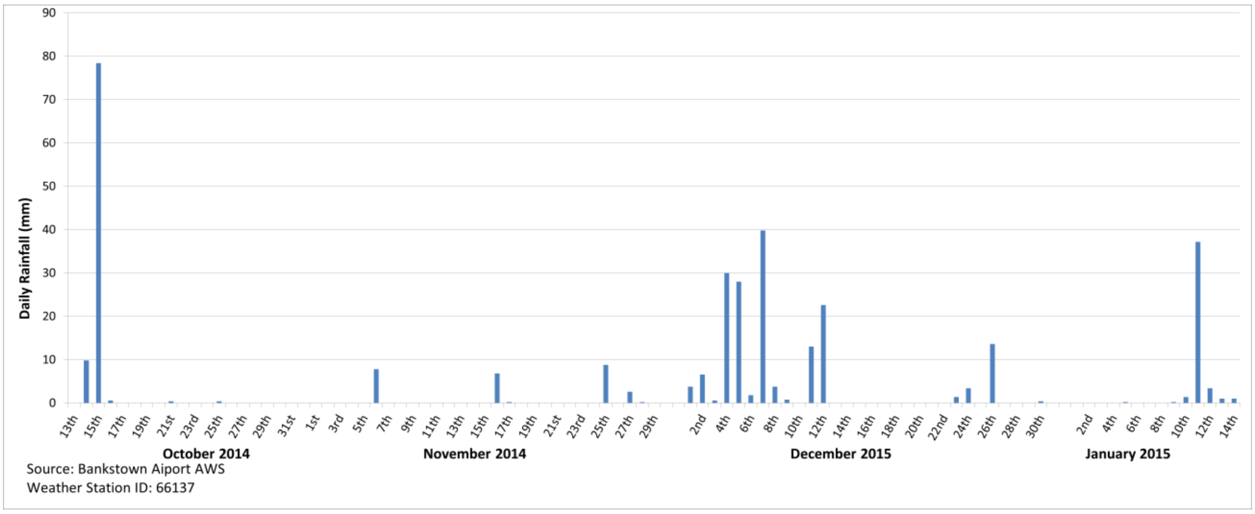


Figure 2: 2014/2015 (Stage 1 Geotechnical Investigation Campaign) Daily Rainfall Records from Bankstown Airport (7.1 km from MPW Site)

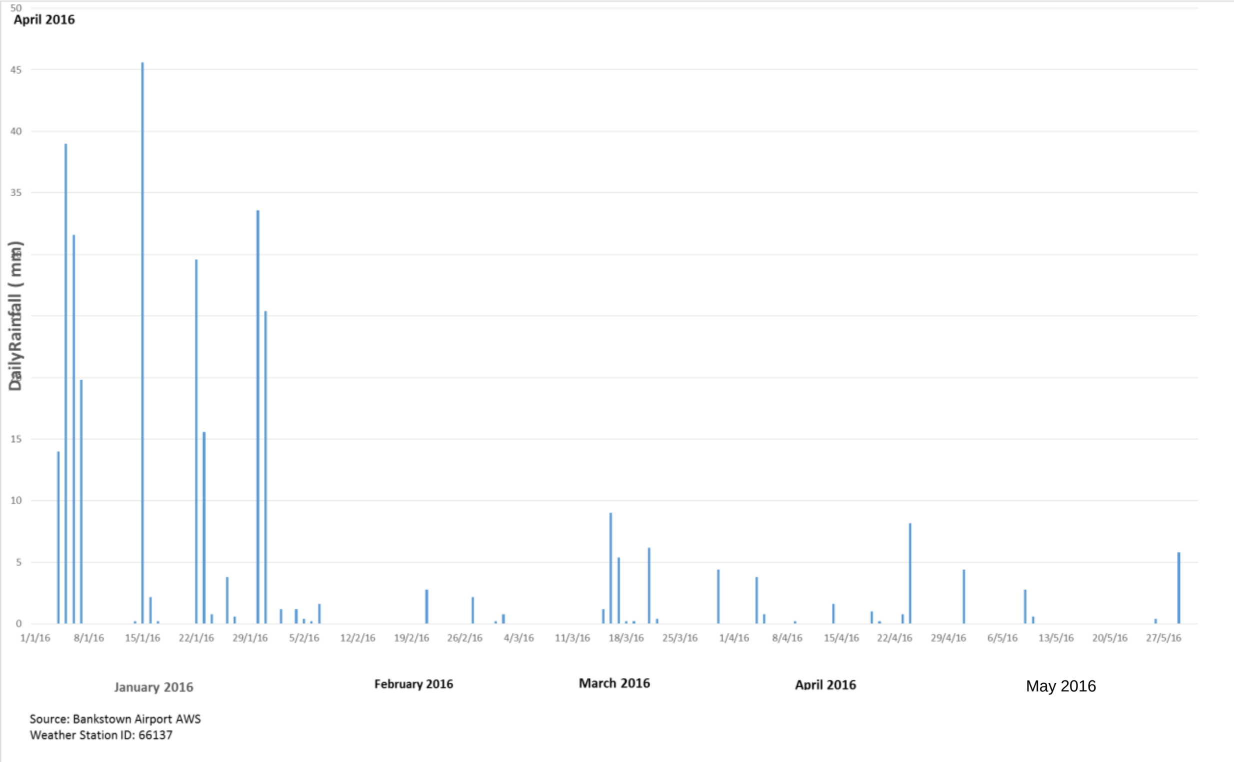


Figure 3: 2016 (Stage 2 Geotechnical Investigation Campaign) Daily Rainfall Records from Bankstown Airport (7.1 km from MPW Site)

2.5 Previous Investigations

2.5.1 Information Sources

Several geotechnical and geochemical investigations have been previously carried out at the MPW site (refer to Table 2). Information from previous geotechnical and geochemical investigations was supplied to Golder by MIC. Previous geotechnical investigation exploratory locations are shown, together with the Golder 2014 and 2016 locations on Figure A017.

Earth Tech (2006) reviewed investigations completed prior to its 2006 investigation, and PB (2015a) included a detailed review of the Earth Tech investigation and partial reviews of other selected investigations completed prior to the Earth Tech (2006) investigation.

Some of the previous data is not in current Association of Geotechnical & Geoenvironmental Specialists Data Interchange Format (AGS) format. Soils were not always described in accordance with the Australian Standard for Geotechnical Site Investigations (Standards Australia (1993) AS 1726). However the information, does provides some valuable information on near surface conditions, and therefore, this existing information has been considered, together with the information obtained from our current field investigations, in developing our geotechnical model for the MPW Project.

Table 2: Previous Investigations

Author	Report Title
Groundwater Technology (1994)	Environmental Site Assessment
Dames and Moore (1996)	Environmental Management Plan and Environmental Audit
CMPS&F, July (1998)	School of Military Engineering (SME) and adjoining areas, Preliminary Environmental Investigation

Author	Report Title
Egis Consulting Australia (2000)	Stage 1 Preliminary Site Investigation, Moorebank Defence Site
HLA Envirosciences (2002)	Soil & Groundwater Investigation Precinct H (DNSDC) Moorebank Defence Land
HLA (2003)	Preliminary Groundwater Study, Moorebank Defence Land (2003)
URS (2003)	Investigation of Potential Sources of TCE, North West Precinct of Moorebank Defence Lands
GHD (2003)	Asbestos Report and Register for the Liverpool Military Area, Updated Registers
GHD (2004a)	Estimated Asbestos Removal and Reinstatement Costs, Liverpool Military Area
GHD (2004b)	Groundwater Investigation of the North Western Portion of the Moorebank Defence Land
GHD (2005)	Proposed Intermodal Freight Hub, Moorebank, Summary of Environmental Planning Reports
HLA Envirosciences (2005)	AST and UST Management Plan, Volume 10, Sydney West Defence Region
Earth Tech (2006)	Stage 2 Environmental Investigation
ERM (2006)	Technical Advice Document, related to Earth Tech (2006) Stage 2 Environmental Investigation
HLA Envirosciences (2006)	Defence Integrated Distribution System (DIDS) Baseline Investigation
GHD (2006)	Proposed Inter-modal Freight Hub Moorebank – Summary of Environmental Planning Reports
G-tek (2011)	Explosive Ordnance Assessment and Safeguarding, Moorebank Intermodal Terminal – Post Activity Report
Parsons Brinckerhoff (2011)	Moorebank Intermodal Terminal - Geotechnical Investigation Report (document no. 2103829A_PR_036)
Parsons Brinckerhoff (2013)	Steele Barracks Moorebank – Dust Bowl Asbestos Management Plan
Parsons Brinckerhoff (2015a)	Phase 2 Environmental Site Assessment, Moorebank Intermodal Terminal (document no. 2103829A-CLM-REP-1 Rev B)
Parsons Brinckerhoff (2015b)	Preliminary Remedial Action Plan (RAP), Moorebank Intermodal Terminal (document no. 2189293C-CLM-REP-2 Rev C)
Parsons Brinckerhoff (2014c)	Phase 1 Environmental Site Assessment, Moorebank Intermodal Terminal (document no. 2103829C-CLM-REP-3321 Rev C) – *included within PB 2015a*
AECOM (2014)	Site Audit Report and Site Audit Statement, Moorebank Intermodal Terminal, Moorebank, NSW (document no. 60327260_SAR_10JUL2014)
Navin Officer Heritage Consultants (2014)	Moorebank Intermodal Terminal – Aboriginal Heritage Assessment Report, June 2014.

2.5.2 Navin Officer Heritage Consultants (2014)

Navin Officer Heritage Consultants completed an aboriginal heritage assessment report (Navin, 2014). The report is useful for geotechnical purposes because it contains logs of test pit excavations from which we have been able to assess shallow soil conditions (approximate topsoil and fill thicknesses) in selected parts of the MPW site.

The main objective of the Navin investigation was to identify geomorphological conditions and to allow recovery and analysis of artefacts. The nature of this investigation means that the sampling points are relatively densely spaced around discrete areas, rather than providing a general coverage of topsoil and fill thickness of the entire Proposal site.

2.5.3 PB Geotechnical Investigation Report (2011)

PB completed a geotechnical investigation of the site in June 2011, comprising twenty CPTs and seventeen boreholes. Of the twenty CPTs, three refused at depths less than 3 m, with a note that refusal was in fill.

The PB investigation characterised the site as comprising very stiff to hard clays with minor bands of medium dense to dense sands, generally at the southern and eastern site boundaries. Closer to the Georges River, along the site's western boundary, the ground conditions were medium dense to very dense sands, with minor bands of very stiff to hard clay. Rock depths varied from 7.6 m below ground level at PB_BH24, in the south east of the site, to a maximum rock depth of 25.8 m below ground level, which was found in PB_BH13, below the centre of the site.

The topsoil thickness was reported to vary between 50 mm and 500 mm, with an average thickness of 200 mm in the seventeen boreholes.

The fill thicknesses varied between 0 m and 1.8 m (PB_BH21), with an average thickness of 0.5 m, but six out of seventeen boreholes were logged as not having fill.

The PB report also included discussion of areas of loose / soft ground. These can be split into two different categories:

- Shallow soils, inferred to be topsoil, fill or alluvium. The soils identified in the PB table ranged in thickness from 0.2 m to 2 m thick; and
- Deeper soils, inferred to be 0.1 m to 1.1 m thick were inferred in CPTs at depths generally greater than 10 m below existing ground level. The layers identified by PB are relatively thin and generally correspond to low cone resistance values between stiffer / denser zones. Due to the deposition environment in which they were laid down it is possible that these layers represent over consolidated organic materials or layers of ash, which can occur within alluvial soils.

3.0 GEOLOGY AND SOILS

3.1 Regional Geology

According to the published 1:100,000 Penrith Geological Map (NSW Department of Minerals, 1991), the Project site is underlain alluvial sediments over rock. Adjacent to the Georges River the alluvial sediments are Quaternary (Holocene) age (<10,000 years) (Qha). These lay above a stratum of Tertiary (Pliocene) age fluvial deposits, consisting of clayey quartzose sand and clay (Ta). The geological map indicates that the underlying rock conditions in the area are either Triassic Hawkesbury Sandstone (Rh) or Ashfield Shale (Rwa).

Within the Sydney region, a relatively thin layer known as the Mittagong Formation (Rm) is sometimes present between the Hawkesbury Sandstone and Ashfield Shale units. It is not shown on the geological map in the site vicinity as being a significant near surface bedrock unit. The Mittagong Formation is typically transitional between the Hawkesbury Sandstone and the overlying Ashfield Shale with a maximum thickness of 10m. We have found what we interpret to be Mittagong Formation in borehole BHBI at the south eastern corner of the site. We found similar rock conditions in a borehole for another client at the Moorebank Avenue railway overbridge. In general, the Ashfield Shale occurs in areas of higher elevation, where it forms a cap over the Hawkesbury Sandstone or Mittagong Formations. An example close to the MP site is the western bank of the Georges River, which geological maps show to comprise shale. The general geological sequence in the area was observed during a site walkover of the Glenfield Waste Facility in December 2014. A photograph taken during this inspection shows the Ashfield Shale overlying Sandstone (with heavily eroded alluvial soils with ironstone bands in the background).

Figure 4: Photograph in Glenfield Waste Facility showing general stratigraphy looking northwest

The bedrock conditions that are anticipated as being present below the site are shown in Table 3, with the formations expected to occur in the vicinity of the site shown by green shading below. The bedding of the sedimentary sequence generally dips between 0° and 15° to the west although localised variations can occur with steeper bedding planes often associated with cross-beds.

Table 3: Regional Geology of Sydney

Group	Formation	Member	Recorded Thickness (m)
Wianamatta Group (Triassic)	Bringelly Shale (youngest)		0 to 256
	Minchinbury Sandstone		0 to 6
	Ashfield Shale	Mulgoa Laminite	0 to 61
		Regentville Siltstone	
		Kellyville Laminite	
		Rouse Hill Siltstone	
Mittagong Formation (Triassic)			0 to 10
Hawkesbury Sandstone (Triassic)			0 to 290
Narrabeen Group (Triassic)	Newport Formation		0 to 50
	Garie Formation		0 to 8

The geology beneath the site is illustrated on geological sections (Refer to Figures A023 to A035) that we have developed using the existing information. The geological sections form the basis of our geotechnical model, discussed later in the report.

3.1.1 Quarternary / Holocene Fluvial and Estuarine deposits

Geological maps indicate that soil deposits comprise sands, clays and silts and that they are present on terraces adjacent to the Georges River and associated with other creeks and ponds in the area.

Over recent geological time, the Georges River has laid down sediments in the form of channel deposits, sand banks and silt flats in the general area of the Proposal site. On the nearby Glenfield Waste site, the Georges River sediments were dredged through the mid to late 1900s as a source of construction materials. The channel of the Georges River is likely to have moved over geological time and hence buried former channels and associated deposits may be present below the MPW site. The fluvial deposits derived from the Georges River are likely to be laterally and vertically variable with gravels and sands being found close to the river and in old buried channels and silts and clays being found further from the river across the floodplain.

These shallow soil deposits have likely been impacted and reworked by natural and man-made activities. They may have been originally deposited by flooding, but may have been impacted by dredging for building resources (Glenfield Waste Facility), vegetation removal and regrowth, agricultural development of the site and then due to the development and use of the site as a military base. A photograph showing these soils on the adjacent Glenfield Waste Facility is included as Figure 4, above.

3.1.2 Rock Formations

The Ashfield Shale is typically a dark grey to black sideritic claystone and siltstone, which grades upwards into a laminite of fine sandstone and siltstone. Bedding within the unit is typically close to horizontal, although small scale cross bedding has been reported as occurring in sandier sub-units.

The Mittagong formation forms a marker band between the Hawkesbury Sandstone and the overlying Ashfield Shale. Pells (1993) makes reference to it being “the passage beds” between the two aforementioned rock units. The formation represents the transition from the fluvial or terrestrial environment of the Hawkesbury Sandstone deposition to the marine delta deposition of the Ashfield Shale, with boundaries often not being clearly distinguishable.

The Mittagong Formation comprises an upper, thin very fine grained brown sandstone unit (typically 0.5 metres to 1.5 metres thick) over a lower unit of fine grained sandstone and siltstone (typically one metre to three metres thick, but can be up to ten metres thick).

The Hawkesbury Sandstone is typically a medium to coarse-grained sandstone. Three main sedimentary facies are apparent within the Hawkesbury Sandstone, as follows:

- Massive Facies: Typically internally homogeneous in particle size and massive, with poorly defined undulose bedding. The sandstone is generally fine to medium grained with small flecks of siltstone scattered throughout. Shale breccia (angular siltstone fragments and rounded quartz gravel in a sandy matrix) commonly occurs within the troughs above the erosional surface.
- Sheet Facies: Typically well-developed cross bedding bounded by sub-horizontal bedding surfaces. Cross beds are from a few centimetres to more than 5 m in thickness and commonly dip towards the northeast. The sheet facies sandstone is coarser grained compared with the massive facies. Bedding thickness is generally between 1 m to 3 m. Lenses of conglomeritic sandstone may also occur.
- Mudstone Facies: Laterally discontinuous layers between 0.3 m and 3 m thick, composed of grey fissile mudstone (“Shale”) often laminated with fine sandstone (“Laminite”). These layers have significantly different engineering properties to the sandstone. Clay minerals consist of illite and kaolinite with quartz being the most abundant mineral. Slaking occurs on exposure to wetting and drying effects.

The massive facies sandstones generally have a lower proportion of quartz and higher clay content compared with the sheet facies sandstone. Iron cementation is common in the upper weathered areas and can occur as very high strength thin bands (generally less than 200 mm thick), which have been referred to as “ironstone”.

The Hawkesbury Sandstone has a shallow weathering profile (typically <3 m) with variable and often discontinuous residual soil cover of sandy clays and clayey sands.

The published geological map indicates that the structural contour of the Hawkesbury Sandstone and Ashfield Shale interface lies at approximately RL 0m AHD below the southern end of the Proposal site and that this surface dips to the north to approximately RL-20m AHD at the northern boundary.

3.2 Faults and Dykes

Intrusive volcanic features form a minor part of the geology of the Sydney Basin, mainly in the form of diatremes and dykes. There are no dykes shown on the geological plan in the vicinity of the MPW site, however, two lineaments are shown on the geological map to the west and east of the site. These may imply that faults are present in the bedrock close to these features and they may have had some impact on the present route of the Georges River, as the course of rivers can be affected by the presence of weaker zones in bedrock, such as faults.

There are no major (regional) faults or dykes shown within or close to the Proposal site on published geology maps. It is possible, though, that localised unmapped faults and dykes occur. Lower strength zones of crushed rock are often associated with faults, and dykes are often deeply weathered to clay.

Published geological information (Pells, 1993) indicates that small scale faulting occurs within shales of the Wianamatta Group, but that usually they are of limited continuity (i.e. less than 10 m).

No fault zones or dykes were encountered during the recent field investigations. If localised faults or dykes are encountered during construction, advice should be sought from an experienced Geotechnical Engineer.

3.3 Soil Landscapes

The Penrith Soils Landscape Map (Soil Conservation Service of NSW, 1989) indicates that the soils on the MPW site are of the Berkshire Park Group. These are soils produced on alluvial soils, commonly on elevated Tertiary terraces. The soils comprise shallow clayey sand soils, with frequent ironstone nodules. The soils have a very high wind erosion potential if stripped of vegetation. Surface water erosion comprising gully, sheet and rill erosion can also occur in exposed areas.

On lower river terraces, soils of the Richmond Group are present. These are described as poorly structured orange to red clay loams and mapping also indicates that ironstone nodules may be present. These soils are potentially erodible.

On the site of the Glenfield Waste Site, Freemans Reach Group soils are mapped. These are associated with active floodplains that are level with minor (<10 m) relief. They are typically deep brown sands and loams, which have a high potential for stream bank erosion, are prone to flooding and/or high water tables. The mapping of these units also indicates that they are associated with extractive industries, such as sand and gravel mining.

An extract of the Soils Landscape Map is included as Figure A019.

3.4 Hydrogeology

The overall geotechnical and geochemical investigation scope included monitoring of water levels within existing monitoring wells on the Proposal site. Full details of the monitoring procedure and the results of the monitoring are included in the ESAR (Golder, 2015b). The majority of wells sampled were installed with screens in the soils overlying rock.

There are two main aquifer systems on the site; a perched system within alluvial soils and; a deeper aquifer within the bedrock. Based on contouring of the results from groundwater monitoring wells on the site, groundwater in the shallow alluvial aquifer flows towards the Georges River. Two contoured groundwater plans for the site are attached as Figures A020 and A021, showing monitored groundwater levels in 2011 and 2014.

Ashfield Shale has a very low rock mass permeability and may act as an aquitard (barrier to groundwater flow). On the MPW site this unit may well reduce the infiltration of groundwater into underlying sandstone, although some groundwater may flow within this unit through joints or faults. Groundwater in the unit is saline and hard, salinity levels up to 3100 mg/l have been recorded in the region.

Hawkesbury Sandstone (and rock of the Mittagong Formation) usually has a low rock mass permeability with groundwater flow generally controlled by joints, faults and bedding partings. High permeability is also likely along near-vertical dykes, sheared zones or open joints at relatively low cover below valleys and/or paleochannels.

Groundwater in sandstone is generally of reasonable quality (typical salinity: 200 to 2000 mg/L), mildly acidic and typically with high iron content. Oxidation of iron carbonates on exposure to the atmosphere results in the characteristic red brown staining.

3.5 Slope Stability and Erosional Processes

There are no known areas of natural slope instability (landslide) within the site area. With the site being located immediately adjacent to the Georges River, some accumulation of soil by the river banks will have occurred over geological time and the river's course may have changed. As a result of these fluvial processes, some weathering and erosional processes will have impacted areas of the site close to the river. Although the river banks are heavily vegetated, older colluvial deposits may have formed when sea levels were higher than they presently are now. From field observation there appears to be low likelihood that colluvial slopes of significant depth have formed in the area and colluvium is most likely to have been stabilised or modified by human activity.

An area of soil erosion was observed on the western bank of the Georges River, this suggests that soils formed in the local area can be prone to erosion when exposed to concentrated water flow or where not otherwise protected (Refer Figure 5).

Figure 5: Area of erosion within Glenfield Waste Facility

No rock outcrops were observed on the MPW site area, although some areas of the western bank of the Georges River have outcrops of sandstone close to the road bridge at Cambridge Avenue (Refer Figure 6).

Figure 6: Sandstone outcrop to the south of Cambridge Avenue road bridge

3.6 Contaminated Soils and Acid Sulphate Soils

The extent and nature of possible contaminated soils and acid sulphate soils in the project area are discussed in the ESAR (Golder, 2015b).

3.7 Geological Units

For the purpose of geotechnical characterisation of the subsurface conditions, we have generalised the soil and rock types at the site into the following units, as illustrated in Table 4.

The geotechnical characteristics of each of these units are discussed in the following sections of the report, followed by a description of the ground conditions encountered beneath different parts of the site.

Table 4: Geotechnical Model

Unit		Sub-unit	
1	Surficial Soils	1A	Topsoil
		1B	Anthropogenic Fill
		1C	Granular Fill
		1D	Cohesive Fill
2	Recent Alluvium	2A	Sand
		2B	Clay
3	Older Alluvium	3A	Sand
		3B	Clay
4	Shale	4A	Residual Shale Soil
		4B	Extremely Low to Low Strength Shale
		4C	Shale of medium strength or higher
5	Sandstone	5A	Residual Sandstone Soil
		5B	Very Low to Low Strength Sandstone
		5C	Sandstone of medium strength or higher

3.8 Surficial Soils

3.8.1 Unit 1A – Topsoil

A thin surface layer of topsoil was generally encountered on the site, varying in thickness up to approximately 0.5 m. It is generally associated with well-established landscaped areas with grass cover. It generally comprised brown silty sand or clayey sand with rootlets. The colour of the topsoil varied from pale to dark grey and brown, with darker material typically, but not always, containing greater organic content. Interpreted topsoil thickness contours, calculated from discrete investigation locations are shown in Figure A036.

It is noted that apparent 'buried' layers of older topsoil were encountered beneath a thin layer (typically 0.3 m thick or less) of fill at a number of locations (e.g. GA-HP-6009, GA-HP-6026 and GA-HP-6040). 'Older' topsoil also appeared to have been worked into filling/re-grading of the surface at some locations (e.g. GA-HP-6015)

The topsoil layer can be further sub-divided on the basis of soil horizon definitions as applied by the Soil Conservation Services of NSW, based on the humic content. This further sub-division may be applied to facilitate rationalisation of topsoil stripping in accordance with a site specific Earthworks Specification.

The assessment of what constitutes "topsoil" can be subjective and the term is best applied in a project specific sense which takes due consideration of the desired end usage of the material. Characterisation of material as topsoil, where it implies a lack of suitability as an engineered material, should be based upon an assessment of appropriate characteristics and parameters pertinent to the desired usage (or rejection) of that material.

For the purposes of field logging, topsoil has been taken as the near surface layer of material with an observed higher proportion of organic material (be that humic material, roots or rootlets) in contrast to the underlying fill or natural material. Organic Content testing was undertaken to inform re-use testing potential for the topsoil (particularly the lower portions of topsoil or older 'buried' topsoil layers below fill). Organic Content testing was also undertaken on Unit 1B, 1C and 1D material and those results are discussed in the following Chapters.

A total of 30 Organic Content tests were undertaken on Unit 1A samples with results ranging from 0.4% to 2.5% (GA-HP-6024), with an average value of 1.3%. These are considered relatively low values for a topsoil and not outside a range which might be accepted within general filling, dependent on the particular application of the fill and its performance requirements.

Standard compaction and California Bearing Ratio (CBR) testing was also undertaken on two samples of Unit 1A material, returning CBR values (after 4 day soak) of 10 % and 20 %. This reflects the dominantly sandy nature of the topsoil, as does the recorded swells of 0% and 0.1%. Standard Maximum Dry Density (SMDD) testing returned values of 1.64 and 1.77 tonnes/m^3 and Optimum Moisture Contents (OMC) of 11.2% and 14.9% were recorded. It should be noted that the testing was undertaken on samples of soil which were obtained from beneath the surficial vegetative layer (such as the root mat of turf overlying topsoil layers). Significantly higher organic contents would be recorded should such vegetation be included in topsoil samples.

3.8.2 Unit 1B – Anthropogenic Fill

In some parts of the site there are above or below ground areas where waste materials (anthropogenic fill) have been placed. These include areas where former valleys have been in-filled and above ground waste stockpiles, as shown in Figure A037. Our ESAR contamination report (Golder 2015b) identifies and discusses areas of anthropogenic fill in more detail. Where encountered, Unit 1B material typically extended to depths of more than 2m and up to 4m (GA-BH-3102).

The compaction of anthropogenic fill zones is expected to be poor and variable as evidenced at GA-BH-3102 which reported a mix of SPT hammer refusal (on obstructions within the fill such as sheet metal) and low blow counts (initial seating under rod and hammer weight alone followed by an N value of 1) over the 4 m thickness of Unit 1B encountered.

A number of test pits were undertaken during the MPW Stage 2 campaign within areas of anthropogenic fill 'hotspots', with laboratory testing undertaken to assist in assessing the opportunity for re-use of the Unit 1B material, subject to processing and screening for unsuitable material.

Mixing of material Units has occurred in zones of Unit 1B filling. As such topsoil will likely be mixed in with some of the fill and evidence of this was observed within the MPW Stage 2 test pits. Three organic content tests were undertaken on Unit 1B samples as with results ranging from 0.4% to 1.0% (GA-TP-3113), and an average value of 0.7%.

The material encountered was variable but typically sandy with silt and clay. Inclusions ranged in size and included steel, concrete and timber to boulder size as well as apparent domestic waste such as a dilapidated pram and butter knife (refer to Golder 2016a for conditions encountered at specific locations).

Standard compaction and California Bearing Ratio (CBR) testing was also undertaken on two samples of Unit 1B material, returning CBR values (after 4 day soak) of 10 % and 19 %. This reflects the dominantly sandy nature of the fill (excluding the included waste material and debris), as does the fact that no swell was recorded. Standard Maximum Dry Density (SMDD) testing returned values of 1.89 and 2.0 tonnes/m^3 and Optimum Moisture Contents (OMC) of 12.1% and 12.2% were recorded.

3.8.3 Units 1C and 1D – Fill

In developing the site into its current form it is likely that cut / filling operations have been completed to produce level working areas and in the construction of structures over an extended period of time. Fill areas include existing road pavements and hard stand areas. Most of the fill encountered on the MPW Stage 2 site is granular (primarily sand, Unit 1C) although the PB (PB, 2011) geotechnical investigation did record sandy clay / clayey sand fill material in Boreholes 3, 7, 10, 13, 16, 18 and 24 (Unit 1D), as did the 2016, MPW Stage 2 geotechnical investigation.

As the site has been in use since the 1940s compaction of these fill materials will likely have been completed using different equipment and to different specifications than those used currently.

Inferred fill thicknesses over the site area are shown in Figure A038 and are up to approximately 0.5 m thick. The contouring process used in the generation of Figure A038 may lead to overestimation of fill thickness, where a locally thicker fill material was found, for instance, thicker granular fills associated with existing hardstand or internal access roads of the site. However, the figure is useful in that it shows a correlation between greater fill thicknesses and areas of the site that have been extensively developed, with buildings, services and roads constructed.

The thickness of granular fill materials are summarised below:

- Gravels were generally associated with paved or hardstand areas, with thickness ranging between 0.36 m (BH102) and 0.45 m (BH110).
- Sands, silty sands or clayey sands, generally inferred to have been reworked from natural soils had thicknesses ranging between 0.28 m (BH108) to 2 m (BH111).

Greater fill thicknesses may also be expected along former valleys and creeks across the site, behind retaining structures that are present on the lower terraced area and in areas of the site where there are slopes, which fill materials may have been end tipped historically to provide new working areas.

A summary of laboratory testing on sands from Unit 1C is presented in Table 5. These soils were generally dry of optimum moisture content (2 to 10% dry, based on lab testing), so depending on climatic conditions at the time, some moisture conditioning will be required if effective compaction of these soils is to be achieved.

Table 5: Summary of Lab Testing Results for Unit 1C

Test	Minimum	Maximum	Average	Median	Number of Tests
Moisture Content, (%)	1	20.9	8.0	5.9	9
California Bearing Ratio (CBR) (5.0mm) (%)	5	30	15.5	N/A	10
Optimum Moisture Content (OMC) (%)	9.5	17	12.1	11.9	13
Maximum Dry Density (MDD), (t/m3)	1.7	2	1.9	1.9	13
Emerson Class Number	5	6	5.5	N/A	6
Organic Content (%)	0.2	0.8	0.6	0.7	7

3.9 Unit 2 – Recent Alluvium

Unit 2 comprises Recent Alluvium (inferred Holocene age) characterised by very loose to loose sands or silts (Unit 2A) or very soft to soft clays (Unit 2B). This unit was not encountered during the Stage 1 and Stage 2 EPW geotechnical investigation. However, the ESAR (Golder 2015b) included some sediment probing work along existing drains and watercourses on the site, which contained Unit 2 materials. In addition, we consider that existing creeks such as Anzac Creek and the ponds at the northern end of the MPW site are likely to contain recent alluvial materials.

PB (PB, 2011) may have encountered recent alluvial materials in some boreholes during their investigation, based on Table 3 of their report. Generally these layers appear to be relatively thin, or they are associated with fill deposits, which may make differentiating between fill and recent alluvium difficult.

3.10 Unit 3 – Older Alluvium

Older Alluvium (inferred Tertiary age) is found beneath the Unit 1 surficial soils and Unit 2 alluvium (where present) and overly residual soils and bedrock. In some cases it is difficult to distinguish between recent (Unit 2) and older (Unit 3) alluvium. The Unit 3 materials are generally denser or stiffer than the Unit 2 materials.

Unit 3 comprises sub-units of medium dense to very dense sands and silty sands (Unit 3A) and very stiff to hard silty clays (Unit 3B). In general, the unit is formed from interbedded sands and clays. At many of the investigation locations, there is a sharp transition from alluvial sediments into the underlying bedrock, which implies that residual soils have been scoured from the bedrock surface and that transported alluvial soils (which may have been produced from the same parent rocks upstream) have been deposited onto weathered rock.

Both units are inferred to contain iron cemented bands or dense materials, through which CPTs could not penetrate. Numerous CPTs are inferred to have refused at depths ranging between 0.1 m and 15.5 m below existing ground level. Due to the variability in rock head across the site (refer to the Cross Sections of APPENDIX A) and the broad spacing of discrete test locations, it is difficult to infer in all instances whether CPT refusal reflects hard, potentially iron cemented bands with the Unit 3B material or Unit 4 or Unit 5 residual material or bedrock. For more information on CPT refusal refer to the CPT logs in the GDR (Golder, 2016a). Test pits that were excavated using a backhoe at the locations of selected refused CPTs, also refused on inferred iron cemented layers. The presence of these hard layers will need to be considered when contractors consider excavation and piling options for the site.

The CPTs by PB (PB, 2011) identified loose or soft materials at depth within the very stiff or very dense materials. These may be thin clay layers or organic layers.

While we endeavoured to distinguish between sand (Unit 3A) and clay (Unit 3B) layers on the geological sections, due to the complexity and potential variability of the former alluvial depositional environment and the relatively widely spaced position of the boreholes, it was not possible to delineate the Unit 3A and 3B on the interpretive geological sections. The presence and differing engineering behaviour of the units will need to be considered locally during design of each specific facility at the site.

3.10.1 Unit 3A – Silty Sands and Clayey Sands

The unit was a maximum of approximately 18 m thick (BH114).

Table 6 presents a summary of the results of laboratory testing on Unit 3A materials. Atterberg limit tests were carried out on three samples of material described as clayey sand and grouped within Unit 3A. The tests indicated that the samples tested classify as CL (low plasticity clay). Typically a soil can demonstrate clay-like behaviour even if it contains a relatively low percentage of clay size particles and appears to be primarily sand in composition. The composition of the Unit 3 materials is highly variable, with gradational properties between sand and clay. Results of aggression testing undertaken on Unit 3A materials are presented in Chapter 4.6.

CBR test results are likely to vary substantially within this unit dependent upon the relative amount of clay fines within the sample. Where the material is dominantly sand, the CBR test value will be high. For example, a single test was undertaken on a sand sample of Unit 3A material, with a reported 4 day soaked CBR value of 40. MDD and OMC were 1.92 t/m^3 and 10.8 % respectively.

Table 6: Summary of Lab Testing Results for Unit 3A

Test	Minimum	Maximum	Average	Median	Number of Tests
Moisture Content, (%)	3.5	20	10.5	10.3	37
Liquid Limit (LL), (%)	15	42	28.6	N/A	12
Plastic Limit (PL), (%)	8	17	13.6	N/A	12

Test	Minimum	Maximum	Average	Median	Number of Tests
Plasticity Index (PI), (%)	3	29	15	N/A	12
Linear Shrinkage (LS), (%)	7	10.5	8.8	9	3
Emerson Class Number	5	6	5.6	N/A	8

A plot of Standard Penetration Test (SPT) "N" values versus depth is given in Figure 7 for the Unit 3A sands. The N value is a representation of the density of the soils, and indicates that the sands are typically medium dense to dense, although there is no obvious trend of increasing density with depth. Each point on this graph represents an individual SPT test value.

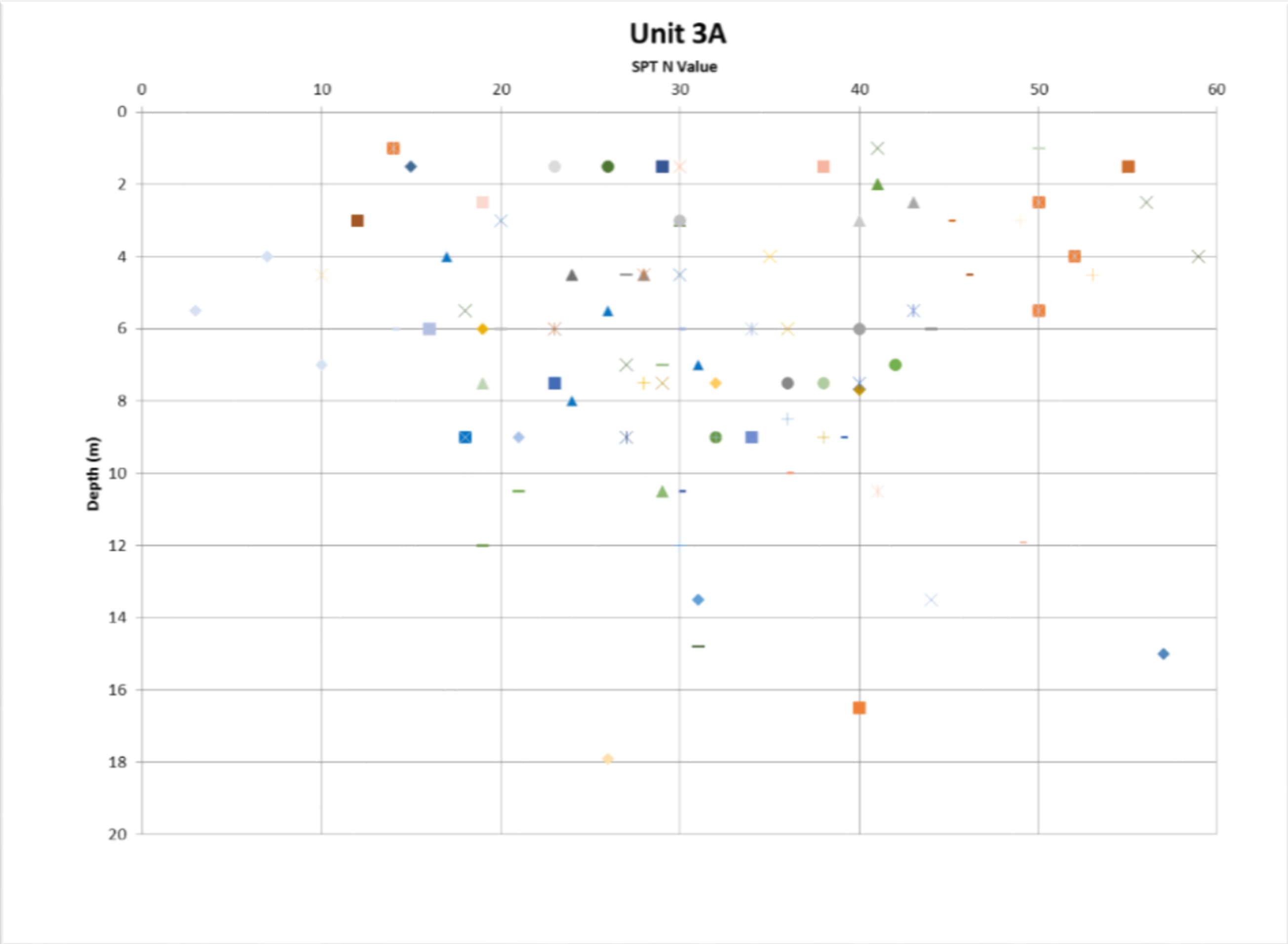


Figure 7: Summary of SPT results in Unit 3A

3.10.2 Unit 3B – Silty Clays and Sandy Clays

Unit 3B clays were a maximum of approximately 20 m thick (BH101) and included interbedded sand or clayey sand layers, based on CPT results. CPT134 is a good example of an interbedded Unit 3A and Unit 3B profile. A summary of laboratory test results for tests on clays from Unit 3B is presented in Table 7.

The samples taken from relatively shallow depth (2 m deep or less) had a relatively wide range in results for both moisture content and optimum moisture content. In general the soils were slightly dry of optimum content (approximately 2%). However in some areas these materials may also require drying-back, particularly where earthworks are conducted during periods of wet weather. The average OMC of Table 7 is shown as a line on Figure 8. The majority of samples tested were dry of the inferred average OMC for Unit 3B.

Table 7: Summary of Lab Testing Results for Unit 3B

Test	Minimum	Maximum	Average	Median	Number of Tests
Moisture Content, (%)	11.2	30.2	18	17.5	20
Liquid Limit (LL), (%)	18	97	50.8	47	35
Plastic Limit (PL), (%)	8	26	15.5	15	35
Plasticity Index (PI), (%)	3	77	35.2	32	35
Linear Shrinkage (LS), (%)	1.5	19.5	12.8	14	22
% < 0.075 mm	47	92	63.7	N/A	10
California Bearing Ratio (CBR) (5.0mm) (%)	1	7	3.2	2.5	5
Optimum Moisture Content (OMC) (%)	13.6	30	20.8	20.5	5
Maximum Dry Density (MDD), (t/m3)	1.44	1.86	1.68	1.72	5
Emerson Class Number	5	6	5.5	N/A	16
Shrinkage index	0.7	2.8	1.3	1.3	6

The field moisture content of the clay is plotted versus depth in Figure 8 below.

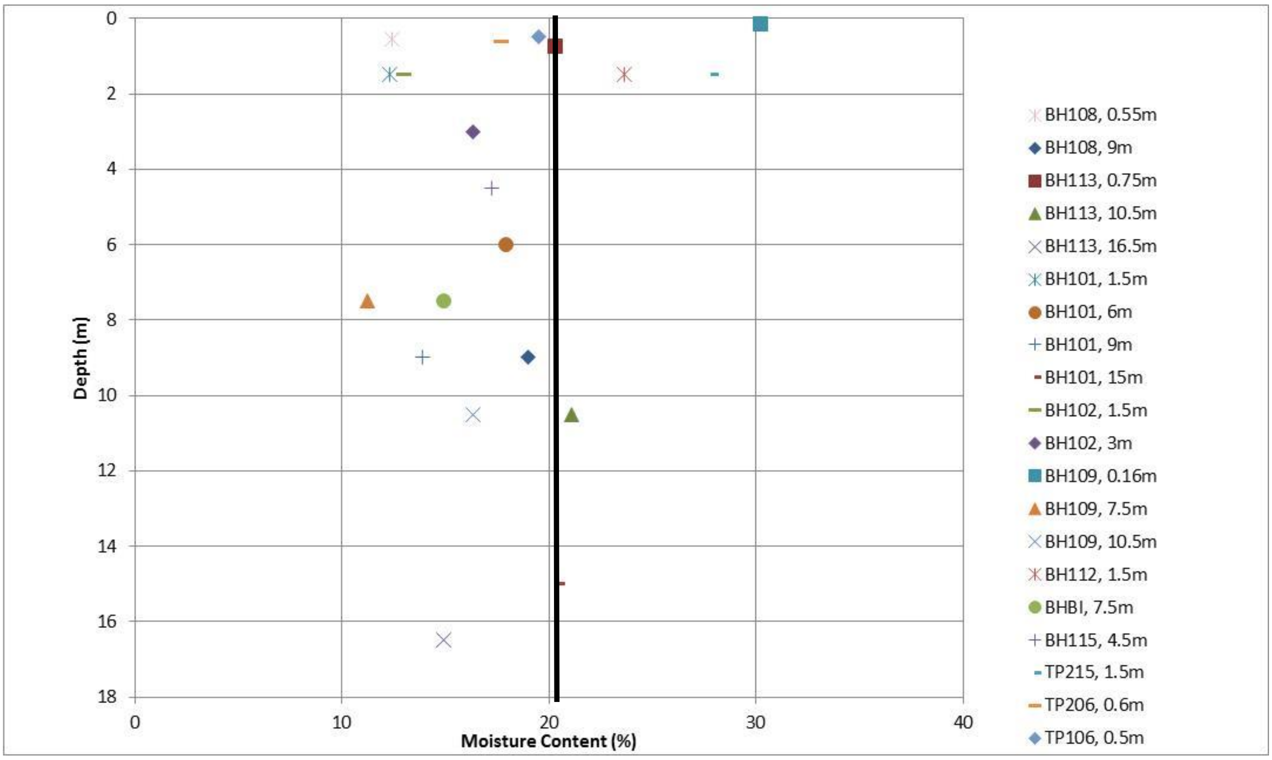


Figure 8: Field Moisture Content vs Depth – Unit 3B

As illustrated on the plasticity chart in Figure 9, the Unit 3B clay has a Unified Soil Classification System (USCS) symbol typically of CI to CH (medium to high plasticity). This is consistent with the average and median values calculated for Table 7. However as can be seen in Figure 9 a number of very high plasticity outliers (e.g. Liquid Limit greater than 80%) have been recorded. Care should be taken in applying average values. Given the size of the site and the relatively widely spaced nature of investigation and testing undertaken to date it is possible that locally relatively large areas of material may be encountered which did not conform well to average values.

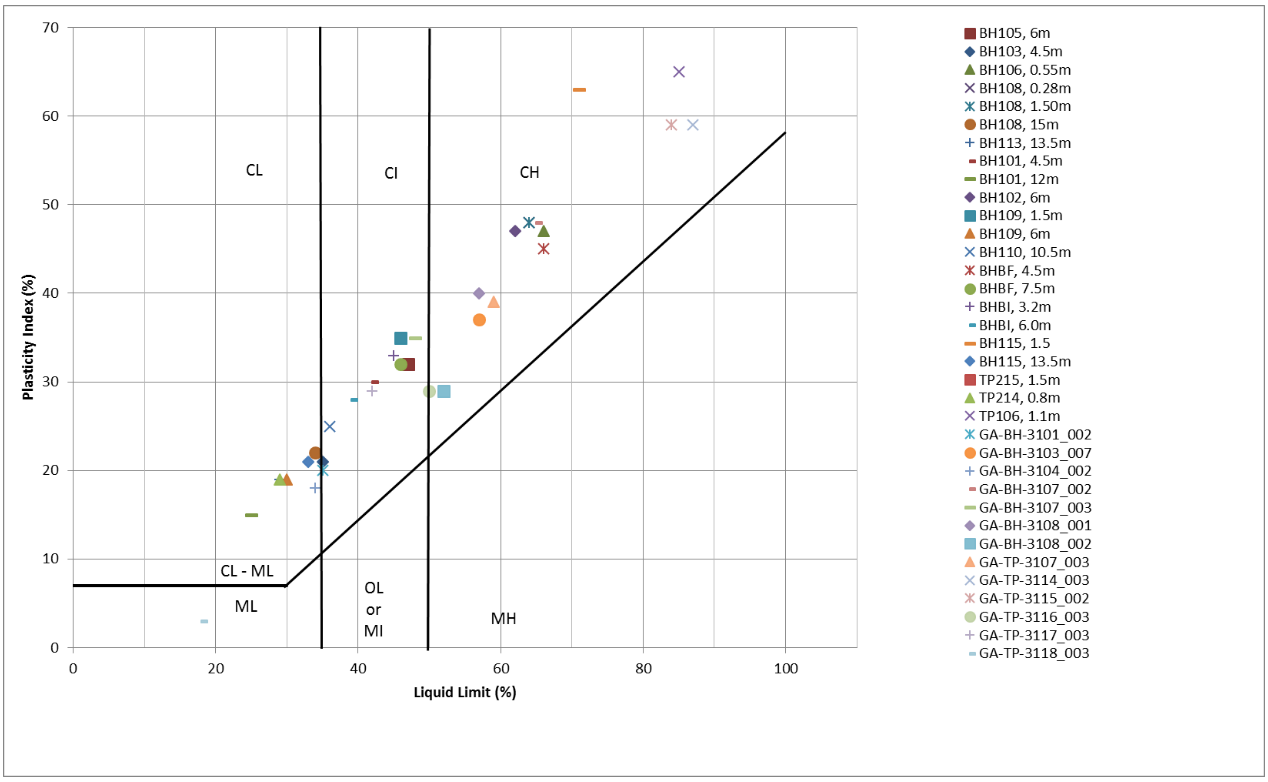


Figure 9: Liquid Limit vs Plastic Limit – Unit 3B

A plot of Standard Penetration Test (SPT) "N" values versus depth is given in Figure 10. The N value is a representation of the strength of the soils, and indicates that the clays are stiff to hard. Each point on this graph represents an individual SPT test value.

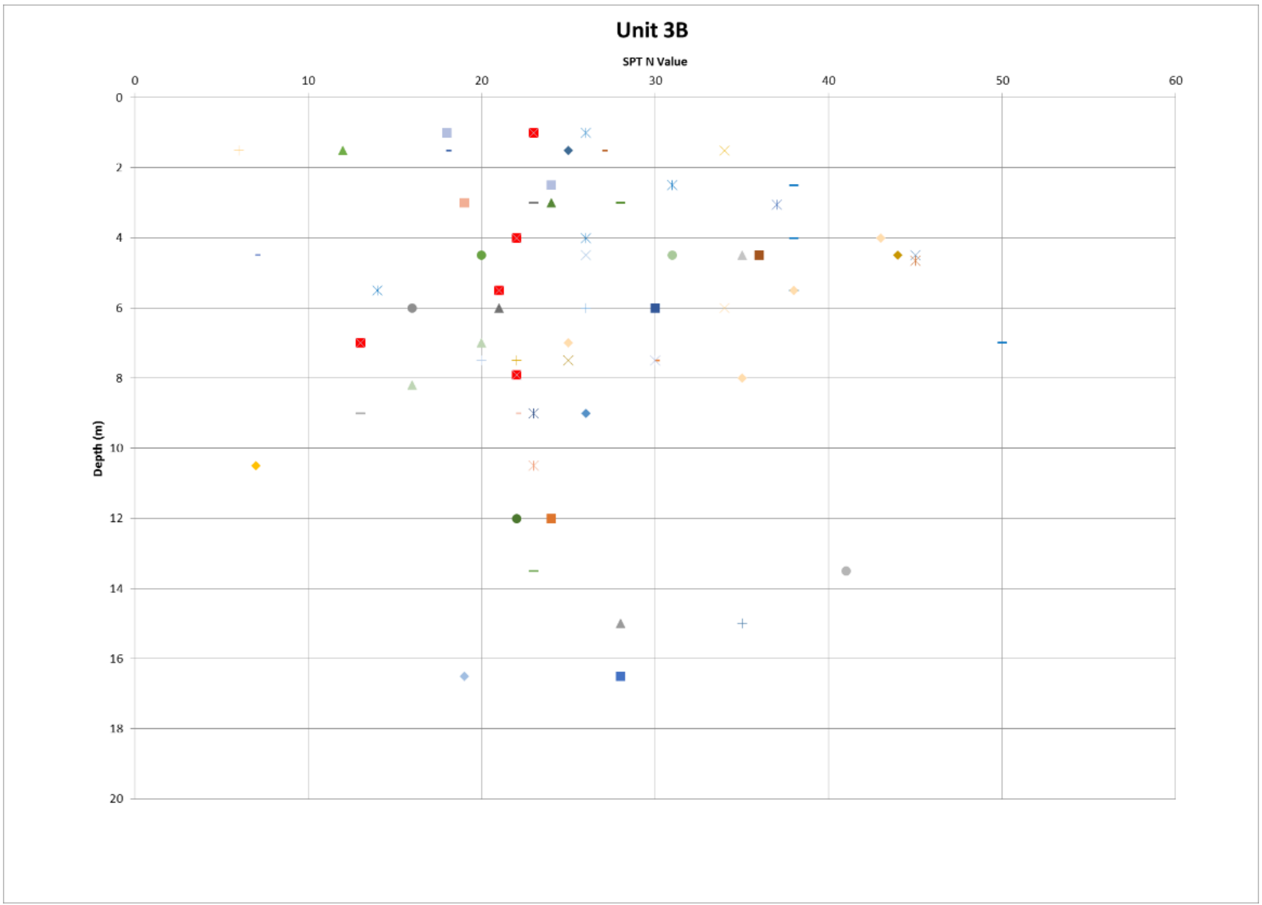


Figure 10: Summary of SPT results in Unit 3B

Dilatometer (DMT) Testing was completed at locations adjacent to boreholes BH109, BH111 and BH114. In two of the three proposed test locations the DMT refused at relatively shallow depth (3 m and 5 m). Both of these locations were underlain by denser Unit 3A sand. At the third location, underlain by very stiff Unit 3B clay a DMT test was completed successfully to a depth of 12 m. The results of DMT testing are included in the GDR (Golder, 2015a).The results of DMT testing corroborate the SPT and CPT data which indicate that the Unit 3A and 3B materials typically comprise stiff to hard sandy clay and dense to very dense sand.

3.11 Unit 4 – Ashfield Shale and associated Residual Soils

3.11.1 Unit 4A – Residual Soils

Unit 4 includes sub-units 4A (Residual Soil), 4B (very low to low strength siltstone) to 4C (medium strength or higher siltstone).

In general the residual soils below the site appear to be relatively thin, with a relatively abrupt transition from the older alluvium to extremely weathered siltstone, which also generally quickly improves in strength to medium to high strength. Figure 11 shows the transition between the alluvial soils and extremely weathered shale rock in BH111. A thin layer of possible residual soil, approximately 150 mm in thickness was observed in this borehole, which we consider to be typical for the area, considering its geological history and the results of boreholes.

The geological profiles interpreted from the seismic reflection surveys and the borehole information correlate reasonably well. The seismic results also appear to confirm that residual soils are thin or absent.

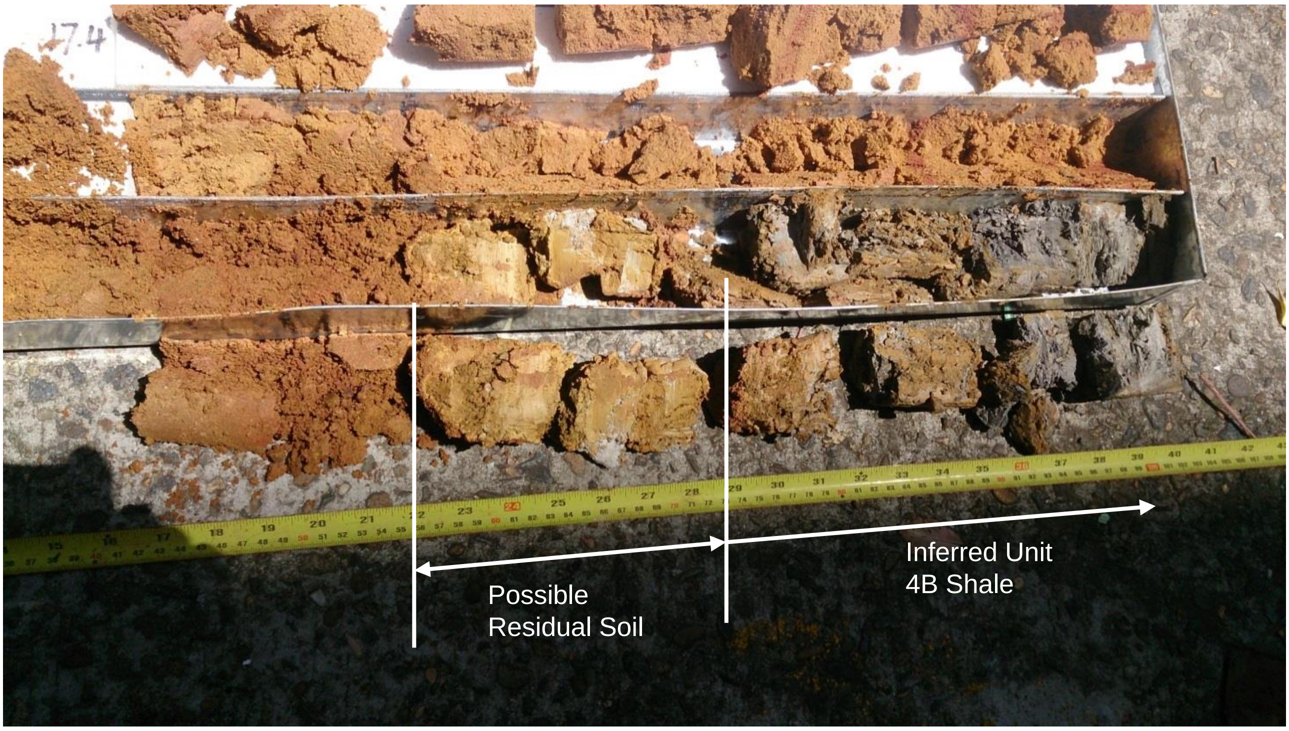


Figure 11: Transition between alluvium and shale bedrock

3.11.2 Unit 4B – Extremely Low to Low Strength Shale

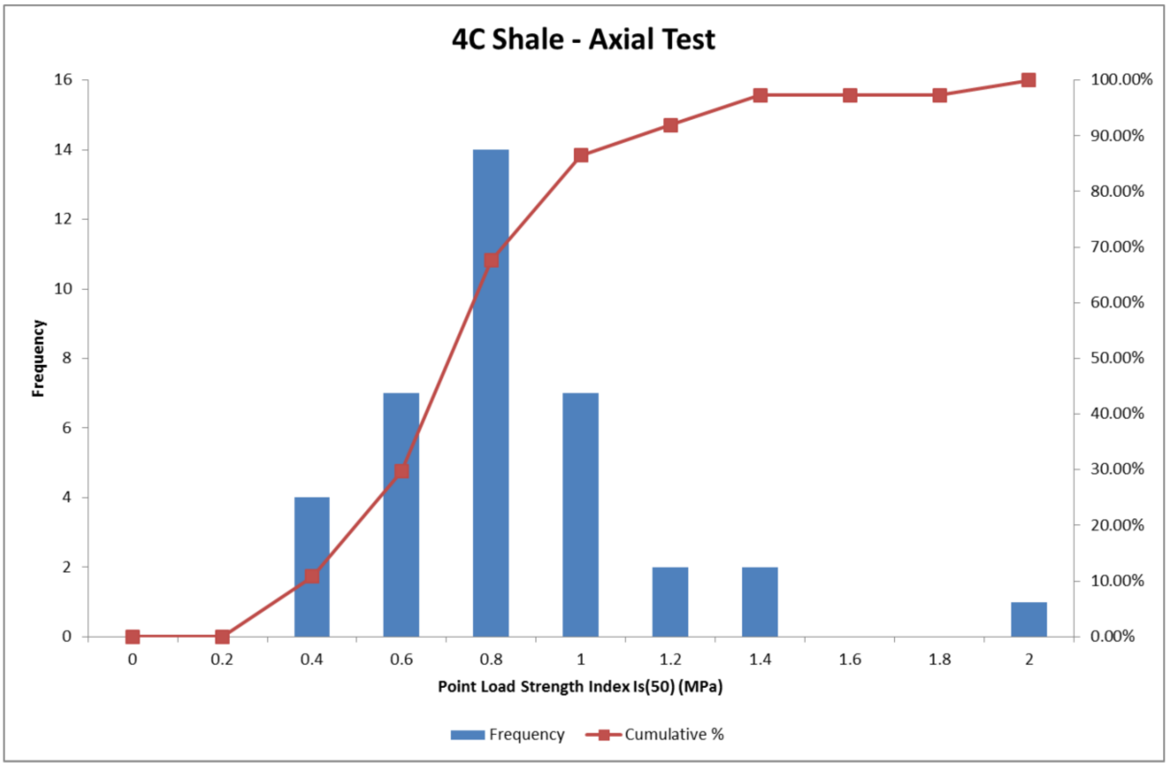
Shale was found in the majority of boreholes over the site at depths ranging from 8.5 m to 21.8 m. Generally, the shale encountered across the main investigation site does not exhibit deep weathering, with slightly weathered to fresh and medium to high strength shale encountered within approximately 2 m of the top of the unit in the majority of boreholes. The shale encountered in the southern end of the site exhibited a deeper weathering profile with Unit 4B shale inferred to be up to 5 m thick.

Contours of the top of rock are included in Figure A039. Figure A039 does not distinguish between the top of sandstone or shale. We have inferred the potential shale / sandstone boundary on cross sections A023 to A027 based on the results of boreholes and published geological maps.

3.11.3 Unit 4C – Shale of Medium Strength or Higher

Unit 4C shale observed during the investigations was generally slightly weathered to fresh and medium to high strength. Figure 12 below gives a summary of the Is_{50} rock strength results obtained from point load testing carried out on shale samples during the investigation. As expected the data shows a strong anisotropy related to the horizontally fissile nature of the shale.

Three UCS tests were carried out on shale samples which indicated compressive strengths of 7 MPa, 17.4 MPa and 25.7 MPa.



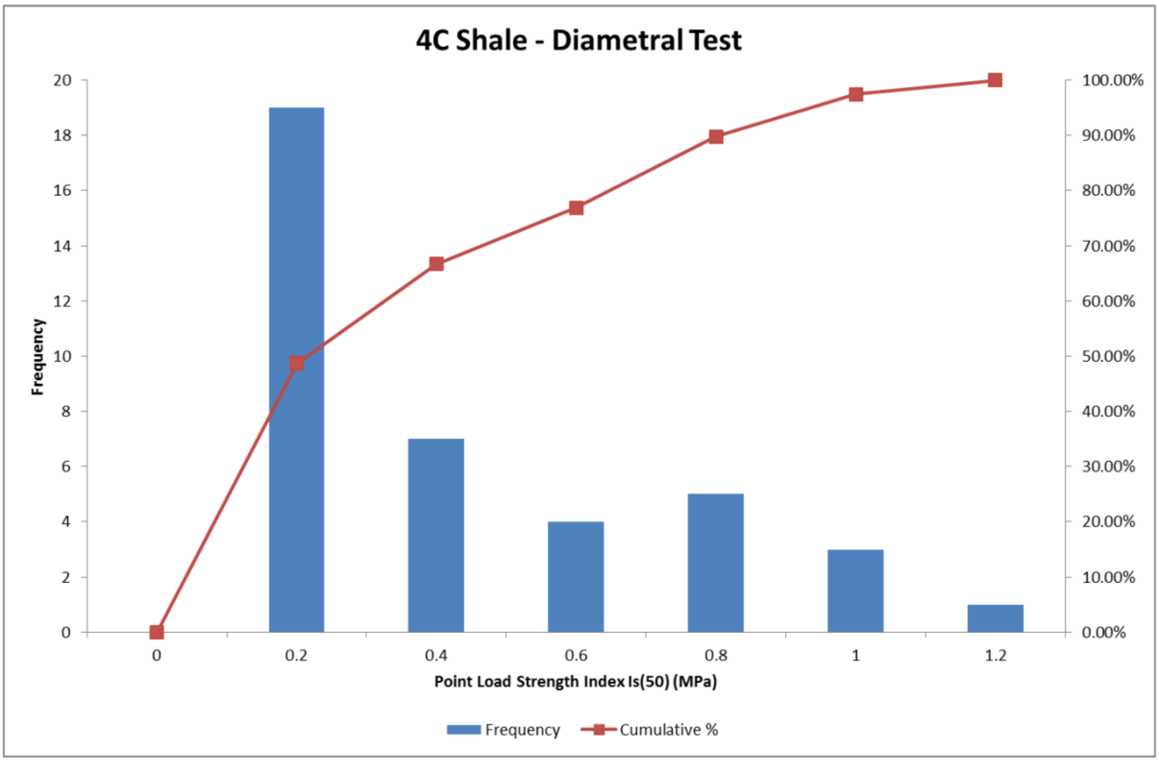


Figure 12: Point Load Test Results for Unit 4C

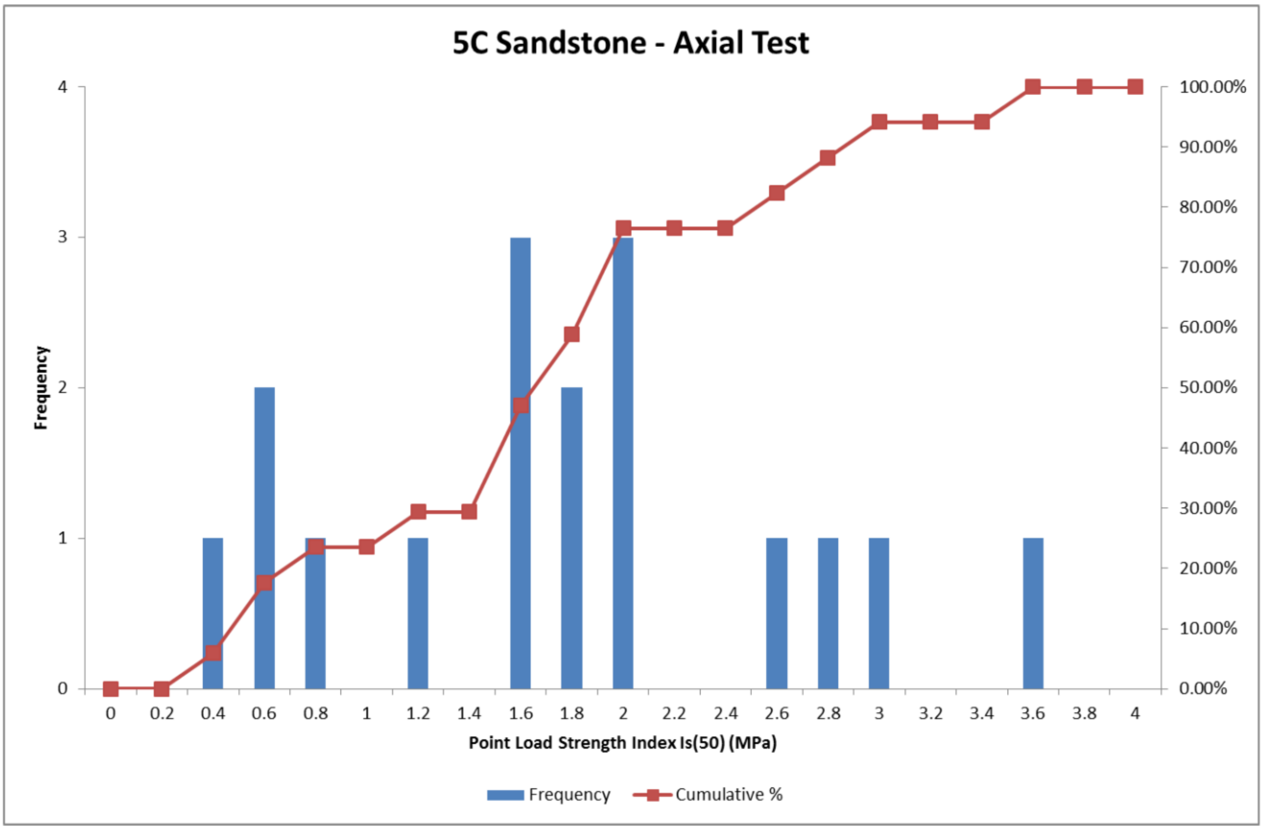
3.12 Unit 5 – Hawkesbury Sandstone and associated Residual Soils

The findings of the geotechnical investigation seem to be consistent with published geological information. Sandstone (in the absence of a shale cap) was only encountered below the southern end of the site (BH101). A thin layer of residual soil 1 m thick was observed in this borehole comprising silty clay of hard consistency. Elsewhere, the residual soil was likely eroded prior to deposition of the overlying alluvial sediments.

The Hawkesbury Sandstone was also observed in other locations, below a shale cap (BH103, BH108 and BHBI).

The majority of the Hawkesbury Sandstone encountered during the investigations was slightly weathered to fresh and medium to high strength. Generally the sandstone encountered does not exhibit deep weathering, with Unit 5C sandstone encountered within approximately 2 m of the top of the unit in the four boreholes in which it was encountered (BH101, BH103, BH108 and BHBI).

Figure 13 below gives a summary of the Is_{50} rock strength results obtained from point load testing carried out on sandstone samples during the investigation. Two UCS tests were carried out on sandstone samples which indicated compressive strengths of 20.2 MPa and 22.6 MPa.



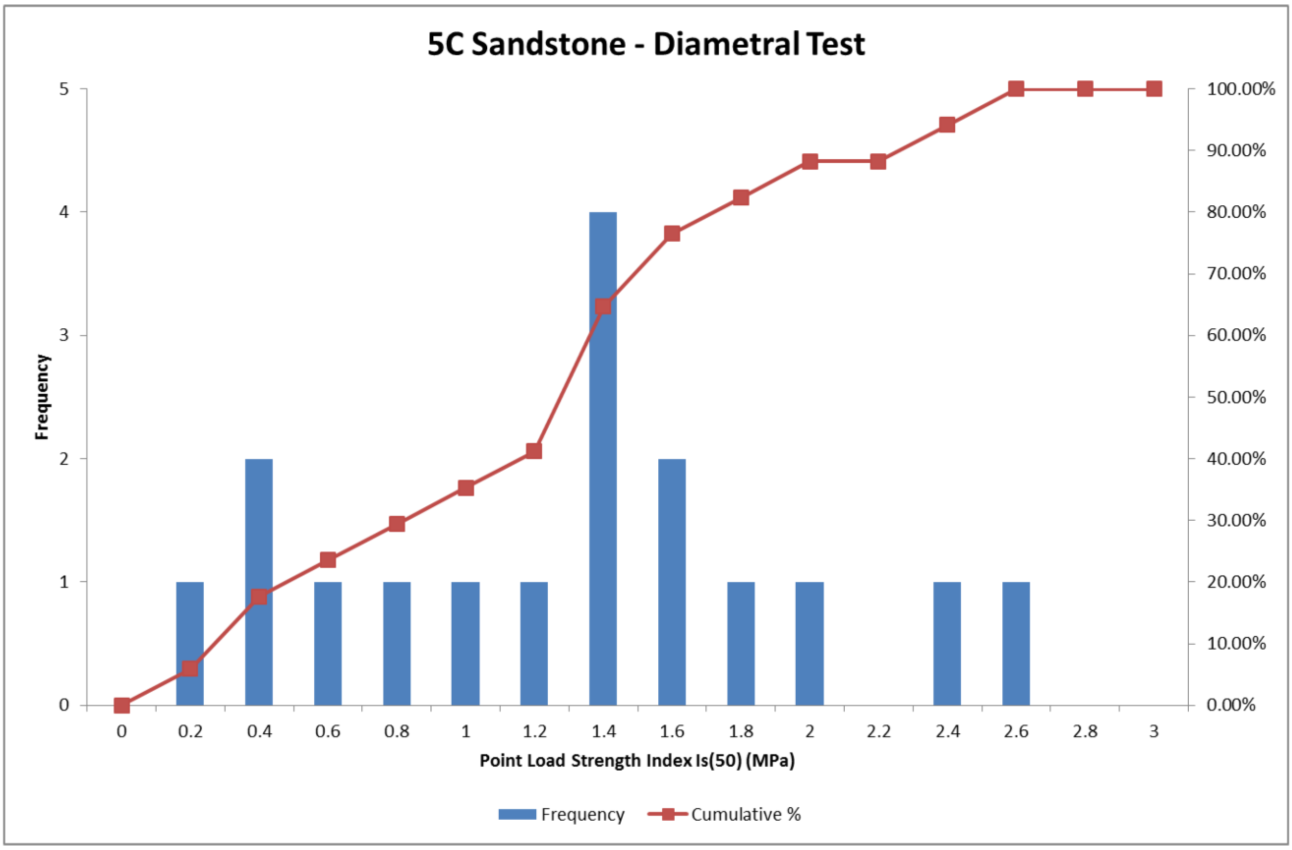


Figure 13: Point Load Test Results for Unit 5C

3.13 Rock Defects

Generally the rock defects encountered during the field investigation were associated with the bedding features in the sedimentary rocks. The majority of defects dip between 0° and 15°. Based on the borehole information it is difficult to assess the presence of any major defect sets that may be present, other than the sub-horizontal bedding defects.

A typical characteristic of weathered sandstone and shale is planar weathered seams running parallel with bedding. These defects are a major factor in the engineering classification of rocks in the Sydney Basin using Pells (Pells et al, 1998). The weathered seams are variable in thickness (usually less than 100 mm thick), generally sub-horizontal and usually contain a combination of sand, silt and high plasticity clay, depending on the parent rock. They generally decrease in frequency with depth and degree of weathering of the parent rock. In general, on the MPW site the rock conditions immediately below rock-head level include weathered seams, but rock quality generally increased rapidly within 1 to 3 m. This appears to be consistent with the generally thin residual profile over the site inferred to be due to erosion.

3.14 Acid Sulphate Soils

An extract from acid sulphate soil mapping is attached as Figure A040. In general this shows recent alluvial soils within or close to the Georges River as having the greatest risk of containing acid sulphate soils. Further discussion of acid sulphate soils is included in the Golder ESAR report (Golder, 2015b).

3.15 Summary of Ground Conditions

The MPW site has a relatively thin surficial fill layer (i.e. Unit 1 materials per Table 4 above), generally being approximately 0.5 m thick, but up to 4 m or more in some areas of the site, generally related to filling pre-existing depressions in the site or disposal of waste materials (typically Units 1B and 1C). There is a relatively rapid transition to stiff / dense alluvial deposits, comprising sands or clays (Units 3A and 3B). In general greater depths of alluvial material were encountered towards the northern end of the site (up to approximately 20m) compared to the south (typically 10m or less). Although both sands and clays were interbedded, which is consistent with the variable alluvial conditions under which they were deposited, the proportion of sand was found to be greater towards the northern end of the site (with some locations comprising nearly all sand) than at the southern end (where selected locations comprised only clay). These soils exhibited a low potential of erodibility when subjected to water.

Ashfield shale rock (Units 4B and 4C) was generally found below the overlying alluvium for the majority of the site area (to depths of up to 25 m). The exception to this is the southern end of the site, where Hawkesbury sandstone was observed (Unit 5C) below the overlying alluvial material. The shale rock forms a cap above the sandstone. The depth to rock varies between approximately 8 m to 21 m below existing ground level. The results from the current investigation appear consistent with earlier seismic refraction surveys completed by PB in 2011, which indicated rock levels varying by a similar range as the existing survey, with a maximum rock elevation difference over the survey runs completed of about 10 m.

4.0 DESIGN PARAMETERS

4.1 Design Loading

The following design loading assumptions have been adopted in this report:

- Floor loads of warehouses, 40 kPa;
- Pad or strip footing loads, >150 kPa; and
- Ground levels to be raised to achieve a typical design level of RL16m (Arcadis, 2016a).

4.2 Performance Criteria

The following performance criteria have been considered in the preparation of this report:

- Long term post-construction differential settlements of top of the surface (in areas of fill or virgin material) equal to or less than 1 in 400 over 30 years;
- Future industrial lots may be subjected to characteristic ground movements similar to those anticipated for a Class M site as defined in AS 2870 – Residential Slabs and Footings.

4.3 Ground Stiffness

Ground stiffness parameters (modulus) are required for the estimate of foundation performance (settlement) and the design of piles.

Our assessment of ground stiffness parameters has focused on Unit 3A and Unit 3B materials, as these materials, along with the nature of the new fill used to form the Earthworks Platform (including the Structural fill layer and any underlying General Fill) are most likely to influence foundation performance. Our assessment of ground stiffness has been made directly, or indirectly using published correlations, from the results of in situ testing: SPT "N" values, CPT cone tip resistance, dilatometer (DMT) tests and downhole seismic testing.

Ground stiffness is a soil property which is strain dependant. Where strains are small the soil stiffness tends to be high and conversely where strains are large the soil stiffness reduces. Different site investigation techniques assess soil properties at different strain levels; we have included an indicative summary of the testing methods used during the current investigation below:

Table 8: Indicative Strain Levels for Investigation Techniques

Testing Method	Approximate Strain Level	Comment
Geophysics	0.0001 to 0.001 %	Maximum Modulus (E_0)
DMT	0.01 to 0.1 %	Used for deformation analyses
CPT, SPT	1 to 10 %	Used for bearing capacity and stability analyses

Due to this strain dependency, there can be a large variation in modulus for the same material. In assessing appropriate parameters to use, the nature of the material and the type of assessment required need to be taken into account. Hence, while for assessment of stability or bearing capacity mechanisms a lower modulus may be used, for some deformation analyses a higher value may be appropriate.

Plots showing our interpretation of soil stiffness versus depth for the granular Unit 3A soils and clay of Unit 3B are presented in Figure 14 to Figure 16, below:

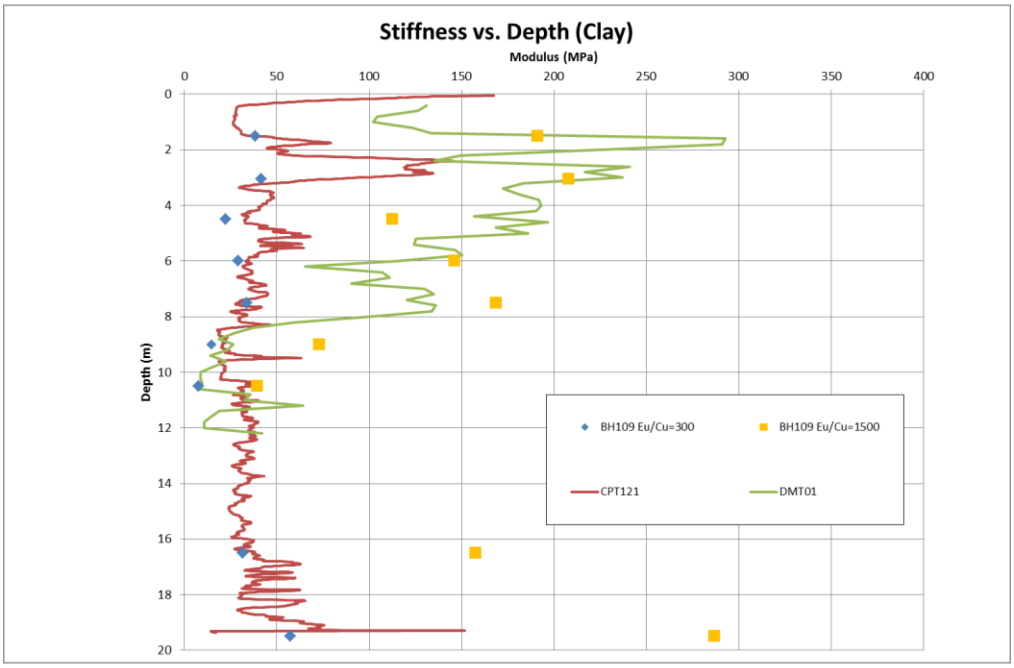


Figure 14: Stiffness vs Depth Plot for BH109 / CPT121 / DMT01 (Unit 3B Clay Profile)

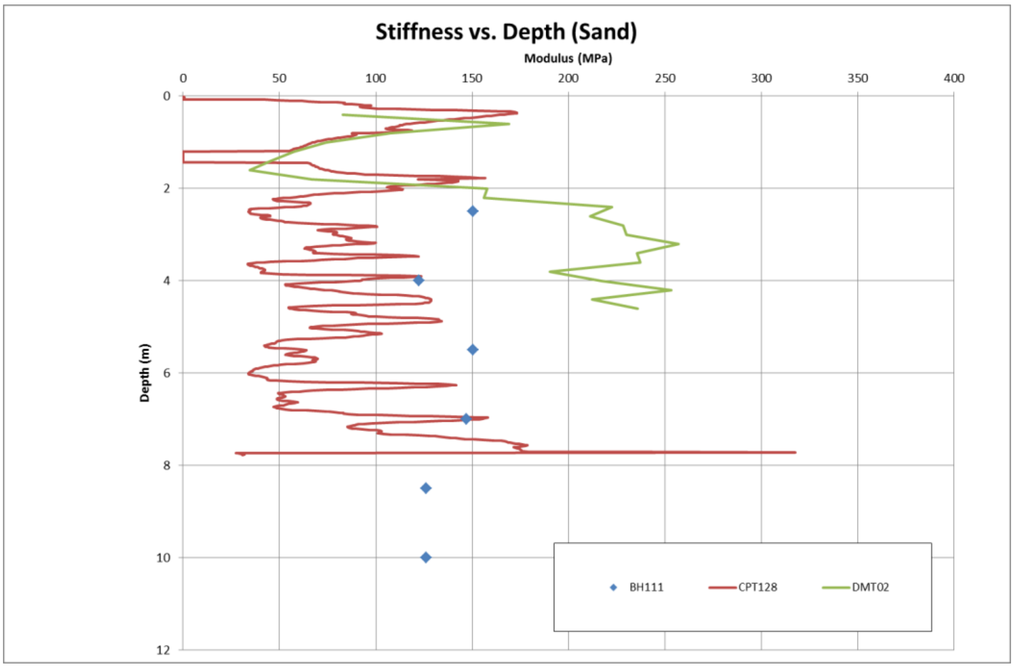


Figure 15: Stiffness vs Depth Plot for BH111 / CPT128 / DMT02 (Unit 3A Sand Profile)

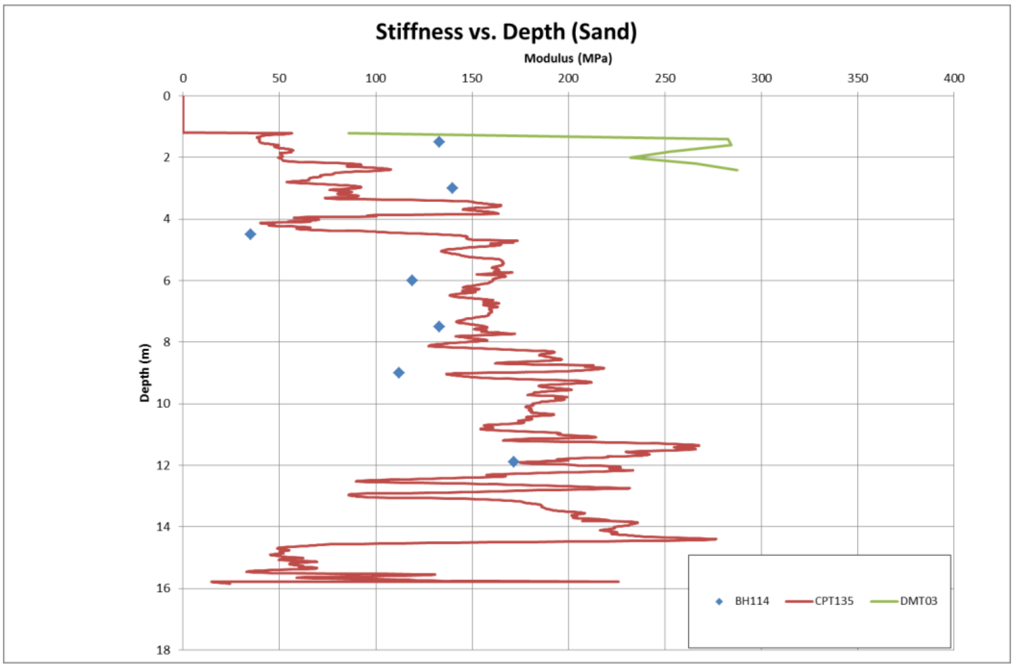


Figure 16: Stiffness vs Depth Plot for BH114 / CPT135 / DMT03 (Unit 3A Sand Profile)

4.4 Geotechnical Engineering Parameters

Design parameters are nominated in Table 9, below.

4.5 Geotechnical design parameters

Table 9: Design Parameters

Unit	Description	Moist Unit Weight γ (kN/m^3)	*Undrained Strength*		*Drained Strength*		Undrained Modulus E_u (MPa)	Drained Modulus E'_s (MPa)	Poisson's Ratio v'	At-rest coefficient K_0 [1,2,3,4]	Active Earth Pressure Coefficient K_a [1,2,3,5]	Passive Earth Pressure Coefficient K_p [1,3,5]	Overconsolidation Ratio OCR	Serviceability End Bearing Pressure (kPa) [6,7]	Ultimate End Bearing Pressure (kPa) (rock only)	Ultimate Shaft Adhesion (kPa) [6, 7]
			Su (kPa)	Φ_u (°)	c' (kPa)	Φ' (°)										
1A	Topsoil	16	N/A	N/A	0	25	NA	5	0.3	0.5	0.5	2.2	N/A	N/A	N/A	N/A
1B	Anthropogenic Fill	17	NA	NA	0	28	N/A	5	0.3	0.6	0.4	2.5	N/A	N/A	N/A	N/A
1C	Granular Fill	18	N/A	N/A	0	32	N/A	15	0.3	0.5	0.3	3.2	N/A	N/A	N/A	N/A
1D	Cohesive Fill	18	75	0	0	25	15	10	0.3	0.5	0.5	2.2	N/A	N/A	N/A	N/A
2A	Loose Sand	18	N/A	N/A	0	30	N/A	10	0.3	0.5	0.3	3	N/A	N/A	N/A	N/A
2B	Firm Clay	18	30	0	0	23	7	5	0.3	0.6	0.5	2	N/A	N/A	N/A	N/A
3A	Dense Sand	20	N/A	N/A	0	38	N/A	100	0.3	0.7	0.25	4	N/A	300Z (Max 2,500)	N/A	4Z (Max 60, bored) 8Z (Max 120, driven)
3B	Very Stiff Clay	20	150	0	5	28	55	40	0.3	1.2	0.3	2.8	3	200 (shallow footing) 400 (pile footings)	N/A	75
4A	Residual Shale Soil	20	150	0	5	28	40	40	0.3	1.2	0.3	2.8	3	400 (pile footings)	N/A	75
4B	Extremely Low to Low Strength Shale	22	N/A	N/A	25	35	N/A	150 to 500	0.25	1.2	0.2	4	N/A	700 to 1,500	1,500 to 3,000	100 to 300
4C	Shale of medium strength or higher	24	N/A	N/A	50	40	N/A	500 to 1,000	0.2	-	-	-	N/A	4,000 to 8,000	10,000 to 20,000	300 to 1,000
5A	Residual Sandstone Soil	20	150	0	5	28	40	40	0.3	1.2	0.3	2.8	3	400 (pile footings)	N/A	75
5B	Very Low to Low Strength Sandstone	22	N/A	N/A	50	35	N/A	200 to 600	0.25	1.2	0.2	-5	N/A	1,000 to 1,500	3,000 to 5,000	300 to 500
5C	Sandstone of medium strength or higher	24	N/A	N/A	100	42	N/A	600 to 2,000	0.2	-	-	-	N/A	8,000 to 12,000	20,000 to 50,000	300 to 2,000

The following notes should be considered when using these parameters:

1) All values of K assume level ground above the wall. Higher coefficients would apply where the ground surface slopes above the wall, or alternatively this should be modelled as a surcharge load.
2) Appropriate vehicle/structural surcharge pressures should be added to the above earth pressures.
3) Appropriate water pressures should be added unless effective drainage at the rear of the wall is provided.
4) K_0 values are appropriate for rigid wall design; lower values may apply on consideration of wall movements and development of partial or full active pressures. Design tools should be used that allow for modelling of staged excavation processes and stress relaxation. Where design methods do not account for this, alternative pressure envelopes are suggested in Figure 16, below for propped/anchored retaining systems (refer to Figure E5 of AS4678 for further information). Water pressures and appropriate vehicle / surcharge pressures would need to be added to the earth pressure design profiles in Figure 16, below.
5) Active and passive earth pressure coefficients based on Caquot and Kerisel, 1948, assuming zero soil / wall friction, as the wall is to be designed for no or negligible wall movement. Golder note that generally 0.1%H to 0.4%H movement (4 to 16 mm for a 4m wall) is required to develop active pressures, but that 5 to 10%H movement (200 mm to 400 mm for a 4 m wall) is required to develop full passive pressures. The stability and serviceability performance of walls should both be assessed.
6) Preliminary geotechnical design parameters for piles are summarised in Table 9 below, including serviceability and ultimate limit state end bearing and ultimate limit state shaft resistance.
7) The geotechnical reduction factor ϕ_g to be applied to the ultimate capacities will depend on the foundation type, structural redundancy and level of testing proposed, in accordance with Australian Standard AS2159 (2009). Higher load capacities may be able to be adopted if a limit state approach is adopted and settlements calculated using higher end pressures and shaft adhesion values are found to be acceptable. Trial piles and/or pile testing may be necessary to justify adoption of high ϕ_g factors and/or higher design parameters than suggested in Table 9.
8) Soil properties are derived from typical values, based on laboratory classification of the soils encountered during borehole excavations, the in-situ tests (SPT N values and CPT results) and engineering judgement.

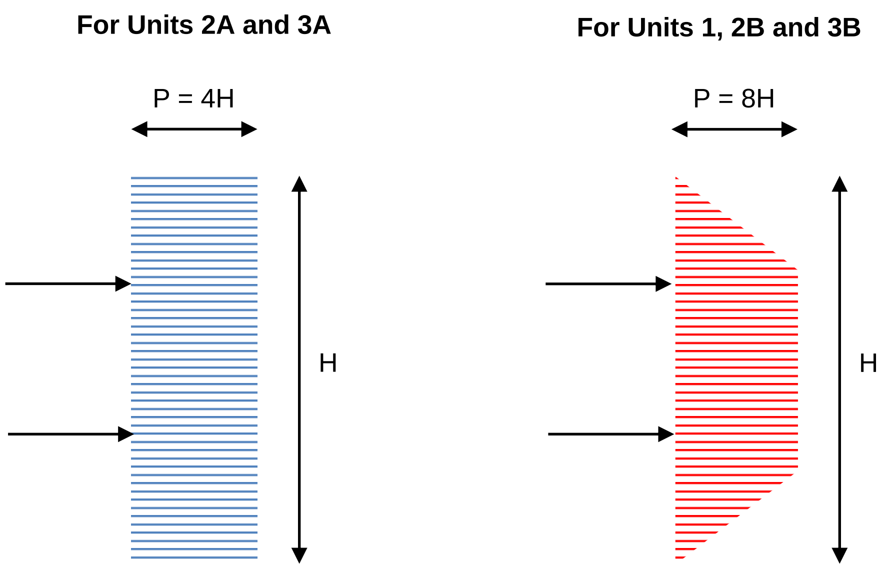


Figure 17: Alternative Earth Pressure Envelopes

4.6 Soil, Rock and Water Aggressivity to Concrete and Steel

The laboratory test results for aggressivity testing were compared with the guidelines for durability presented in Tables 6.4.2 (C) and 6.5.2 (C) of AS 2159-2009 *Piling – Design and Installation*. A summary of the aggressivity exposure classification for the soil is presented in Table 10.

Table 10: Aggressivity Exposure Classification

Sample ID	Exposure Classification			
	For Concrete Piles		For Steel Piles	
	Above Groundwater	Below Groundwater	Above Groundwater	Below Groundwater
BH111 0.3-2m (Unit 1C)	Non-aggressive	Mild	Non-aggressive	
BH111 8.5-8.95m (Unit 3A)	Mild	Moderate	Non-aggressive	Mild
BH101 1.5-1.95m (Unit 3B)	Mild	Moderate	Non-aggressive	Mild
BH107 0.20-0.35m (Unit 1C)	Non-aggressive	Mild	Non-aggressive	
BH109 7.50-7.95m (Unit 3B)	Non-aggressive	Mild	Mild	Moderate
BH109 10.50-10.95m (Unit 3B)	Mild	Moderate	Moderate	Severe
BH110 0.65-0.95m (Unit 1C)	Mild	Moderate	Non-aggressive	Mild
BH112 0.07-0.60m (Unit 1C)	Mild	Moderate	Non-aggressive	
BH112 1.50-1.95m (Unit 3B)	Non-aggressive	Mild	Non-aggressive	Mild
BHBF 0.00-0.30m (Unit 1C)	Mild	Moderate	Non-aggressive	
BHBI 0.30-1.0m (Unit 1C)	Mild	Moderate	Non-aggressive	
BH114 6.00-6.45m (Unit 3A)	Mild	Moderate	Non-aggressive	Mild
BH114 14.90-15.21m (Unit 3A)	Mild	Moderate	Non-aggressive	Mild
GA-TP-3102_002 (Unit 3A)	Non-aggressive	Mild	Non-aggressive	
GA-TP-3104_03 (Unit 1B)	Non-aggressive	Mild	Non-aggressive	
GA-TP-3106_001 (Unit 1C)	Non-aggressive	Mild	Non-aggressive	
GA-TP-3107_02 (Unit 3A)	Non-aggressive	Mild	Non-aggressive	
GA-TP-3111_03 (Unit 1C)	Non-aggressive	Mild	Non-aggressive	
GA-TP-3112_01 (Unit 1B)	Non-aggressive	Mild	Non-aggressive	
GA-TP-3118_003 (Unit 3B)	Non-aggressive	Mild	Non-aggressive	
GA-TP-3120_002 (Unit 1B)	Non-aggressive	Mild	Non-aggressive	

In general, exposure classifications for the site above groundwater level are non-aggressive to mild for concrete and steel piles. Below the groundwater table, exposure conditions are more severe, with moderate exposure conditions for concrete piles and mild to severe exposure conditions for steel piles.

The soil exposure classification for both concrete and steel piles is governed by acidic pH values. These findings appear consistent with groundwater monitoring results and the potential for acid generation in the soils. Refer to the ESAR (Golder, 2015b) for further discussion of this.

4.7 Earthquake Parameters

4.7.1 Design Earthquake (PGA)

The subsurface profile generally comprises very stiff / dense alluvial soils over bedrock. Based on AS1170.4 (Standards Australia, 2010) the following parameters are recommended for earthquake design:

- Probability Factor, k_p = 1.0 (assuming a 1 in 500 Annual Probability of Exceedance);
- Hazard Factor, Z = 0.08 for Sydney;
- Site Sub-soil Class = Ce (Shallow Soil Site).

4.7.2 Preliminary Liquefaction Assessment

Based on the generally dense nature of the granular soils on the site, we consider that there is a low risk of liquefaction being triggered under a 1 in 500 year AEP event.

4.8 Erodibility of Soil and Weathered Rock

Unit 1C and Unit 3B exhibited low to no dispersive potential during laboratory testing. Unit 4 and Unit 5 rocks are also typically non-dispersive. Re-moulding of Unit 4B and Unit 4C at a moisture content near optimum (i.e. excavation and re-compaction) does not increase potential for dispersive behavior, however further breakdown of the soil may occur, by water turbulence or concentrated rapid water flow. We therefore recommend that these materials not be exposed to concentrated water flow over or through the soil profile (e.g. by lining drainage channels).

5.0 EXCAVATIONS

5.1 Excavation Conditions

Temporary excavations will be required for the removal of existing redundant structures, services and unsuitable soils. Excavations up to 4 m deep may be required for installation of new drainage and sewer systems for the site.

The fill deposits on the site are generally up to 2 m deep. There may be localised site areas, possibly in in-filled former valleys or in areas with Unit 1B waste fill, where a greater excavation depth is required to remove unsuitable soils.

A conventional bulldozer or hydraulic excavator can be used to excavate the Unit 1 surficial soils. Removal of obstructions in the fill such as building foundations may require the assistance of a rock breaker.

If Unit 2 soils have to be removed, then a conventional bulldozer or hydraulic excavator should be able to excavate the material. Some pre-treatment or drying of the material may be required at the time of excavation to make the material easier to handle for re-use or disposal.

If excavations need to extend into the Unit 3 soils, iron cemented bands may be encountered at shallow depth. A rock breaker or a dozer with ripper may be needed to excavate through the iron cemented bands.

Emerson Crumb testing indicates relatively low erosion potential, but there are soils in the local area that have been eroded due to surface run-off. Where possible, topsoil and grassed areas should be left in place until construction works start.

5.2 Vibration

Care should be taken during excavation (and backfilling compaction) to limit the vibration impacts on new structures that may be built as a part of progressive staging of the development works. In addition, the potential vibrations from construction, such as driving piles, impact roller compaction or use of a hydraulic rock breaker may need to be considered with respect to buried services, nearby commercial, industrial, and residential properties. We recommend that the following measures are taken to assess and manage vibration risks:

- Carry out an assessment of the proximity of vibration sensitive structures to the site;
- Carry out dilapidation surveys on vibration sensitive structures before work commences and after work has been completed; and
- Prepare a vibration management plan setting limits on Peak Particle Velocity (PPV) and install, where required, monitoring systems to assess vibrations.

5.3 Groundwater

Groundwater beneath the MPW site area was about 8 to 12 m below the existing ground levels at the time of the geotechnical investigation, which is deeper than the expected depth of excavations.

However, higher water levels were encountered in the vicinity of established ponds on the site (e.g. 0.8m below surface at GA-BH-3102 and 2.8m below surface at GA-TP-3112). Relatively higher groundwater was also encountered in the vicinity of Anzac Creek at GA-CPT-3116, where groundwater was recorded at approximately 2m below ground level.

Groundwater is likely to be encountered within the depth of bored piles, if used (see Chapter 8.3.2).

Groundwater monitoring was carried out by PB (PB, 2011) and a monitoring round was completed by Golder (Golder 2015b). The results of the PB groundwater monitoring indicated the groundwater within the alluvial soils generally flows westwards towards the Georges River with groundwater levels recorded in 2011 of between RL6mAHD and RL2mAHD. These results are consistent with the results of the Golder monitoring.

As the alluvial soils on the site contain granular horizons, there may be seasonally elevated perched water tables in fill materials and sand layers. These perched water systems could impact retaining walls, excavations for slopes and foundations. Elevated or perched groundwater levels are also expected in the vicinity of established ponds on the MPW site. Perched groundwater inflows could potentially lead to softening of natural alluvial clays in footing excavations, so concrete for footings should be placed as soon as practicable. Potential for perched groundwater should be considered in the design of slopes and retaining walls and control measures such as sump pumping may be required during construction.

5.4 Surface Water Management

Management of surface water will be required during earthworks. Management methods to limit impacts of water on the proposed excavation may include:

- Diverting surface water flows away from excavations; and
- Using sediment controls and pumping from excavation sumps to manage inflows from rainfall, local surface water runoff and seepages from the face of cut slopes.

5.5 Excavation Support Requirements

Recommendations on suitable batter slopes are provided in Chapter 6.7. In areas of the site where excavation induced movements must be kept as low as practical (i.e. to protect existing or new structures and services), or insufficient space exists to accommodate batter slopes the following temporary retention options may be considered:

- Proprietary shoring systems (i.e. hydraulic trench boxes or shoring systems); or
- Anchored/braced sheet pile walls (achieving toe embedment with these walls may require pre-boring if iron cemented layers are encountered).

In areas where permanent structures are required (for example deep pumping stations), the following options could be considered:

- Anchored/braced reinforced concrete contiguous pile walls; or
- Anchored/braced reinforced concrete soldier pile walls with shotcrete infill panels.

Cantilevered sheet pile wall options may be problematic due to uncertainty of achieving toe embedment due to iron cemented layers within Unit 3 soils. For this reason, contiguous bored concrete walls or shallower braced or anchored sheet pile solutions may be preferred. For rigid/propped walls, we recommend adopting at-rest (K_0) pressure coefficients provided in Table 9, above.

However, other retention options such as gravity wall, soil nailing or cantilevered concrete pile wall options could be considered. The appropriateness of such systems will depend on the details of the area to be retained and performance, aesthetic and maintenance requirements.

The earth pressure envelopes shown in Figure 17 assume that effective drainage is provided at the base of, and behind the retaining walls. If this cannot be provided, allowance for hydrostatic pressure should also be included. Any applicable temporary surcharges should be added to the soil pressures, using the values nominated, as appropriate to the permitted deformation condition.

The excavation contractor should undertake a risk assessment for buried services and take appropriate steps to mitigate adverse impacts as appropriate to the excavation geometry and support method adopted.

6.0 EARTHWORKS

Earthworks should be carried out in accordance with AS3798-2007, “Guidelines on Earthworks for Commercial and Residential Developments”, the recommendations in this report and a site specific Earthworks Specification.

Based on our current understanding of performance requirements for warehouses and pavements, there will be a need to provide an Earthworks Platform to the underside of pavement/warehouse slabs and foundations. The need for a layer of engineered Structural Fill (ripped or crushed sandstone) below warehouse slabs and footings is discussed in Chapter 8.0.

There is an opportunity for re-use of site won material as General Fill (i.e. engineered fill below the Structural Fill layer) and this is discussed in Chapter 6.2 and 6.3.

Dependent on the final performance requirements adopted for detail design, it may also be possible to leave some of the relatively low organic content topsoil layer in place as discussed in Chapter 6.3.

6.1 Stripping of Unsuitable Material

Prior to placing new fill materials, the existing Unit 1A topsoil should be stripped from the surface of the site, in accordance with a site specific Earthworks Specification (which may provide for assessment and further sub-division of Unit 1A for foundation preparation purposes). Subject to assessment of suitability from a contamination viewpoint, stripped topsoil should be stockpiled for reuse in landscaped areas of the site.

Based on the recorded properties of Unit 1A, opportunity exists for incorporation of the lower topsoil in General Fill, subject to UXO/EOW and contamination considerations and a sufficiently low final organic content being achievable. With appropriate blending a high proportion of the topsoil encountered (excluding the surficial layer comprising a high proportion of vegetative matter, such as the root mat for areas of turf) should be able to be re-used as General Fill, subject to the performance requirements of overlying development and the heights of filling required.

Unit 1B anthropogenic fill should be managed in accordance with the Remediation Action Plan (RAP).

The extent to which the topsoil and anthropogenic fill is removed should be undertaken in consideration of the performance requirements of the area and the nature of the topsoil and anthropogenic fill in that area.

Alternative options for areas containing anthropogenic fill include:

- Excavating, sorting and then re-using the Unit 1B as fill material.
- Excavating and replacing the Unit 1B material, with excavated 1B material either:
  - re-used on site below landscaped areas of the site.
  - disposed off site.
- Improving the Unit 1B material *in-situ*, using methods such as high energy impaction compaction.

Development of the above options will require consideration of contamination issues and geotechnical issues, as the best geotechnical solution may not be preferred due to contamination constraints.

It is anticipated that the main areas where unsuitable material requiring treatment or removal and replacement will be at or in the immediate vicinity of anthropogenic ‘hotspots’ and established ponds.

6.2 Existing Fill Materials

The fill encountered during investigation of the MPW Stage 2 site was found to typically be about 0.5 m to 1.2 m thick, comprising mainly sand or clayey sand. It is possible that deeper fill, with poorer compaction, is present locally. Locally at anthropogenic ‘hotspots’ fill up to approximately 5m deep was encountered.

The history of placement of the existing fill is not known, and we do not know if it was placed as engineered fill in accordance with an engineering specification. There is some uncertainty as to how the fill might behave under the additional load of new fill plus floor or pavement loads, and whether adverse total and differential settlements could occur that would damage the floor slabs and pavements.

Most of the existing fill encountered on site is mainly granular (sandy). From a geotechnical perspective, the fill would be suitable for reuse as General Fill provided it is moisture conditioned and sorted to remove unsuitable, oversize and deleterious inclusions. Unsuitable materials that should not be used as General Fill include:

- Topsoil and silt;
- Fill which contains wood, metal, plastic, boulders, ash, decaying vegetation and other deleterious substances; or
- Rock fragments or boulders greater than about 200 mm across (or more than ⅔ of the intended compacted layer thickness).

Where Unit 1C fill needs to be excavated to level sections of the site, it could potentially be reused on site as General fill to refill areas that have been excavated (for example old pond areas or areas where Unit 1B fill has been removed). Additional testing and screening of this material may be required on site during construction to comply with the Earthworks Specification.

6.3 Management of Existing Fill Materials

It is noted that in areas of proposed filling, the impact of the underlying existing fill could be mitigated by the thickness of the new fill above. For example, where the thickness of overlying Structural Fill is such that loading is carried substantially within the new fill. However, such benefits would need to be considered in light of the specific design details (e.g. pavement, warehouse slab and foundation requirements, including footing width and depth).

With respect to Unit 1C (and 1D material where encountered), due to its shallow and moderate, but variably compacted nature, the opportunity exists to leave this material in place, where adequate thickness (and quality) of overlying fill can be provided. This would be subject to adequate compaction being achieved and zones of unsuitable material being identified and treated. Management in accordance with a site specific Earthworks Specification would be necessary. The Earthworks Specification must include a means for assessing and treating the foundation to overlying fill for adequacy. Different methods of verification and/or improvement of the existing fill that could be adopted alone or in combination to limit the risk of adverse settlements arising from leaving the existing fill in-situ include:

1) Excavation and replacement of some or all of the existing fill in accordance with an engineering specification. This would be the lowest risk option.

2) As an alternative to excavate and replace, and if further geotechnical investigation indicates it is viable, and compatible, soil improvement using conventional or High Energy Impact Compaction (HEIC). HEIC has the benefit of being able to compact soils to greater thickness than conventional rollers. In our experience compaction to at least 2 m depth should be feasible. A variety of methods could be used to verify the effectiveness of the compaction, including Dynamic Cone Penetrometer, CPT, and geophysical methods.

Unit 1C (and 1D material where encountered) presents an opportunity for re-use as General Fill. This would be subject to meeting the requirements of the Earthworks Specification and UXO/EOW and contamination considerations.

The need for a high quality Structural Fill layer below areas of new development to satisfy that performance criteria of Chapter 4.2 is discussed in Chapter 8.0 below. Within the areas proposed for excavation and the depth ranges envisaged material appropriate for use as Structural Fill to meet the performance criteria of Chapter 4.2 is not anticipated to be available from site won material.

Based on our current understanding of design earthworks levels (Arcadis, 2016a) sufficient volume exists within the areas of filling to accommodate the full volume of excavated material from cut areas whilst still maintaining allowance for an overlying Structural Fill layer.

Prior to placing new fill materials, the existing Unit 1A topsoil, or portion(s) thereof, should be stripped from the surface of the site in accordance with a site specific Earthworks Specification and Unit 1B fill should be treated or removed as required by the RAP and Earthworks Specification. Topsoil should be stockpiled for reuse in landscaped areas of the site where contamination considerations allow. As discussed in Chapter 6.1, an opportunity exists for re-use of lower topsoil layers as General Fill, subject to adequate blending to achieve acceptable organic content and conformance with the Earthworks Specification.

Typically topsoil will need to be removed. However, it may be possible to leave some of the lower organic content sandy topsoil in place (once stripped of surficial vegetative matter). This would only be possible where a sufficiently thick Structural Fill Earthworks Platform can be provided above to the underside of warehouse slabs/footings or pavements. The required thickness of the Structural Fill Earthworks Platform would be dependent on detail design performance requirements for the overlying development, however this layer could potentially be 1.2m thick. Such an approach would require careful consideration and development of an appropriate methodology, likely incorporating HEIC in accordance with item 2 above, in order to sufficiently compact underlying strata and identify zones of poor material which may require special treatment or removal and replacement.

Development of the above options will require consideration of contamination issues and geotechnical issues, as the preferred geotechnical solution may not be possible due to contamination constraints.

6.4 Imported Fill Materials

Imported fill may comprise a range of materials, including sand, gravel, crushed or ripped sandstone, crushed or ripped shale. Depending on the timing of construction on the site, large quantities of sandstone may be available from currently active tunnelling projects in the Sydney metropolitan area. If tunnel spoil is to be used, then it may not require crushing, possibly only screening to remove large rocks. We understand that on previous projects, fresh sandstone spoil from the Cross City Tunnel was placed directly into reinforced soil walls from trucks without screening or moisture conditioning.

Sandstone and shale are typically used as fill materials in Sydney, as they are widely available. Usually the type of fill that is used depends on availability at the time of construction, and the constraints placed on fill types in the design. As discussed later in the report, the geotechnical analyses presented in this report have been developed on the basis that a layer of sandstone fill would be used.

Depending on the materials available at the time of construction, it may be worth considering using a specification that allows the potential of reusing recycled aggregates. These could either be sourced from demolition works in the Sydney area, or potentially from demolishing and processing the current construction materials on the MPW site, from buildings, slabs and pavements. An earthworks specification for such materials is available to download from the following link:

http://www.environment.nsw.gov.au/resources/warr/104SupplyofRecycledMaterial.pdf.

Some older road pavement materials may need to be tested for the presence of coal tar prior to acceptance for reuse.

Unsuitable materials that should not be used as engineered fill include:

- Topsoil and silt;
- Fill which contains wood, metal, plastic, boulders, ash, decaying vegetation and other deleterious substances; or
- Rock fragments or boulders greater than about 200 mm across (or more than ⅔ of the intended compacted layer thickness).

6.5 Proof Rolling and Compaction of Fill

New fill beneath structures (including pavements) should be compacted to be equivalent to a minimum Standard Maximum Dry Density (SMDD) of 98% (AS1289.5.1.1-2003) at a moisture ratio of 60% to 90% of Standard Optimum Moisture Content (SOMC). The upper 600 mm below floor slabs of warehouses should be compacted to 100% SMDD and should be crushed sandstone or similar. This is to provide a suitable subgrade and drainage layer beneath for floor slabs and to support heavy equipment loads during construction and in operation. We note that sandstone spoil can have a tight compaction curve and moisture contents above optimum can lead to heaving in the sandstone layers, this should be considered when developing an earthworks specification for the site, tighter moisture conditioning requirements may be required for some materials.

Two methods of compaction that could be considered are:

- Conventional compaction in layers using a static or dynamic roller;
- Dynamic impact roller (high energy impact compaction) could be feasible given the size of the site. The use of this method would become more efficient the larger the area to be compacted.

Conventional compaction would follow the process described in AS3798-2007. After removal of topsoil and treatment of the subgrade (as described in Chapter 6.1 above), new fill should be placed and compacted, with a maximum loose lift thickness of 300 mm, except the upper 600 mm below warehouse floor slabs, which should be 150 mm loose lift thickness. In proposed fill areas where the existing slopes are steeper than 1V:8H the fill should be keyed-in by excavating horizontal benches on which the fill should be placed.

Conventional compaction should be carried out in the full time presence of a Geotechnical Inspection and Testing authority (GITA) in accordance with the requirements for Level 1 supervision described in AS3798-2007. AS3798-2007 also sets out the minimum requirements for field density and compaction control testing. The GITA should be appointed by the earthworks contractor and be responsible for carrying out the required testing. The GITA should be audited on a regular basis by the geotechnical design consultant.

Dynamic impact roller compaction, also known as High Energy Impact Compaction (HEIC), has the potential to achieve compaction of thicker layers than under conventional compaction. From our experience of HEIC, a compaction trial, completed prior to main site compaction works can help to select the most appropriate plant and compaction methodology for the site, as this will depend on factors that predominantly vary between sites. Generally, dynamic impact rolling is most effective in soils with low fines content (sandy soils), as the effective depth of the compaction is reduced where the fines content increases. The objective on this site would be to develop a methodology to compact fill thicknesses of say up to about 1 m, subject to verification of trial pads.

For efficiency, it may be possible to reduce the frequency of standard earthworks testing regimes, if augmented, by a combination of other testing methods, such as geophysical methods, CPT testing, plate loading tests or Falling Weight Deflectometer testing. A compaction trial could be used to assess or correlate these methods and the most efficient layer thicknesses for placement of fill. Dynamic Impact Compaction should be carried out in the full time presence of the geotechnical design consultant responsible for the earthworks specification for the site.

Conventional compaction equipment (large vibratory smooth drum rollers) may be required to complete the final surface compaction below floor slabs to achieve level control and a uniform surface prior to pouring floor slabs.

6.6 Bulking Factors

We suggest selecting values from Table 11, which are based on a combination of published values and experience with local materials.

Table 11: Suggested Bulking / Compaction Factors

Unit [1]	Geological Origin	Predominant Material Type/ Rock Weathering Condition	Consistency / Density / Inferred Strength	Volumetric Bulking Factor[2] (*in situ* to truck)	Volumetric Compaction Factor[2] (*in situ* to re-compacted)
2 and 3	Quaternary Alluvium, Fill	Cohesive / granular	Mainly Firm to Stiff / loose to dense	1.1-1.3	0.9-1.1
4A	Residual Soil	Mainly Cohesive/ fine grained	Stiff to Hard	1.2-1.4	1.0-1.2
4B and 4C	Mainly Siltstone/ laminite	Ext. to Highly Weathered	Extremely Low to Low Strength	1.3	1.1-1.2
		Mod. Weathered to Fresh	Mostly Medium to High Strength	1.3-1.4	1.1-1.2
5B and 5C	Sandstone	Ext. to Highly Weathered	Extremely Low to Low Strength	1.3	1.1-1.2
		Mod. Weathered to Fresh	Mostly Medium to High Strength	1.5	1.2-1.3

Notes:

1. Excludes fill materials, for which bulking factor is uncertain due to intrinsic variability.
2. Based on estimated values published in McNally (1998).

No bulking factor tests were carried out in materials sampled from site. The bulking factor is the ratio of in situ density of soil or rock against its dry density following excavation or compaction. A bulking factor of less than 1 implies that the insitu dry density of the material is less than the re-compacted material. This generally applies to soil materials as modern compaction plant often compacts soil to a density in excess of that at which it occurs in the natural state. Under this circumstance, we have referred to this as a “compaction” factor in Table 11.

A bulking factor of greater than 1 implies that the insitu dry density of the material is greater than the re-compacted material; which generally occurs for many rocks.

Given the lack of site specific data, we recommend that base case values in the mid-range of the above bulking / compaction factors are adopted along with sensitivity analyses within the range of suggested values above. When considering earthworks volumes, appropriate allowance should also be made for wastage due to unsuitable material, fill rejection, embankment overfilling and haul road construction.

6.7 Cut and Fill Batter Slopes

In accordance with Chapter 1.1, we understand that existing structures on the site will be demolished and removed as part of the Early Works. Dependent on the staging of the works, excavations close to existing and new structures will need to be designed to control ground movements, and may require installation of a rigid shoring/retaining system, prior to excavation commencing.

Alternatively, where space allows, the excavation may be formed using battered side slopes, see Chapter 6.7, below, but these are only recommended in areas that do not have nearby movement sensitive structures or services.

Table 12: Recommended Batter Slopes (excavations / slopes up to 3 m)

Unit	Material	Permanent Batter Slope	Temporary Batter Slope
Units 1, 2, 3A	Fill and Recent Alluvial Soil	1(v):2(h)	1(v):1.5(h)
Unit 3B	Older Alluvium	1(v):2(h)	1(v):1(h)
Units 4 and 5	Shale and Sandstone	N/A	N/A

Surcharge loads (including site traffic loads and spoil) should be kept well away from the excavation crest (i.e. a distance equal to the depth excavation).

If slopes other than those in Table 12 are to be used, or higher slopes are planned, then additional slope stability assessments should be completed. Limit-equilibrium analysis (using software program Slope/W or similar) could be used to assess the stability of the slope and any vehicles, plant or structures at the crest of the slope.

6.8 Structures for Stormwater Detention Ponds

Embankments or bunds for stormwater detention ponds, if required, could be constructed to form the detention areas using site–won or imported materials. We expect that ponds would need to be lined because the on-site soil materials that could be used as fill sources generally include granular seams/layers and have some dispersive potential. However, with appropriate design and detailing based on consideration of the characteristics of the particular material to be used and construction methodologies adopted (potentially including zoned construction) it may be possible to form detention ponds utilising site won material.

Geotechnical design of embankments for detention ponds would be required. The design would need to include recommendations on the maintenance and inspection requirements during operation. An assessment should be made upon the suitability of the design parameters of Table 9 above for use in design calculations (such as stability analysis), once the location, extent and details of the detail design for the detention ponds is available (including the particular materials to be used for the embankment construction). Such an assessment will need to be undertaken by a suitably qualified geotechnical engineer in consideration of the likely variability of foundation and construction materials and the potential need for additional investigation and testing.

7.0 PAVEMENTS

Internal access roads on the site are proposed to carry several thousand fully loaded B-double vehicles per day. Pavement thickness will be heavily influenced by the number of truck movements experienced during the life of the pavement and its subgrade condition. To assist in pricing of various pavement configurations, we have carried out preliminary pavement thickness designs using the following parameters and assumptions:

- Subgrade conditions based on a soaked CBR value of 3%, which is the average subgrade CBR value obtained from laboratory tests. Adopting the average subgrade CBR strength implies that there is a 50% probability that subgrade is weaker or stronger than assumed. A lower design CBR value may need to be considered during detail design to reduce the likelihood of early pavement failure and improve design reliability. Based on the limited laboratory test results available to date on the Unit 3B material, a design subgrade CBR of 2% would reduce the risk of early pavement failure from 50% to 10%.
- We have considered the effect on pavement thickness for a subgrade CBR value of 10% reflecting improved subgrade strength in areas of imported granular fill. For this increased subgrade CBR value to apply, the granular fill should be at least 600 mm thick.
- The suggested number of daily truck passes will result in a high number of design axle repetitions. A review of whole of site traffic movements will allow refinement of vehicle passes and design axle repetitions and optimisation of pavement thickness design.
- We have considered a pavement design life of 10, 15 or 20 years. For this site, once more information is known on vehicle movements, a design life of 30 years may need to be considered.
- We have considered two different pavement profile types, as follows:
  - Fully flexible pavement with thin asphalt surfacing (non-structural wearing course) and granular base and sub-base. This option has lower capital cost but higher maintenance costs for the wearing surface.
  - A thick asphaltic concrete pavement with cement stabilised base and granular sub-base. This option has higher capital cost but lower maintenance costs.

7.1 Design Traffic Calculation

Preliminary design traffic calculations have been carried out based on the following:

- 6000 B-double truck passes per day and no growth rate per year on the number of vehicle passes. All trucks are assumed to be travelling fully loaded, in one direction within one lane.
- B-double axle configuration comprising one 6 tonne single axle with single wheels (SAST), a 16.5 tonne tandem axle with dual wheels (TADT) and two 20 tonne triple axles with dual wheels (TRDT).

It is noted that the above assumptions are understood to be reflective of a high level ultimate precinct external traffic trip estimate. As such those numbers may be greater than the final detail design stage traffic volume calculated for and appropriate for use in detail design of pavements within the MPW precinct itself.

Using the Austroads Guide to Pavement Technology (2012), the following table summarises design axle repetitions for design life of 10, 15 and 20 years considering the two pavement options outlined above.

Table 13: Summary of Design Axle Repetitions

Design Life	10 years	15 years	20 years
Design ESA for Empirical Design	1.3×10^8	1.9×10^8	2.5×10^8
Design SAR_7 for Subgrade Failure,	1.4×10^8	2.1×10^8	2.8×10^8
Design SAR_5 for Asphalt Fatigue,	1.8×10^8	2.8×10^8	3.7×10^8

Design Life	10 years	15 years	20 years
Design SAR_{12} for Cracking of Cemented materials	$3.9x10^8$	$5.9x10^8$	$7.8x10^8$

7.2 Preliminary Pavement Thickness Design

Based on the design traffic summarised above we have carried out a number of mechanistic pavement design analyses using the commercially available pavement design software CIRCLY. Table 14 and Table 15 below summarise the results of these analyses as preliminary options for pavement thickness design. Pavement materials considered in preliminary analysis included:

- Unbound gravel layers (base and sub-base layers) with young's moduli values ranging from 150 MPa to 500 MPa
- Asphalt with a young's modulus of 2,000 MPa
- Heavily bound cemented sub-base with a young's modulus of 5,000 MPa.
- Subgrade of CBR 3% or CBR 10%.

Table 14: Summary of Preliminary Pavement Thickness Design – Subgrade CBR 3%

	Layer Thickness (mm) for Subgrade CBR 3%				Total Pavement Thickness (mm)
Design Life	Full Depth Granular	Structural Asphalt	Cemented Base	Granular Subbase	
10 years	730	-	-	-	730
	-	250	200	300	750
15 years	750	-	-	-	750
	-	250	200	450	900
20 years	770	-	-	-	770
	-	250	200	600	1,050

Table 15: Summary of Preliminary Pavement Thickness Design – Subgrade CBR 10%

	Layer Thickness (mm) for Subgrade CBR 10%				Total Pavement Thickness (mm)
Design Life	Full Depth Granular	Structural Asphalt	Cemented Base	Granular Subbase	
10 years	420	-	-	-	420
	-	175	200	150	525
15 years	435	-	-		435
	-	185	200	150	535
20 years	450	-	-	-	450
	-	190	200	200	590

7.3 Other Considerations

Consideration would need to be given to stabilisation (e.g. by lime or cement) of the upper 300 mm of subgrade in areas where a CBR of 3% or less is anticipated. This will improve moisture stability of the subgrade and improve pavement performance.

Where pavement is constructed on Unit 3B material, which is expansive, an effective subsurface drainage system will be required. The subgrade should also be graded in such a way to minimise ponding of water and to allow the water to migrate to the outer edge of the pavement where it can be removed by the subsurface drainage system. This subsurface drainage system should be constructed parallel and along the edge/s of the pavement.

The pavement should be finished with suitable cross-fall and adequate surface drainage to minimise ponding on the surface of the pavement.

All pavement materials should satisfy RMS requirements, in particular, Specification QA3051. For the full depth granular pavement, the upper base layer should be a minimum of 200 mm. The materials should be compacted in loose layers not more than 150 mm or less than 100 mm at 100% Modified Maximum Dry Density (MMDD) in accordance with RMS Specification R71.

7.4 Container Terminal Areas

Designers of future container terminal should use laboratory testing results in this report and the GDR (Golder 2016a) to assess appropriate design CBR values. The selection of design values should also take into account additional fill materials imported to raise ground levels to underside of pavement materials.

8.0 STRUCTURAL FOOTINGS

8.1 Site Classification

The advice below is based on the current proposed site arrangement. Due to the variability in soils below the site, the site classification should be considered for each separate development area of the site and additional testing at each lot may be required, depending on the final locations of structures.

Most of the proposed development will comprise commercial buildings. Advice on site classification has been provided in this report with reference to AS2870, the scope of which covers industrial and commercial buildings of similar scale to residential properties. Specific assessment of appropriate investigation and testing densities and methods will be required once the area, extent and articulation characteristics of slabs and footings are further developed. The minimum number of exploration positions nominated within Clause 2.4.4 of AS2870 will be inadequate for warehouse slabs of the scale contemplated for the MPW Project. Accordingly, in lieu of detailed investigation and assessment, the most conservative (i.e. greatest shrink-swell potential) classification should be adopted from the available data.

8.1.1 Granular Soils

In areas of the site, where granular materials are present over the top 2 m below the final surface level of the site, a site classification of Class S is considered appropriate. This assumes that new granular Structural Fill comprising ripped or crushed sandstone is placed below structures to the surface of the granular material.

8.1.2 Cohesive Soils

AS2870 Table D2 indicates that Sydney sites underlain by clay soils greater than 1.8 m thick should be classified as Class H1 or H2. However, re-classification is possible with additional analysis to quantify the shrink/swell movements based on site specific material properties obtained through laboratory testing. Our initial calculations of shrink/swell movements using the method prescribed in AS2870 are discussed below.

The shrinkage index of samples tested ranged from 0.7 to 2.8. The testing was completed on tube samples and as it was difficult to retrieve samples within some of the very stiff / dense materials on the site, these results may be biased towards softer or more plastic soils.

Assuming that at least 1 m of Structural Fill comprising a ripped or crushed sandstone is provided below the level of warehouse floor slabs and foundations, and the fill is not susceptible to movement caused by moisture changes, we consider that a Class M classification is appropriate for the site.

Where lighter weight structures do not include a granular layer below floor slabs or foundations and they rest directly on natural cohesive soils, either additional testing should be completed at the site of the structure, or alternatively, they should be designed for a site classification of H1.

8.1.3 Uncontrolled Fill

Areas containing Unit 1B or 1C fill would be classified as Class P, requiring engineering measures such as ground improvement or foundations supported on underlying Unit 3 materials (to satisfy foundation performance requirements). Where foundations are supported on the underlying Unit 3 materials, consideration would need to be given to the character of the Unit 3 material in accordance with Chapters 8.1.1 and 8.1.2 to determine requirements. Depending on the selected engineering option chosen in these areas, they could potentially be reclassified if movements from engineered fill and underlying soils in response to long term equilibrium moisture conditions are assessed.

8.2 Lightweight Structures

It should be possible to found lightly loaded structures (i.e. single storey office buildings, small storage buildings, gatehouses etc.) that are not settlement sensitive on either piers or strip footings embedded in new engineered fill layers or directly on natural Unit 3A or 3B soils, if they can be designed to achieve bearing pressures of less than 100 kPa and accommodate anticipated surface movements in response to changes in soil moisture content in accordance with Chapter 8.1. We do not recommend supporting footings in the existing fill or Unit 2 clays or sand because of the risk of unacceptable total and differential settlements, unless the fill has been treated as described in Chapter 6.0, over the depth of influence below footings, so that it can be considered “engineered fill”. Footings should have a minimum embedment depth of 500 mm below finished ground level.

The base of footing excavations should be dry and free of debris and loosened soil. Concrete for shallow footings should be poured within 24 hours of excavating the footing.

8.3 Warehouse Foundations

We anticipate that column loads from the proposed warehouses will be high, depending on the chosen arrangement of columns within the structures. Based on our experience of design of similar sized structures, columns loads can range between 1,250 kN to 7,500 kN or higher. The viability of shallow footings to support columns will need to be assessed between geotechnical and structural designers during the detailed design phase.

8.3.1 Option 1 - Shallow Footings

For column loads at the lower end of the above range, it should be possible to found warehouse column footings at shallow depth in engineered fill, provided that there is an adequate thickness of Structural Fill beneath the base of footings, and provided the footing can be economically dimensioned to achieve bearing pressures no greater than 150 kPa. Where a footing has a width of ‘B’, there must be a thickness of Structural Fill (or in-situ Unit 3A or 3B materials) of at least 1.3B below the base of the footing. Depending on proposed levels, this may require some excavation of existing fill materials.

Alternatively, warehouse footings could be founded directly on Unit 3A or Unit 3B soils, following moisture conditioning and re-compaction of the uppermost 300mm below footings, and designed for allowable bearing pressures of less than 150 kPa, although this may result in footing excavations at least 2m deep to penetrate through new fill and the existing fill.

Footings should have a minimum embedment depth of 500 mm below finished ground level.

If serviceability or stability considerations cannot be met with shallow foundations, then some columns may need to be founded on piles (See Chapter 8.3.2).

8.3.2 Option 2 - Piled Foundations

Where it is not feasible to support column loads on shallow footings, piles will be required. In selecting piles for the proposed site, the view of piling contractors should be sought, as this will be useful in identifying the most appropriate system. In general, we consider that bored piles would be most appropriate for use on the site, given the presence of iron cemented bands within the Unit 3A and 3B soils. CPTs consistently refused on these layers, and this can be a good indicator of where driven precast concrete piles will also refuse. Bored piles should be able to penetrate these layers, however, piling contractors should be asked for advice about the most appropriate drilling methods to penetrate these layers.

If bored piles extend below the groundwater table (at about 9 to 12 m depth), they will likely need to be cased to prevent groundwater inflow and maintain wall stability prior to concreting. As discussed in Chapter 5.3 groundwater may be encountered at higher levels, particularly in the vicinity of Anzac Creek and established ponds. If piling is proposed in these areas precautions against groundwater inflows may be encountered at relatively shallow depths.

Depending on the magnitude of loading required, driven piles may be able to be used for some structures as the capacity achieved can be assessed immediately after the driving process. In general we consider that this would be a riskier option if uniform load-displacement behaviour is required from the piles (i.e. driven piles should be avoided for a piled raft) but they could be considered as an option for some structural columns. These pile types would likely refuse on iron cemented layers as discussed above, which could lead to different piles or piles groups resting at different levels, the design of the structure supported by driven piles would need to have the potential to accommodate this.

Continuous flight auger (CFA) piles could be a good option for the site, with either single piles or pile groups used, depending on the magnitude of column loads. CFA piles would avoid some of the issues that bored piles could face if high groundwater flows are experienced. Depending on column loads, floating piles founded in Unit 3A/3B may be possible. Alternatively, piles could be advanced into bedrock, with the achievable depths depending on the equipment being used and the experience of the piling contractor. CFA piles may be able to be advanced into Unit 4C shale and 5B sandstone, based on experience on recent projects. To accommodate higher column loads a pile group in soil could be used, but this would need to take into account potential reduced capacity, due to group effects.

The installation method for CFA piles requires elevated concrete pressures during concreting. This can lead to higher shaft and base resistances obtained being higher than those normally adopted for bored piles. This may be considered in pile design for the site, and should be verified by pile testing (PDA and CAPWAP).

Another option, depending on the magnitude of column loads required, would be to have a single larger diameter bored pile socketed into rock of medium strength or greater. As an initial example of potential capacity, a 1,000 mm diameter bored pile could have a working (serviceability) load of up to about 6 MN.

Consideration could be given to procuring piling works through a design and construct delivery model, as this often gives piling contractors the ability to innovate as well as take on a higher degree of risk for the installation and performance of the piles.

8.3.2.1 Pile Type Selection

In selecting suitable pile types for the site there are a range of advantages and disadvantages that need to be considered. We have summarised some of the site specific considerations in Table 16, below.

Table 16: Advantages and Disadvantages of Different Pile Types

Driven Piles (precast concrete)	
Advantage	**Disadvantage**
Ability to make visual observation of pile quality prior to installation	Risk of refusal on iron cemented bands
Cheap and readily available	Noise and vibration
	May adversely impact adjacent piles when driven in groups
Driven Piles (steel I-section)	
Advantage	**Disadvantage**
Greater penetration of cemented layers possible	Smaller section area for cost, compared with precast or bored piles
Driving equipment readily available	Noise and vibration during installation
Bored Piles (CFA)	
Advantage	**Disadvantage**
Greater penetration of cemented layers possible, depending on type of equipment	Cannot penetrate far into high strength rock, so lower capacities than bored piles
No casing, dewatering or cleaning required	Expensive relative to driven piles
Bored Piles (Open bored)	
Advantage	**Disadvantage**
Penetration of cemented layers possible	Temporary liners, dewatering and cleaning required
Potential to construct sockets into bedrock for higher pile capacity	Expensive relative to driven piles
Higher capacity piles available by socketing into rock	

8.3.2.2 Pile Load Tests

Pile load testing should be completed in accordance with the recommendations in AS1259. Detailed pile design should take into account the type and quantity of pile testing in assessing the available pile capacity. In general terms a higher cost pile testing methodology can result in reduced pile lengths, the cost / benefit balance would need to be assessed during the design process.

8.3.2.3 Supervision of Bored Piles Construction

Prior to concreting, all piles on rock should be inspected by a geotechnical engineer or engineering geologist to assess the exposed rock at toe level.

9.0 SETTLEMENT ASSESSMENT

We have reviewed our initial settlement assessment, (which was based on the MPW Stage 1 investigations and presented in Figure A041) for the additional investigation undertaken for the MPW Stage 2 Proposal, using the proposed indicative cut to fill diagram provided by Arcadis (Arcadis, 2016a) which assumes a 1 m Structural Fill Earthworks Platform is provided between the stripped earthworks surface and the underside of pavement level.

One dimensional settlement calculations have been used to assess potential settlement under loading comprising changes in ground level, plus slab loading of 40 kPa. The soil stiffnesses used in calculations were based on results of 57 CPTs that are inferred to have refused close to or on rock. The soil stiffness assumptions used in these calculations are as shown in Table 9.

Preliminary estimates of settlement under the slabs of proposed large scale industrial warehouses are in the range of 5 mm to 35 mm. South of GA-CPT-3111 estimated settlements are typically less than 10 mm. North of GA-CPT-3111, estimated settlements are typically in the range of 10 mm to 30 mm. Estimated settlements at GA-CPT-3102 were well in excess of 50 mm, reflective of the poor ground conditions encountered over the upper 4m. However, it is noted that this is an area of a known drainage feature/pond and outside the currently proposed earthworks zone. It is illustrative of the need to carefully identify and manage zones of potentially poor ground/fill (such as may be associated with established ponds) in accordance with a site specific Earthworks Specification,

The magnitude of the calculated settlements within the zone of proposed development is likely to be within the typical tolerance limits for industrial structures.

During detailed design of structures, additional considerations will need to be made, including:

- Checks by structural engineer to assess the compatibility of predicted movements with the sensitivity and tolerance of each proposed structure, super-imposing any expected long term settlements and shrink/swell movements, as appropriate.
- Undertaking investigations for specific structures to confirm foundation compressibility. This would need to consider the consistency of foundation materials over the depth of influence associated with any give strip / slab loading. The study would also need to delineate uncontrolled fill areas within the vicinity of structures (if not already completed) and take account of imported fill being used to replace existing uncontrolled fill.

10.0 GEOTECHNICAL RISKS AND OPPORTUNITIES

- There are likely areas of Unit 1B fill that have not been found during the geotechnical and ESAR investigations. This would require proactive management and good geotechnical supervision on site to identify and address each occurrence. The opportunity would be to plan for this eventuality prior to construction commencing so well understood procedures are in place during construction.
- Removing anthropogenic fill and retain on site in a contained area (for example the “dust bowl”, or potentially below a stormwater detention basin (assuming contamination risks are acceptable).
- Subject to removal of vegetation (e.g. turf cover and trees) and the root affected zones (potentially extensive for mature trees) and compaction/ground improvement, largely leaving the ‘topsoil/fill’ layer in place could be feasible. This would reduce the scale of risk across the overall site relating to interaction of potential contamination and UXO/EOW, as some areas may not need to be excavated other than to prepare the surface as required by a site specific Earthworks Specification. Note, for this approach to be adopted, final design levels would need to allow for the installation of an Earthworks Platform of sufficient quality and thickness to satisfy the detail design performance requirements.
- Designing piles as settlement reducing piles, rather than conventional piles. This could result in an overall reduction in pile length for the site.
- Raising site levels, such that the need for removal of potentially contaminated material is limited.

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Report Signature Page

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APPENDIX A

Figures

A001	SITE LOCATION PLAN - REGIONAL
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A003	PLAN OF INVESTIGATION LOCATIONS
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A003B	PLAN OF INVESTIGATION LOCATIONS – SHEET B
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A005	HISTORICAL AERIAL PHOTOGRAPH - 1930
A006	HISTORICAL AERIAL PHOTOGRAPH - 1956
A007	HISTORICAL AERIAL PHOTOGRAPH - 1961
A008	HISTORICAL AERIAL PHOTOGRAPH - 1965
A009	HISTORICAL AERIAL PHOTOGRAPH - 1970
A010	HISTORICAL AERIAL PHOTOGRAPH - 1978
A011	HISTORICAL AERIAL PHOTOGRAPH - 1986
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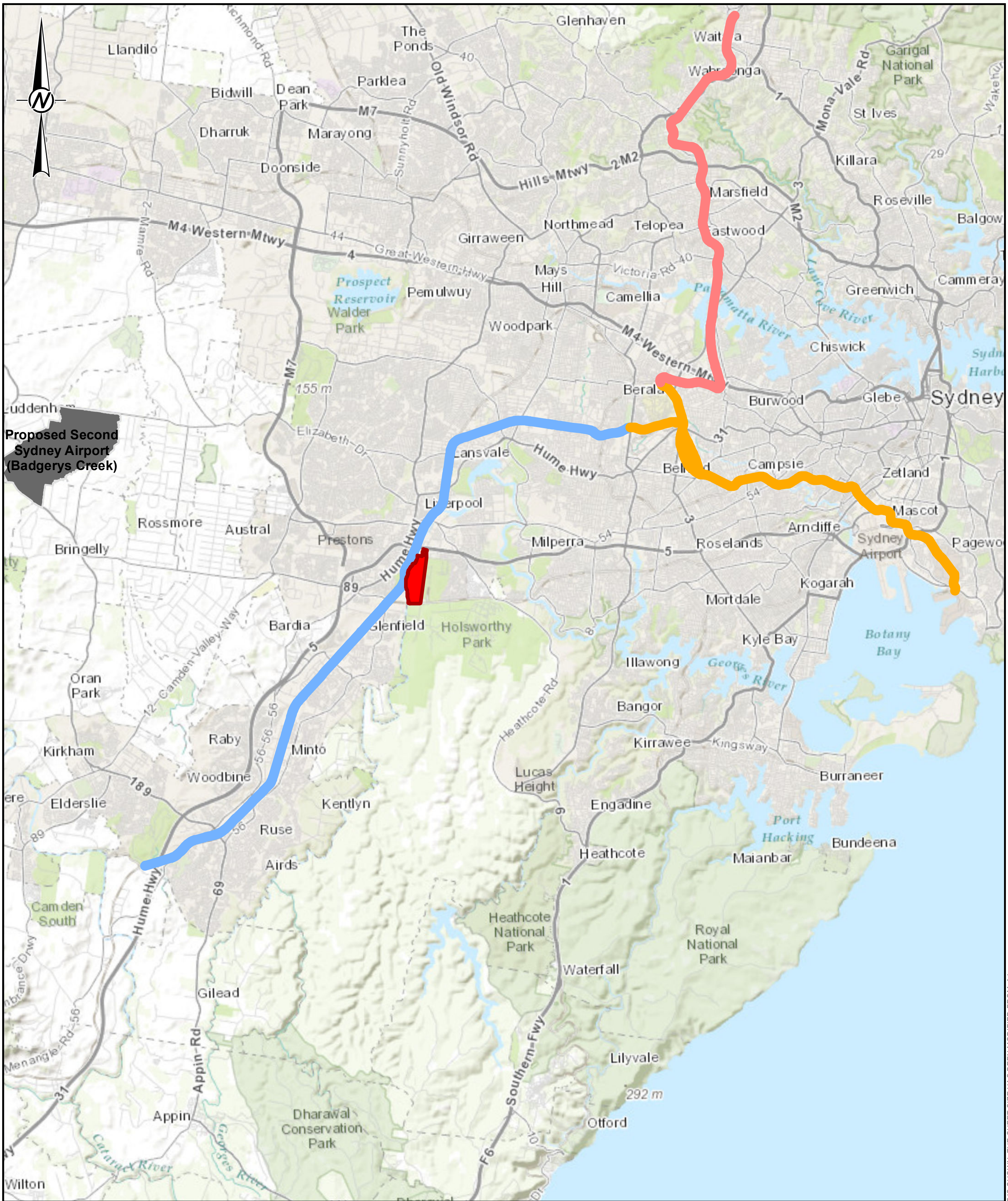
A040	ACID SULPHATE SOIL MAP
A041	ESTIMATED SETTLEMENTS UNDER 40KPa SLAB LOADING



LEGEND

- Approximate Site Boundary
- North Sydney Freight Corridor
- Port Botany Rail Upgrade
- South Sydney Freight Line

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Basemap (World Topo Map) sourced from Esri and its data providers.
2. Regional features sourced from Figure 2.1 in Chapter 2 of the 'Moorebank Intermodal Terminal Project – Environmental Impact Statement', prepared for the Moorebank Intermodal Company by Parsons Brinckerhoff, 3 October.

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REFERENCE SCALE: 1:280,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: SITE LOCATION PLAN - REGIONAL

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
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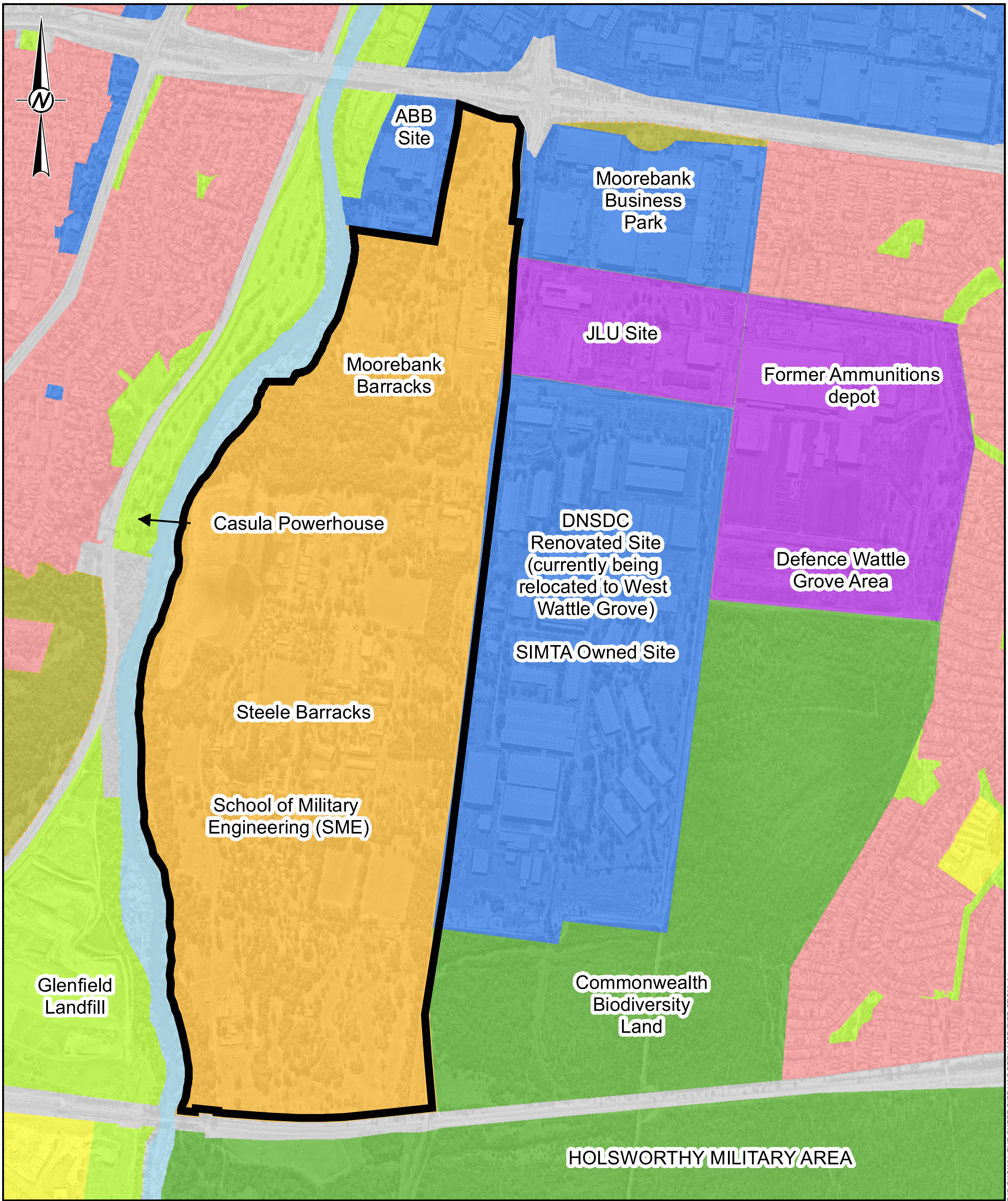

LEGEND

- MPW Site Boundary
- Commercial/Industrial
- Commonwealth
- Defence
- Infrastructure (Roads)
- Open Space/Recreation
- Residential
- Special Uses
- Vegetation
- Vegetation (environment protection)
- Waterway

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.
2. Local features sourced from Figure 2.2 in Chapter 2 of the 'Moorebank Intermodal Terminal Project – Environmental Impact Statement', prepared for the Moorebank Intermodal Company by Parsons Brinckerhoff, 3 October

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REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: SITE LOCATION PLAN - LOCAL

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
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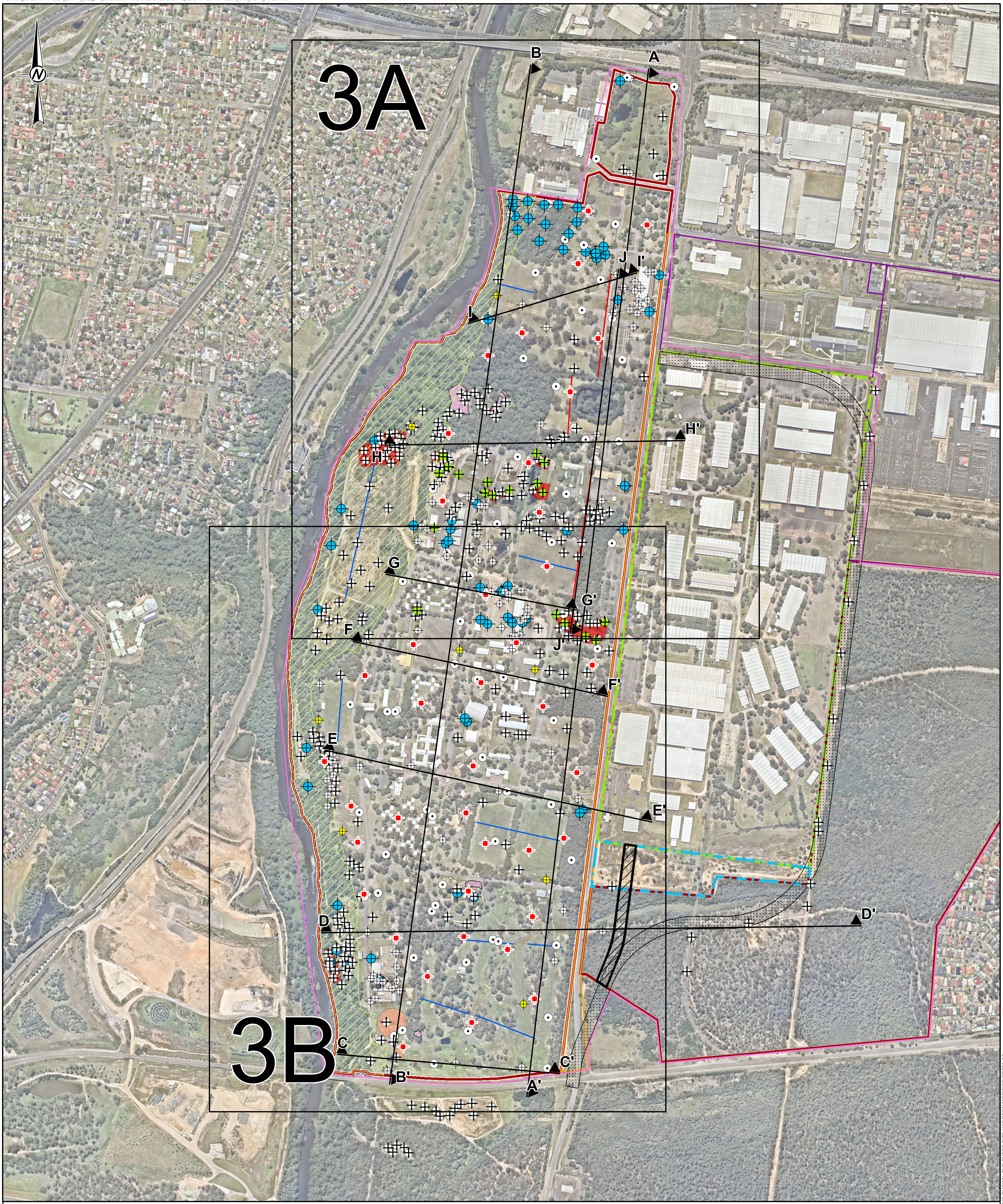

LEGEND

- The Precinct (approximate)
- MIC Property West
- Bootland (MIC Property East)
- Butchers Knife
- SIMTA Property
- Joint Defence Logistics Complex Moorebank
- Moorebank
- Moorebank Ave Realignment
- Rail Access Corridor
- Anthropogenic Fill (confirmed)
- Anthropogenic Fill (potential)
- Stockpile

Investigation locations (Golder 2016)

- Borehole
- Hand dug pit
- Test pit

Previous Investigation locations

- Borehole
- CPT
- Groundwater Well
- Test Pit
- ETS seismic refraction line
- EarthTech seismic refraction line
- Section Lines

NOTE(S)

1. Conservation Area digitised from Drawing PREC-RCG-AR-SKC-00002a (Masterplan Precinct, 09/06/2016 issue K)

REFERENCE(S)

1. Property boundaraies provided by Land and Property Information NSW

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PROJECTION: GDA 1994 MGA Zone 56

CLIENT	THE TACTICAL GROUP
PROJECT	MPW GEOTECHNICAL SITE INVESTIGATION
TITLE	**PLAN OF INVESTIGATION LOCATIONS**
CONSULTANT	Golder Associates
YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGNED	NRS
REVIEWED	NRS
APPROVED	BJF

PROJECT NO.	CONTROL	REV.	FIGURE
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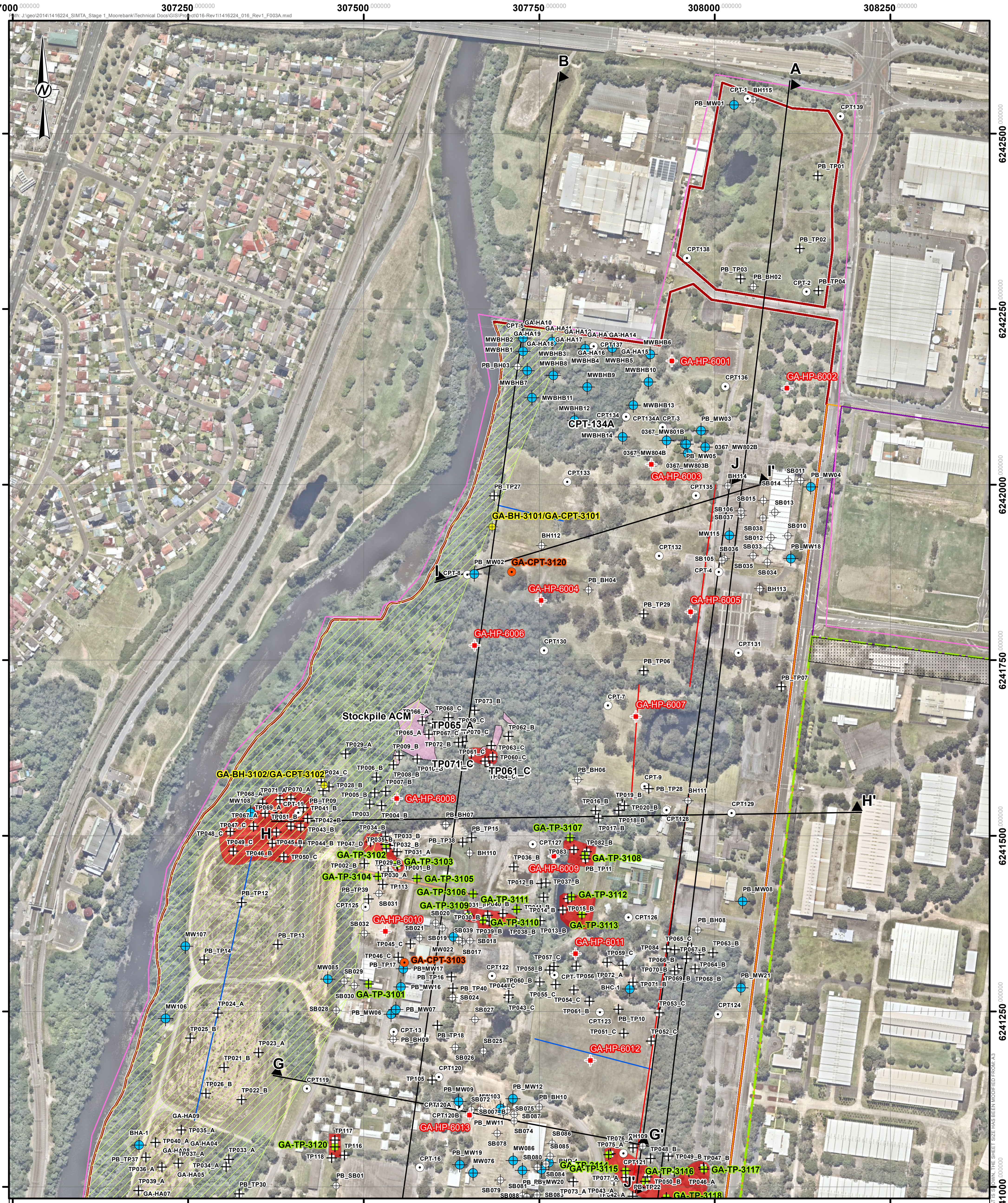

LEGEND

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THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
PLAN OF INVESTIGATION LOCATIONS

CONSULTANT

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGNED	####
REVIEWED	JD
APPROVED	GVS

Golder Associates

PROJECT NO.	CONTROL	REV.	FIGURE
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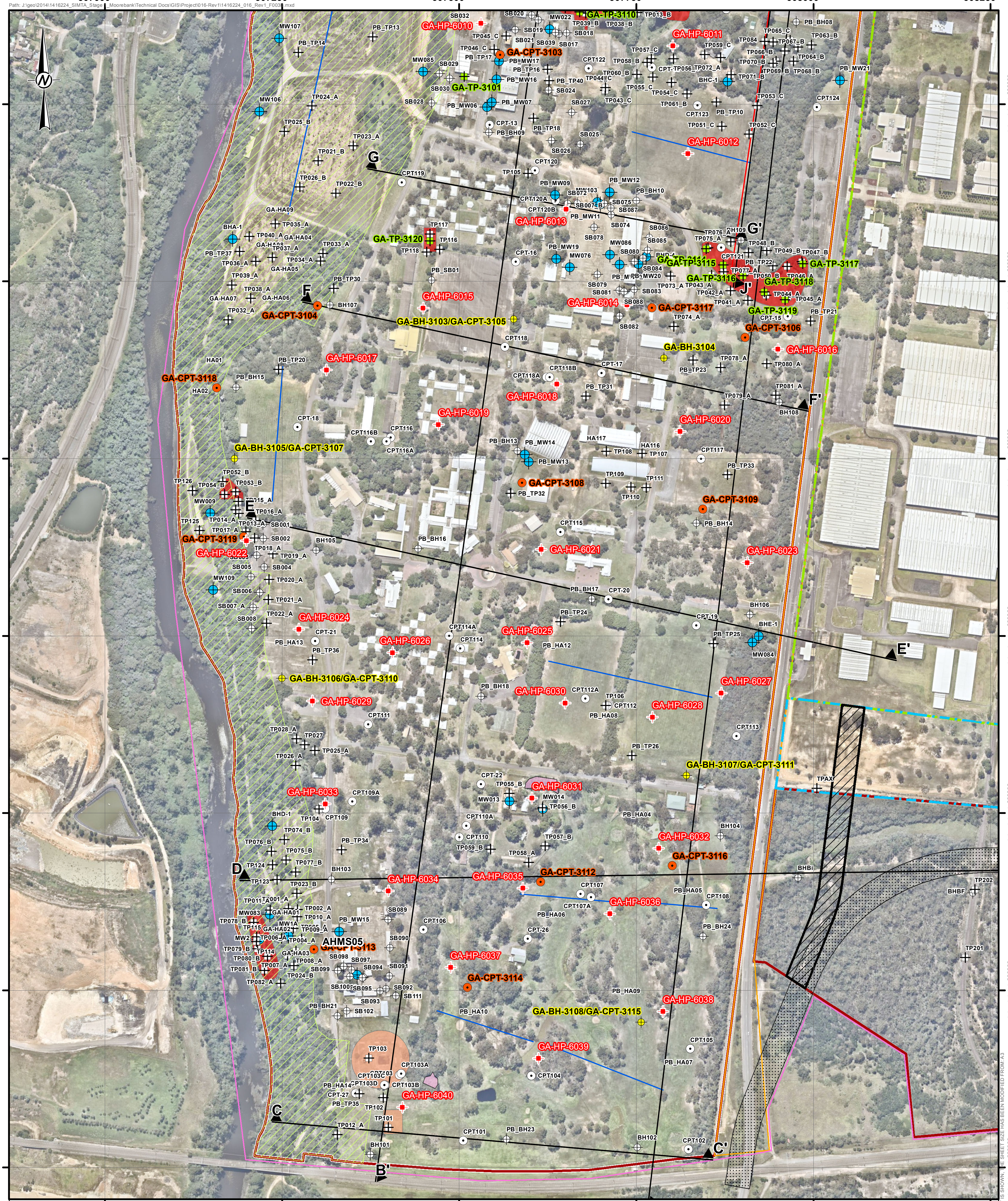

LEGEND

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PROJECTION: GDA 1994 MGA Zone 56

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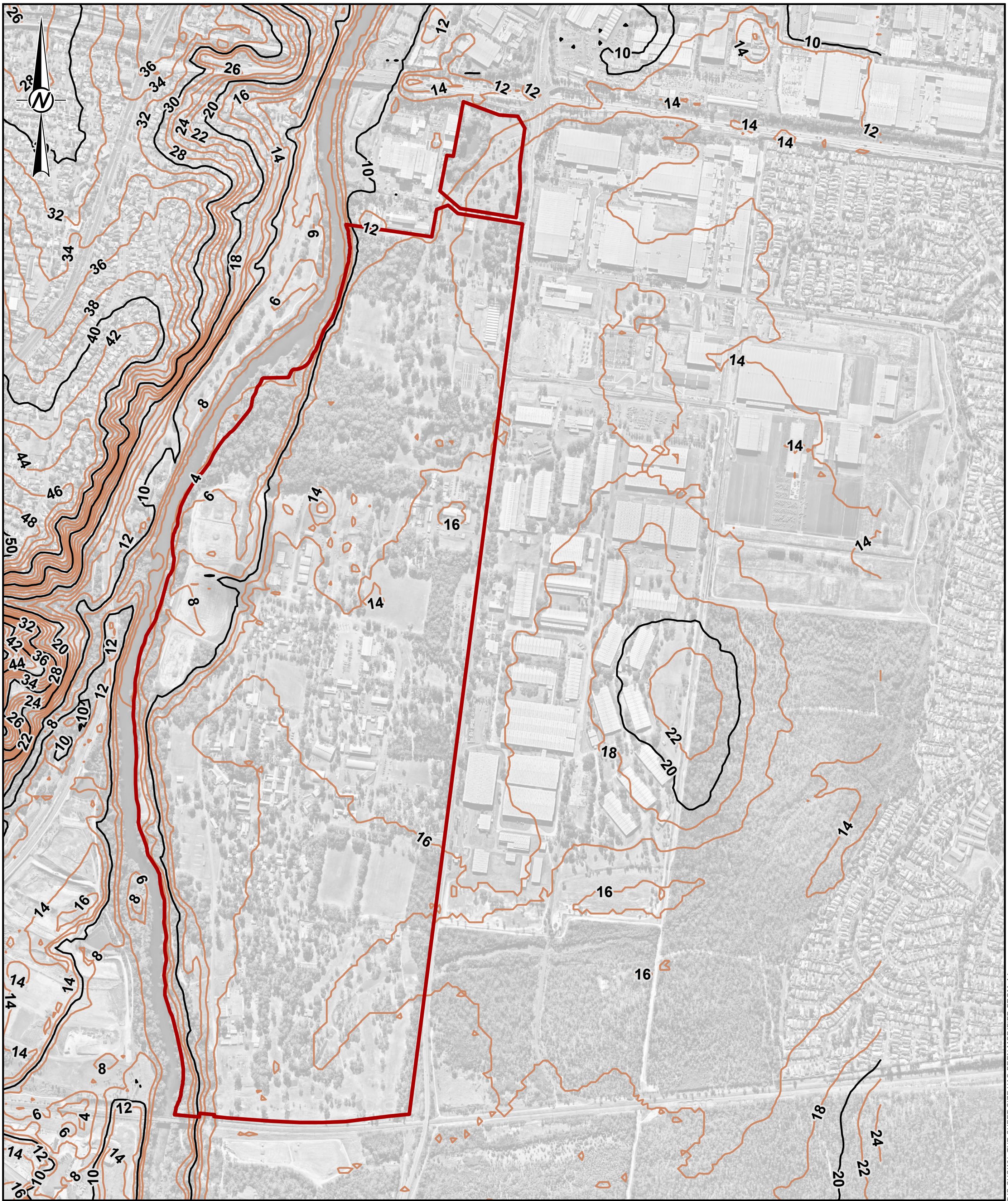
PROJECT	MPW GEOTECHNICAL SITE INVESTIGATION
TITLE	PLAN OF INVESTIGATION LOCATIONS

CONSULTANT		
Golder Associates	YYYY-MM-DD	2016-09-02
	PREPARED	KJS
	DESIGNED	####
	REVIEWED	JD
	APPROVED	GVS

PROJECT NO.	CONTROL	REV.	FIGURE
1416224	016	1	A003B

25mm



LEGEND

Approximate Site Boundary

Ground Surface Elevation (mAHD)

10 m Contours

2 m Contours

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: GROUND SURFACE LEVEL CONTOURS

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A004

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F004.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

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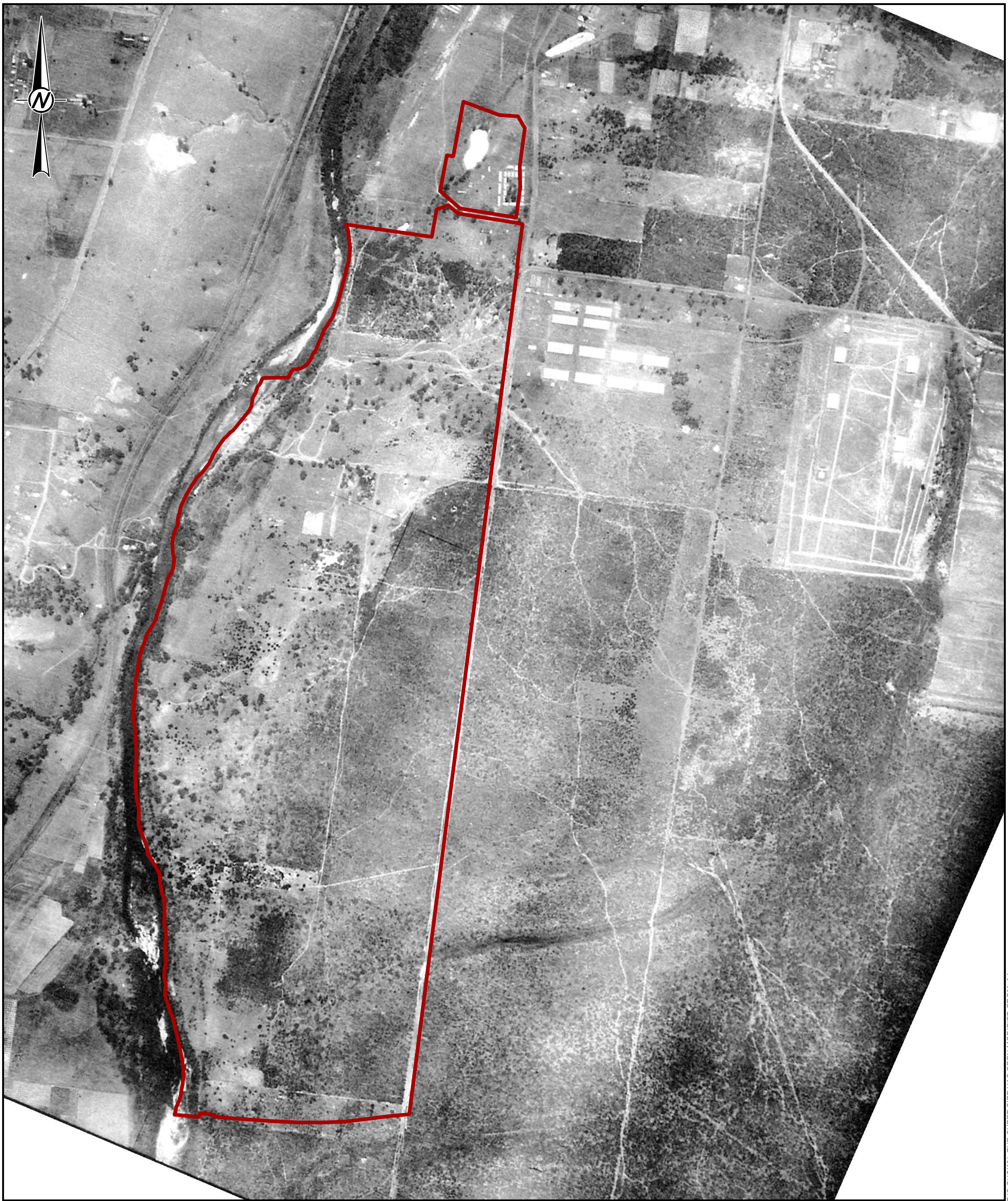

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 1930

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	AOB
DESIGN	-
REVIEW	JDM
APPROVED	JDM

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A005

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F005.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

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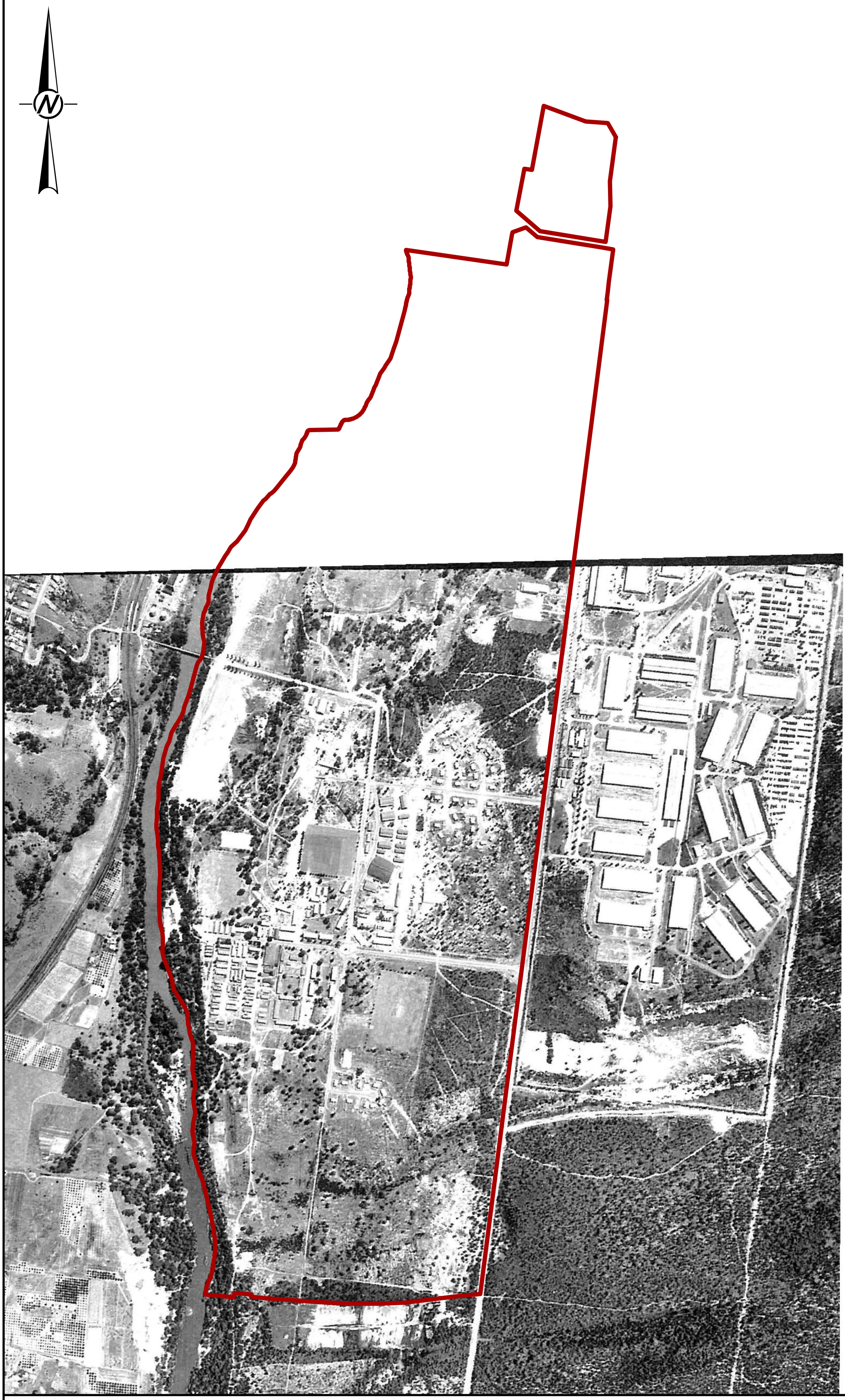

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPWGEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 1956

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	AOB
DESIGN	-
REVIEW	JDM
APPROVED	JDM

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	**A006**

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F006.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

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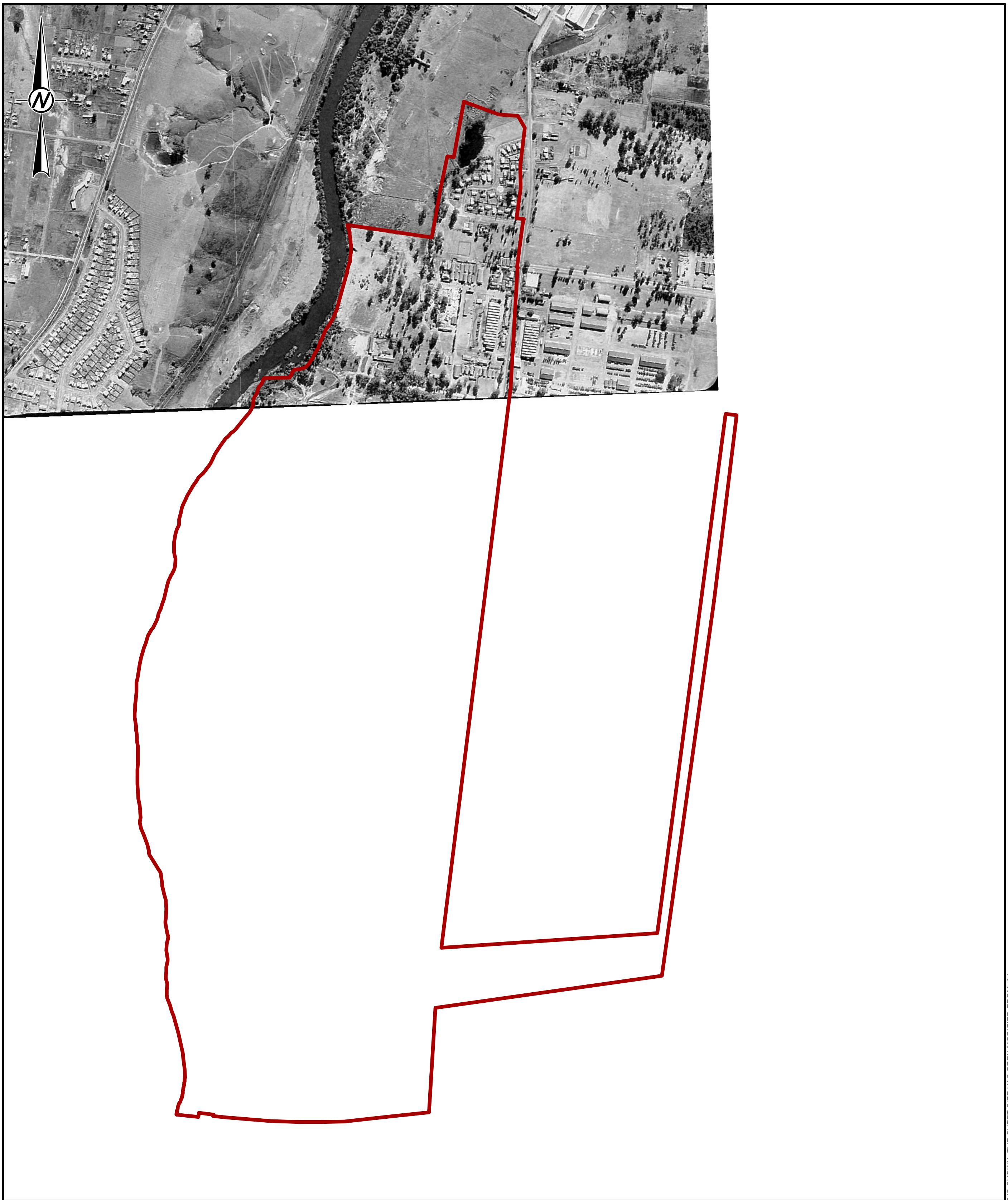

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 1961

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	AOB
DESIGN	-
REVIEW	JDM
APPROVED	JDM

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A007

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F007.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

0 25mm

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 1965

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	AOB
DESIGN	-
REVIEW	JDM
APPROVED	JDM

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	**A008**

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F008.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

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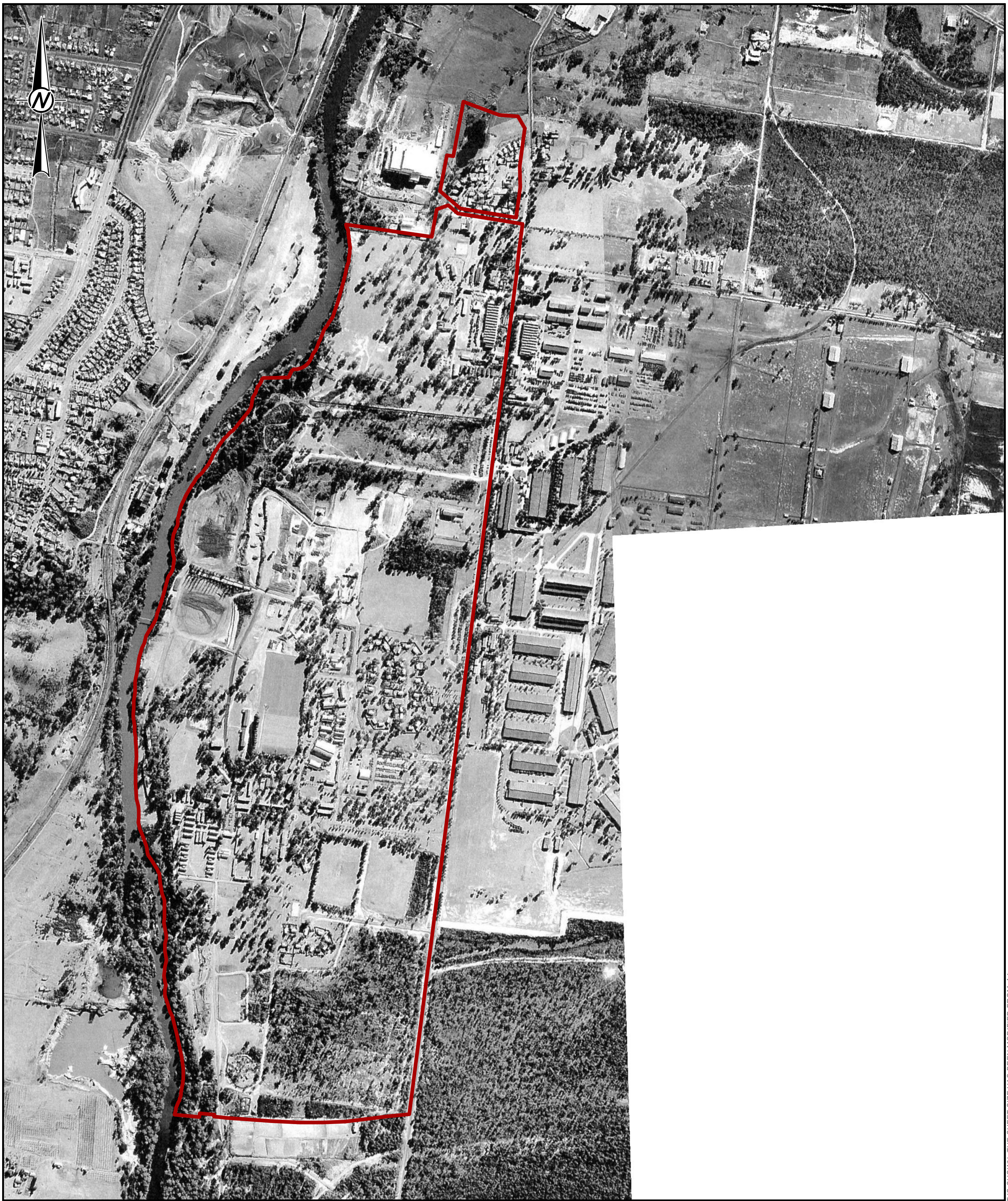

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 1970

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	AOB
DESIGN	-
REVIEW	JDM
APPROVED	JDM

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A009

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F009.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

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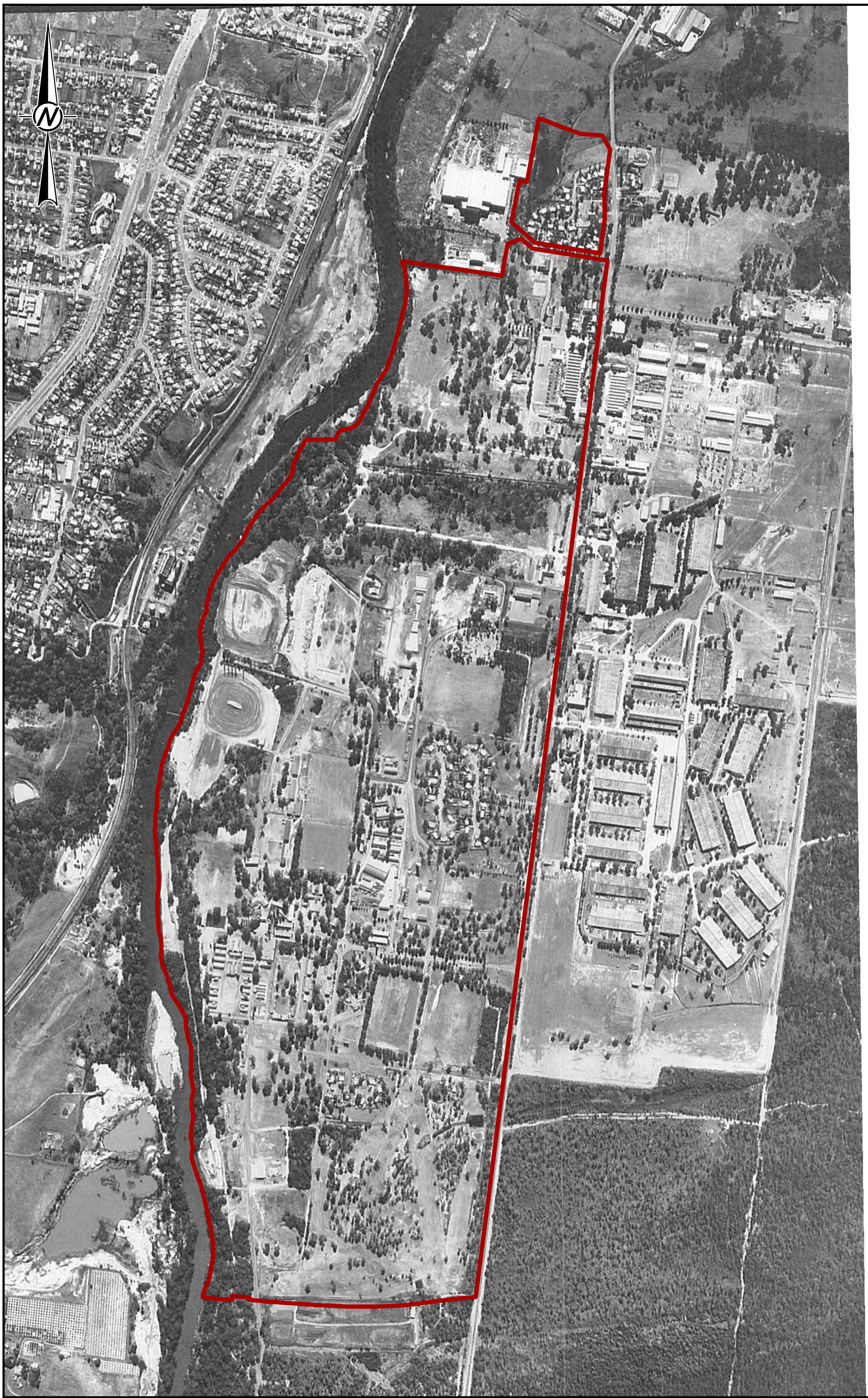

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT	THE TACTICAL GROUP
PROJECT	MPW GEOTECHNICAL SITE INVESTIGATION
TITLE	**GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 1978**

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	**A010**

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F010.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

0

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT	THE TACTICAL GROUP
PROJECT	MPW GEOTECHNICAL SITE INVESTIGATION
TITLE	**GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 1986**

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	AOB
DESIGN	-
REVIEW	JDM
APPROVED	JDM

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A011

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F011.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

0

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 1994

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A012

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F012.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

0

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image provided by Parson Brinckerhoff

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 2005

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A013

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F013.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

0

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: HISTORICAL AERIAL PHOTOGRAPH - 2009

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	**A014**

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F014.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

0

LEGEND

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: CURRENT AERIAL PHOTOGRAPH - 2014

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	**A015**

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F015.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

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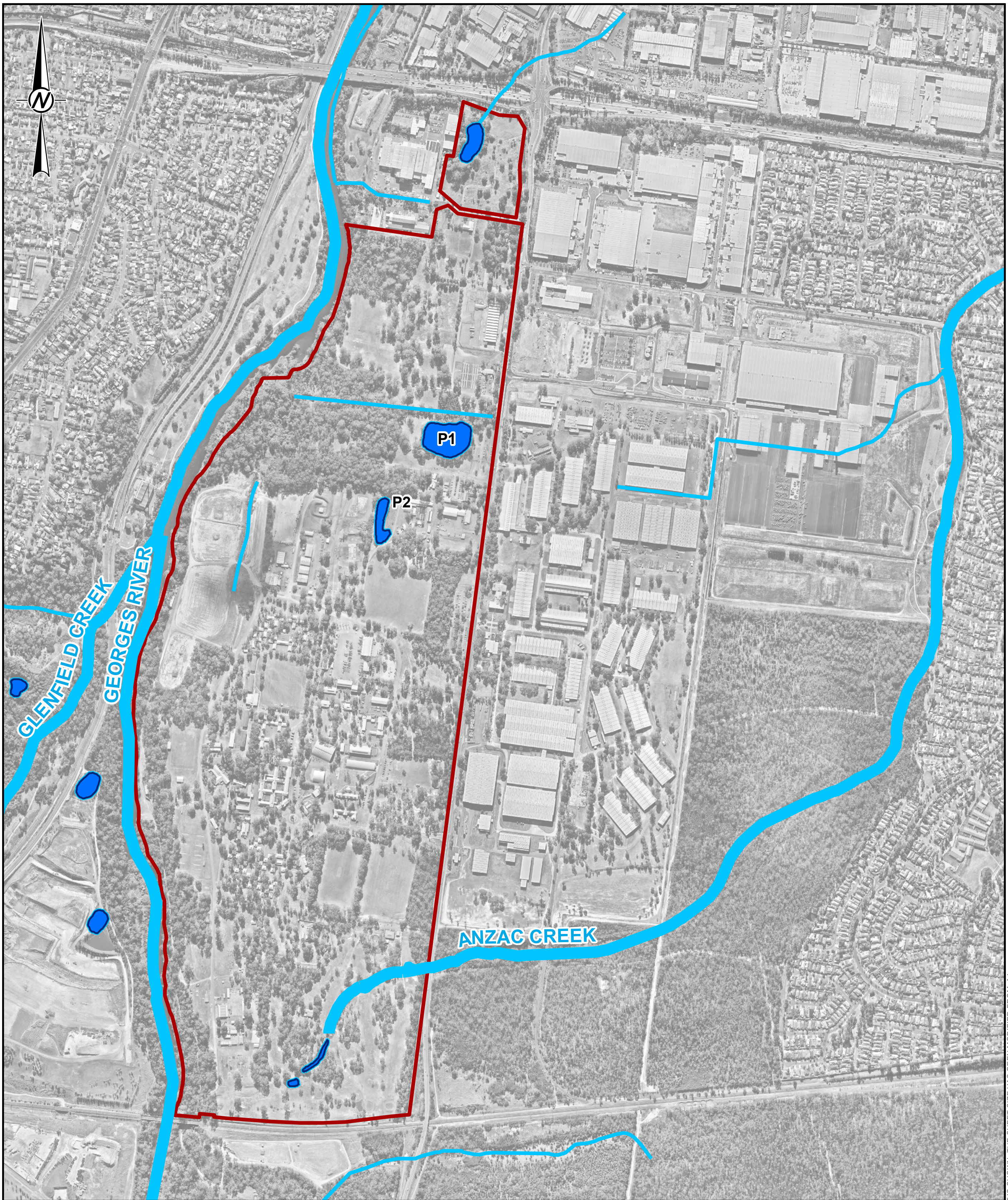


LEGEND

- Approximate Site Boundary
- Pond
- Drainage

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.
2. Drainage and water features sourced from CAD file titled "DPI_DrainageLines.DWG".

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: SITE WATER SYSTEMS

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

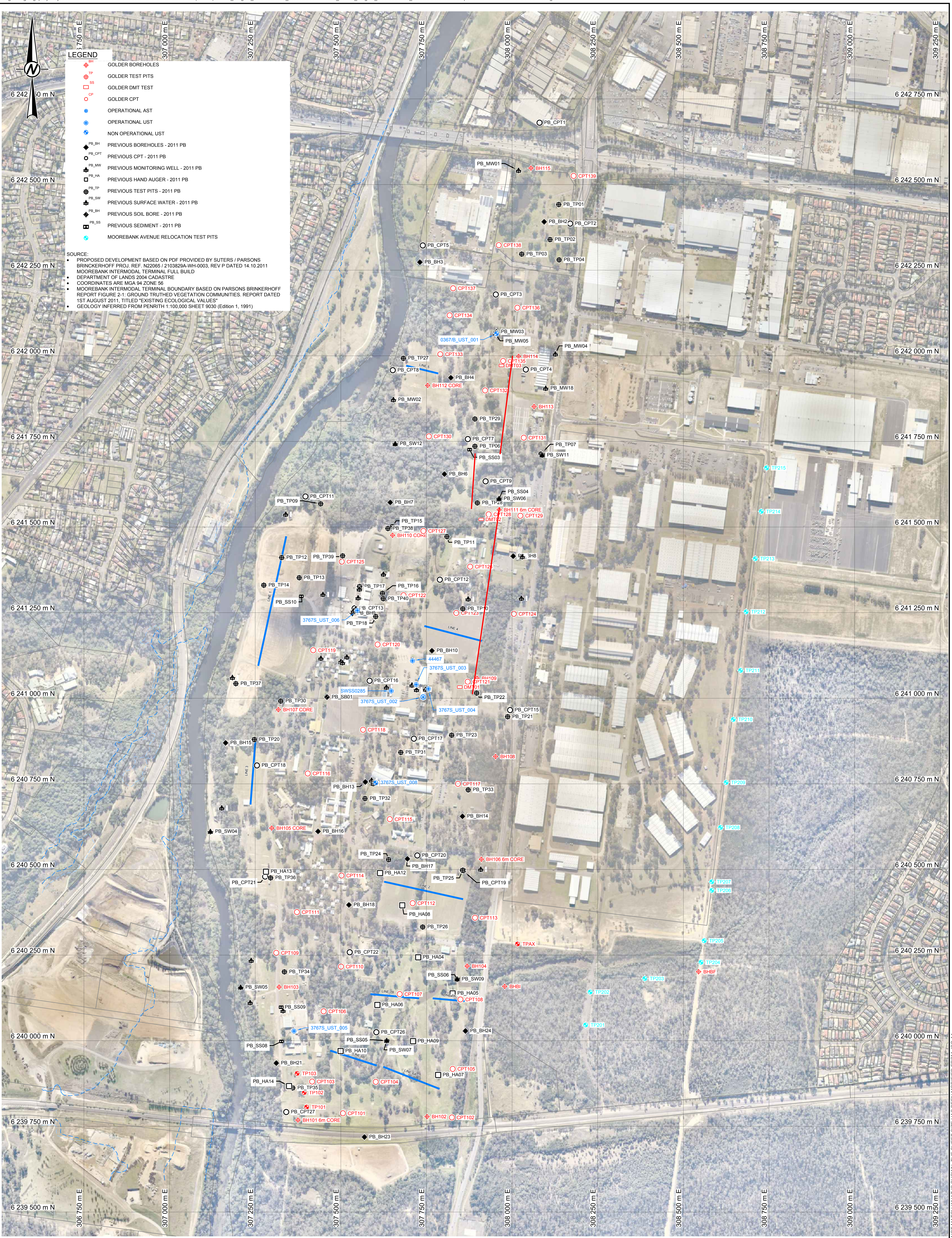
PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A016

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F016.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

Path: \\golder.gds\gap\Sydney\Geomatics\SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)\SIMTA_Stage 1_Moorebank\99_PROJECTS\1416224_SIMTA_Stage 1_Moorebank\02_PRODUCTION\DWG\ | File Name: 1416224-016-R-A017.dwg



0 200 400
1:5,000 METRES

IMAGE DATED 2014-06-30
SOURCED WITH PERMISSION FROM NEARMAP ON 2014-09-30
IMAGE GEOREFERENCED BY GOLDER AND INTENDED FOR INDICATIVE PURPOSES ONLY
www.nearmap.com.au

nearmap

PROJECT
MPW Geotechnical Investigation

CLIENT
THE TACTICAL GROUP

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	JDM
APPROVED	JDM

TITLE
HISTORICAL GEOTECHNICAL INVESTIGATION LOCATIONS

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016	2	A017

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A1

25 mm
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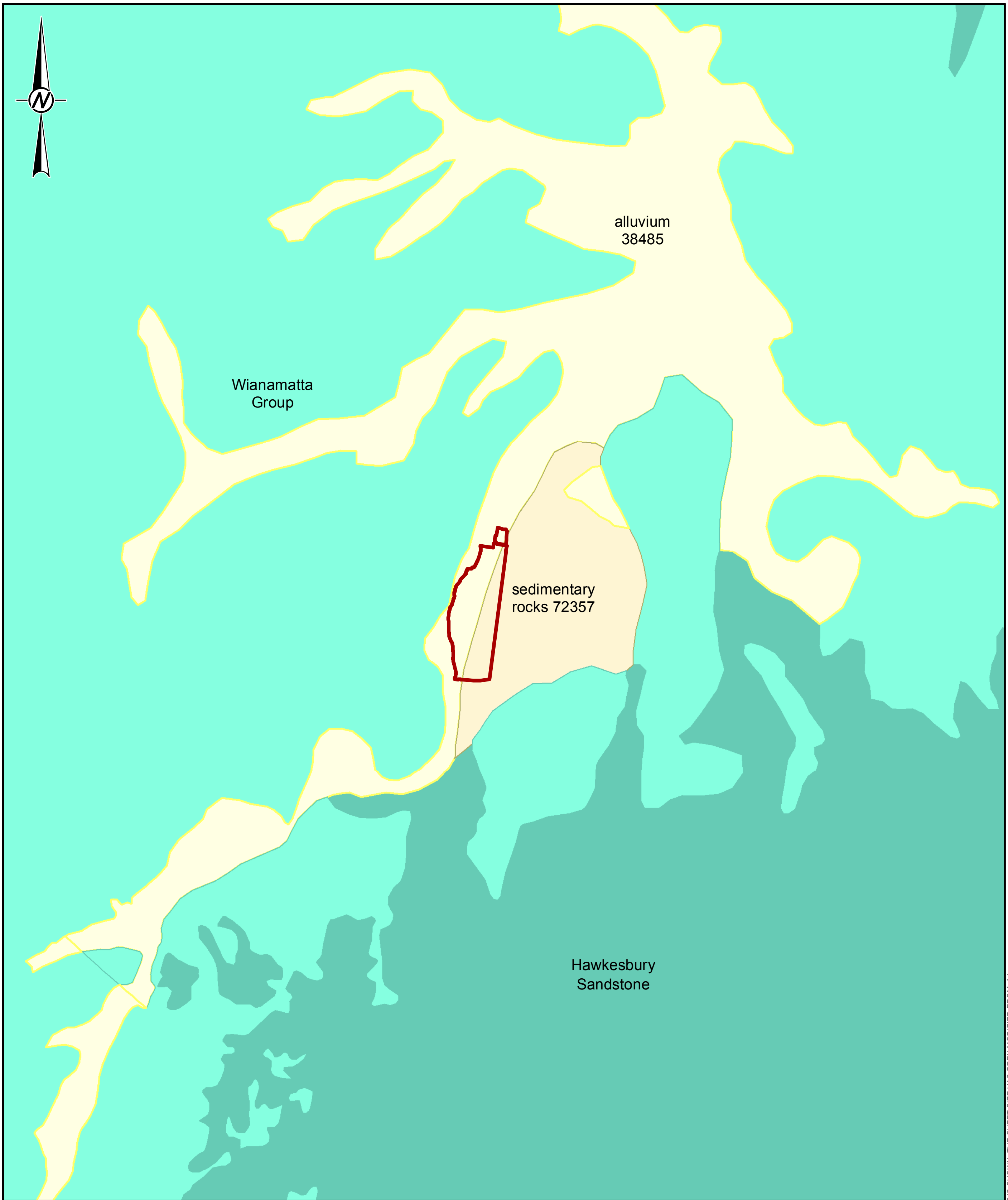

LEGEND

Approximate Site Boundary

Geology (1:1million)

TRIASSIC

- -Rsw
- -Rshw

QUATERNARY

- Qa

CAINOZOIC

- Czc

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.
2. Geology sourced from Geoscience Australia Dataset: Raymond, O.L., Liu, S.F., Kilgour, P., Retter, A.J., Stewart, A.J., Stewart, G., 2007, Surface geology of Australia 1:1,000,000 scale, New South Wales 2nd edition [Digital Dataset]

0 500 1,000 2,000 3,000 4,000 5,000 Metres

REFERENCE SCALE: 1:100,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: REGIONAL GEOLOGY MAP

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A018

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F018.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

0 25mm

LEGEND

Approximate Site Boundary

Soil Landscapes

- ALLUVIAL
- EROSIONAL
- RESIDUAL
- WATER

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.
2. Soil Landscapes Sourced from NSW Department of Environment,Climate Change and Water (DECCW): Bannerman SM and Hazelton PA 1990, Soil Landscapes of the Penrith 1:100 000 Sheet Map, Soil Conservation Service, Sydney.

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: SOIL LANDSCAPES MAP

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A019

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F019.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

0

LEGEND

Approximate Site Boundary

Inferred Groundwater Contours (mAHD)

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.
2. Groundwater Contours sourced from Figure 9 in 'Site Audit Report, Moorebank Intermodal Terminal, Morebank, NSW', prepared for the Department of Finance and Deregulation by Aecom, 3 May 2012

REFERENCE

1. Aerial Image sourced from Nearmap.

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: GROUNDWATER CONTOURS - 2011

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A020

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F020.mxd

25mm

0

LEGEND

Approximate Site Boundary

Inferred Groundwater Contours (December 2014 mAHD)

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: GROUNDWATER CONTOURS - 2014

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A021

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F021.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

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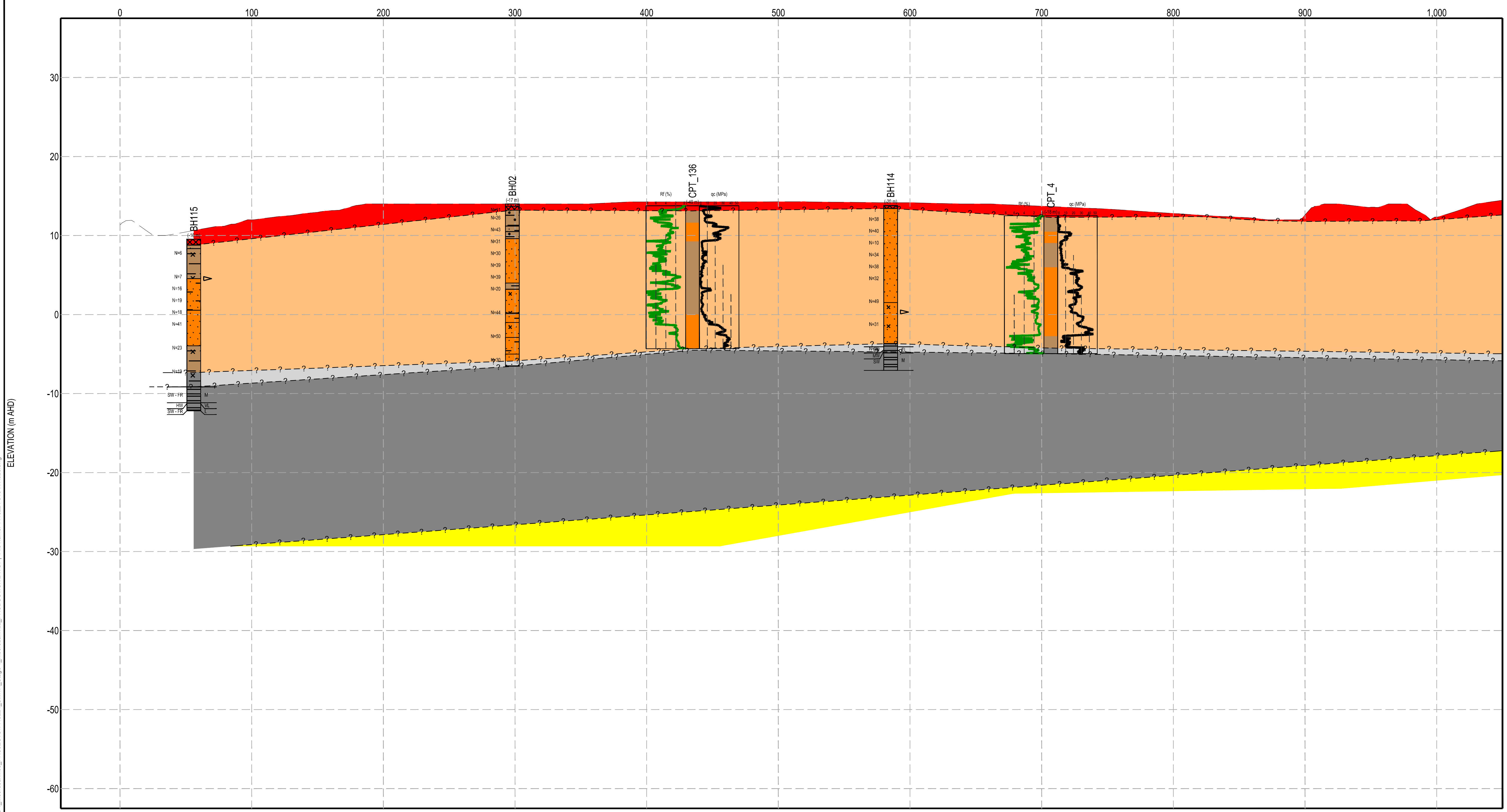
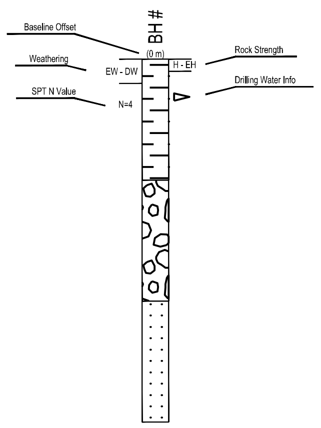


POST LEGEND



MATERIAL GRAPHIC

TOPSOIL
Clayey SAND
Silty SAND
ASPHALTIC CONCRETE
FILL
SAND
SHALE
Gravelly SAND
Sandy CLAY
CLAY
Silty CLAY

UNIT 1 - SURFICIAL SOILS
UNIT 2 - RECENT ALLUVIUM
UNIT 3 - OLDER ALLUVIUM
UNIT 3A - DENSE -VERY DENSE SAND
UNIT 3B - VERY STIFF - HARD CLAYS
UNIT 4A - RESIDUAL SHALE SOIL
UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

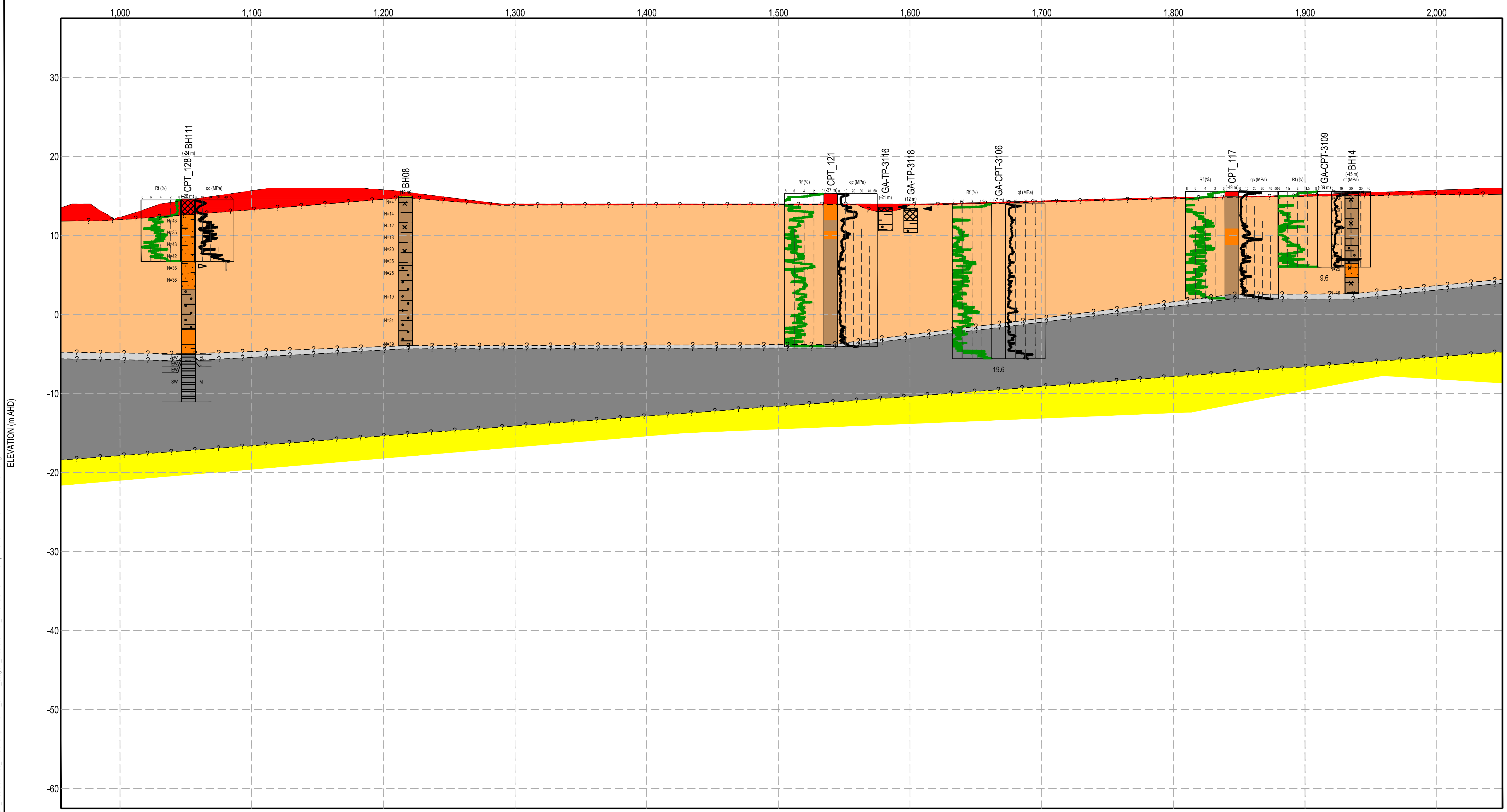
CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

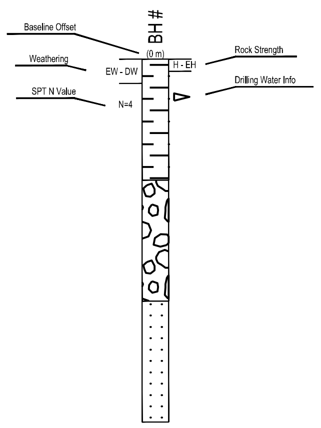
TITLE
INFERRED SUBSURFACE SECTION A - A' SHEET 1 OF 3

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A023

25 mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3



POST LEGEND



MATERIAL GRAPHIC

TOPSOIL	Silty SAND	CLAY	SAND
Silty CLAY	SHALE	Clayey SAND	
Sandy CLAY	FILL	CORE LOSS	

UNIT 1 - SURFICIAL SOILS
UNIT 2 - RECENT ALLUVIUM
UNIT 3 - OLDER ALLUVIUM
UNIT 3A - DENSE -VERY DENSE SAND
UNIT 3B - VERY STIFF - HARD CLAYS
UNIT 4A - RESIDUAL SHALE SOIL
UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

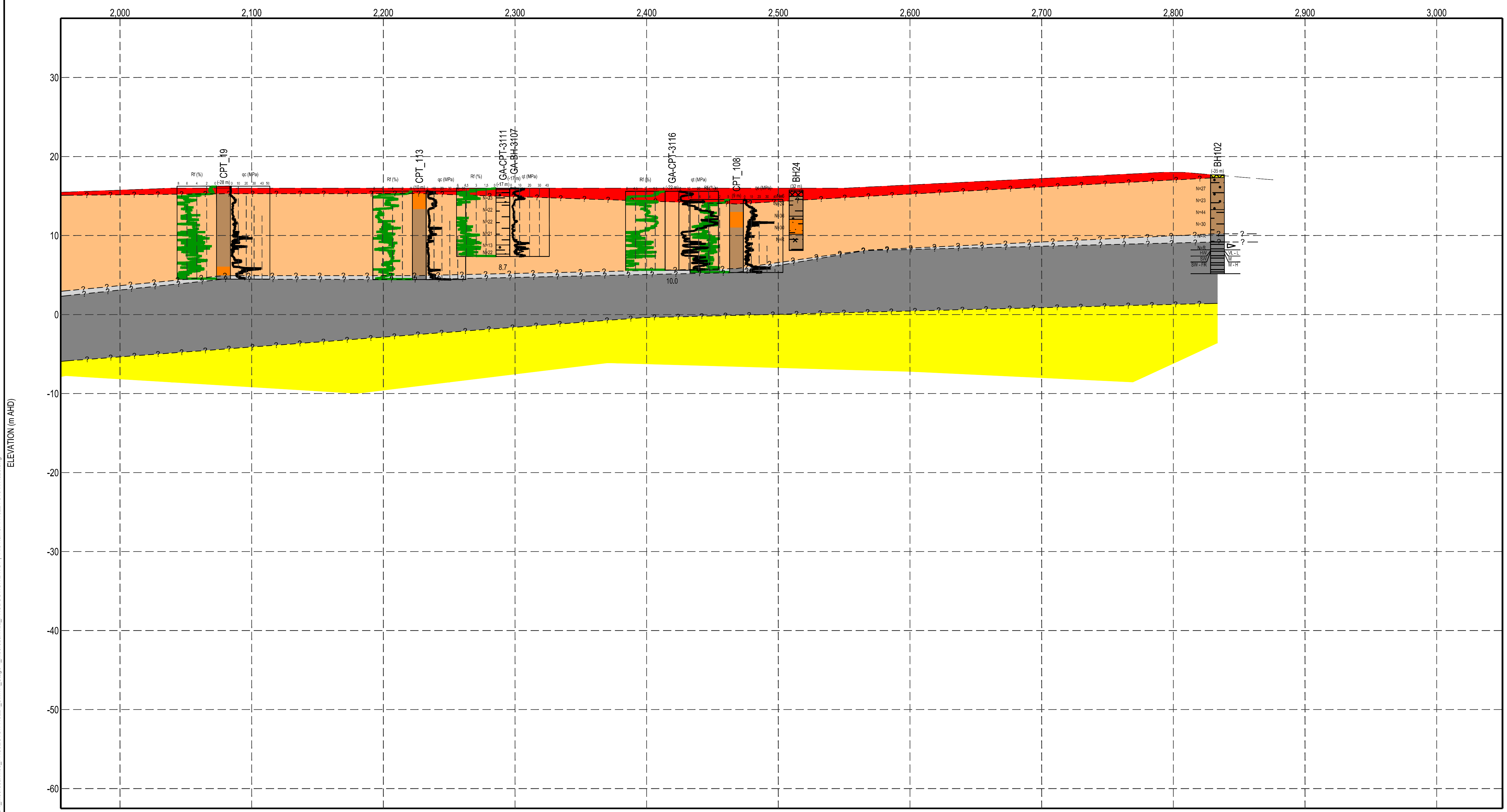
CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

TITLE
INFERRED SUBSURFACE SECTION A - A' SHEET 2 OF 3

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A024



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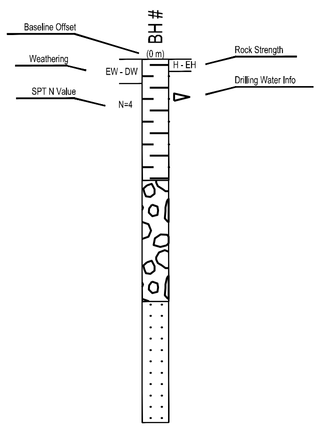


MATERIAL GRAPHIC

- TOPSOIL
- FILL
- CLAY
- Sandy CLAY
- Clayey SAND
- Silty CLAY
- SHALE
- SAND
- CORE LOSS

- UNIT 1 - SURFICIAL SOILS
- UNIT 2 - RECENT ALLUVIUM
- UNIT 3 - OLDER ALLUVIUM
- UNIT 3A - DENSE -VERY DENSE SAND
- UNIT 3B - VERY STIFF - HARD CLAYS
- UNIT 4A - RESIDUAL SHALE SOIL
- UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
- UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
- UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

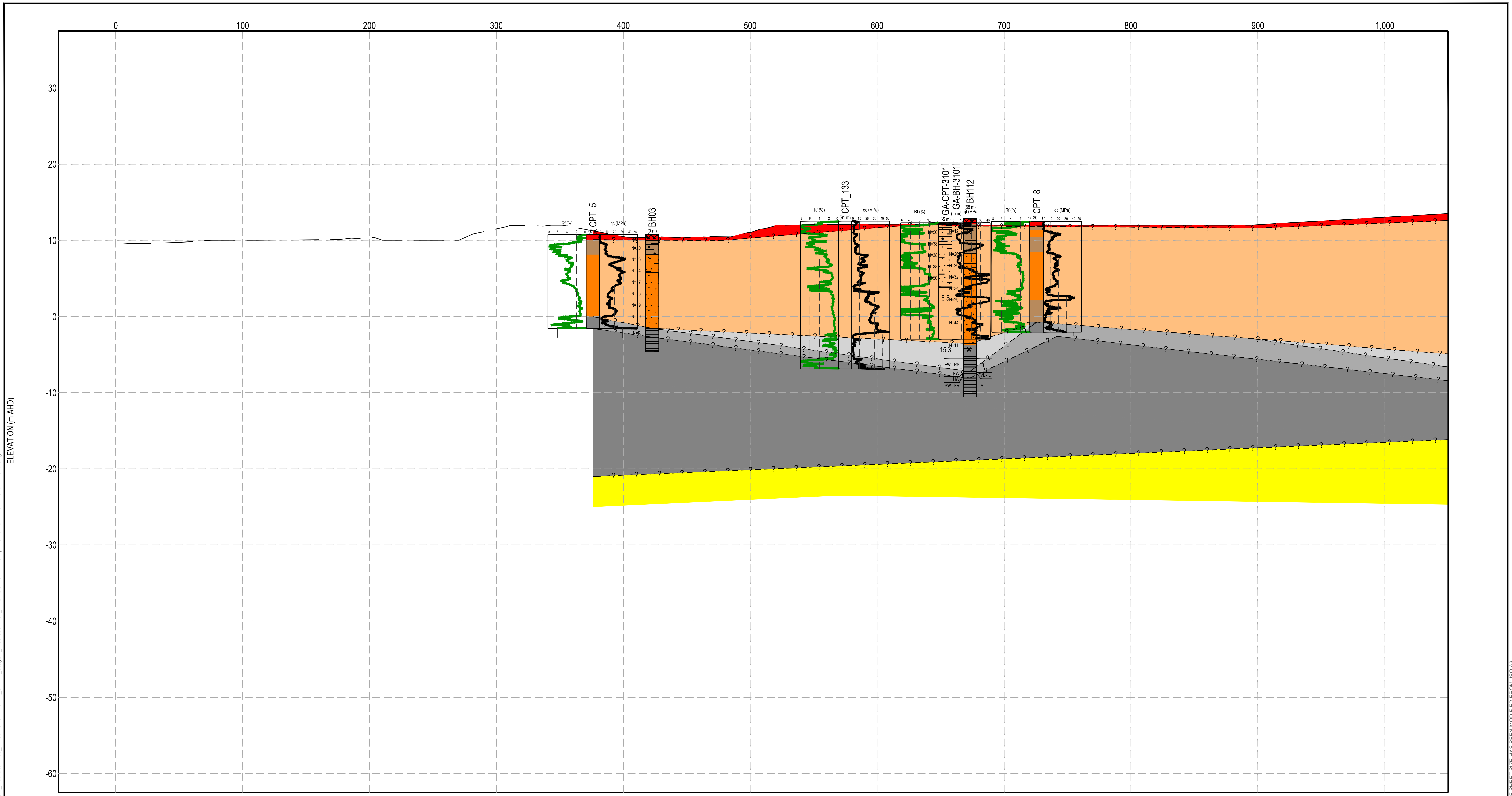
CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

TITLE
INFERRED SUBSURFACE SECTION A - A' SHEET 3 OF 3

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A025



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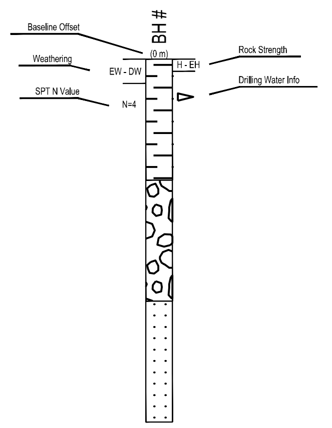


MATERIAL GRAPHIC

- TOPSOIL
- FILL
- Sandy CLAY
- CLAY
- Silty SAND
- Clayey SAND
- SAND
- SHALE
- Silty CLAY
- CORE LOSS

- UNIT 1 - SURFICIAL SOILS
- UNIT 2 - RECENT ALLUVIUM
- UNIT 3 - OLDER ALLUVIUM
- UNIT 3A - DENSE -VERY DENSE SAND
- UNIT 3B - VERY STIFF - HARD CLAYS
- UNIT 4A - RESIDUAL SHALE SOIL
- UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
- UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
- UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

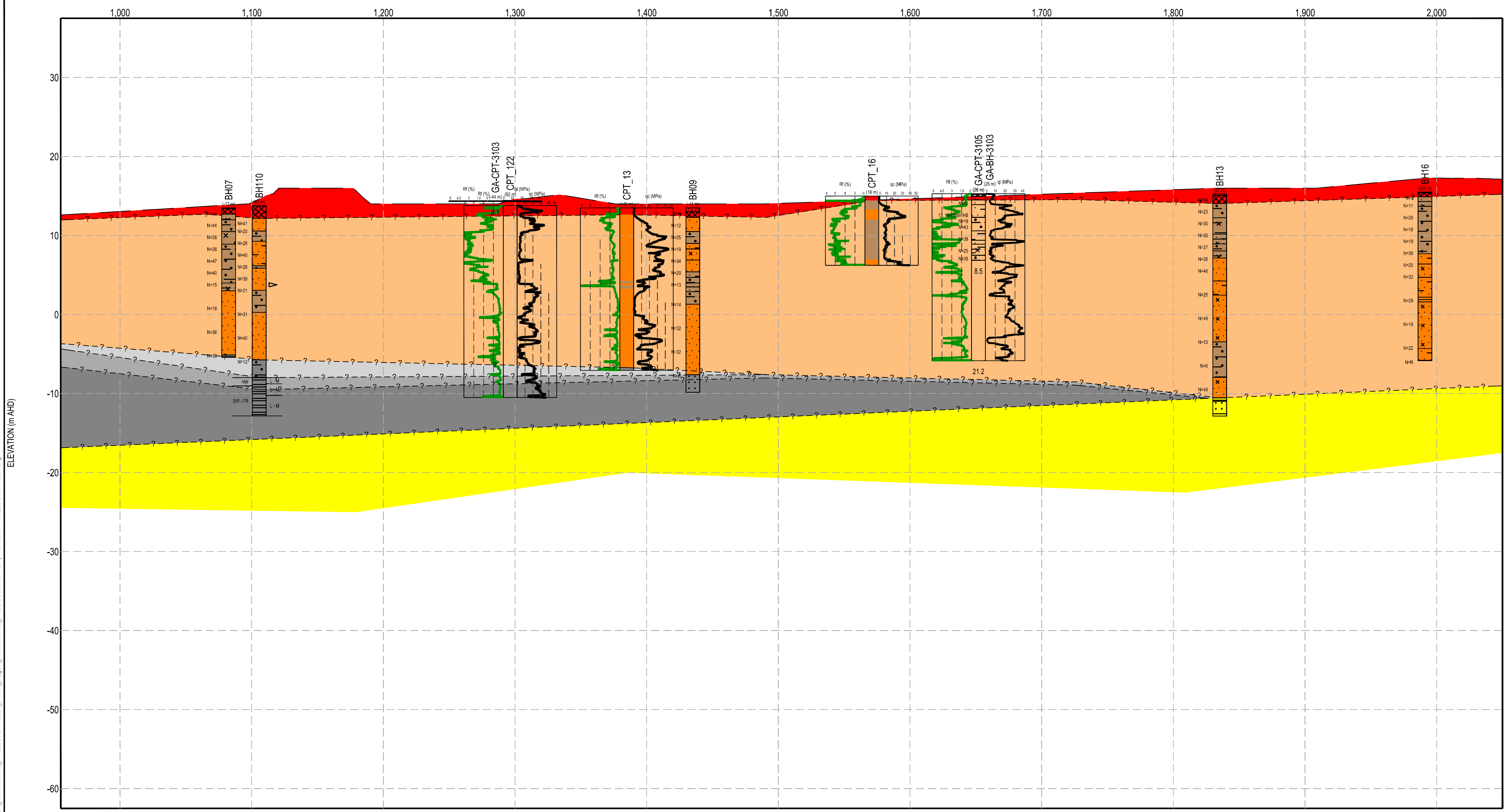
PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

TITLE
INFERRED SUBSURFACE SECTION B - B' SHEET 1 OF 3

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A026



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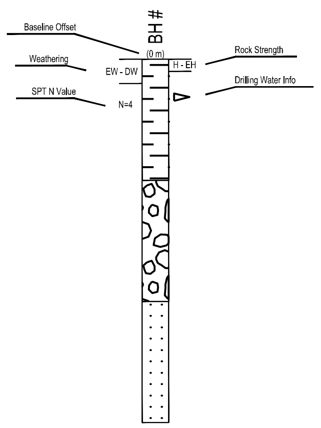


MATERIAL GRAPHIC

- TOPSOIL
- FILL
- Silty CLAY
- Sandy CLAY
- Sandy SILT
- SAND
- Clayey SAND
- Silty SAND
- SANDSTONE
- SHALE
- CORE LOSS
- LOW PLASTICITY CLAY

- UNIT 1 - SURFICIAL SOILS
- UNIT 2 - RECENT ALLUVIUM
- UNIT 3 - OLDER ALLUVIUM
- UNIT 3A - DENSE -VERY DENSE SAND
- UNIT 3B - VERY STIFF - HARD CLAYS
- UNIT 4A - RESIDUAL SHALE SOIL
- UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
- UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
- UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

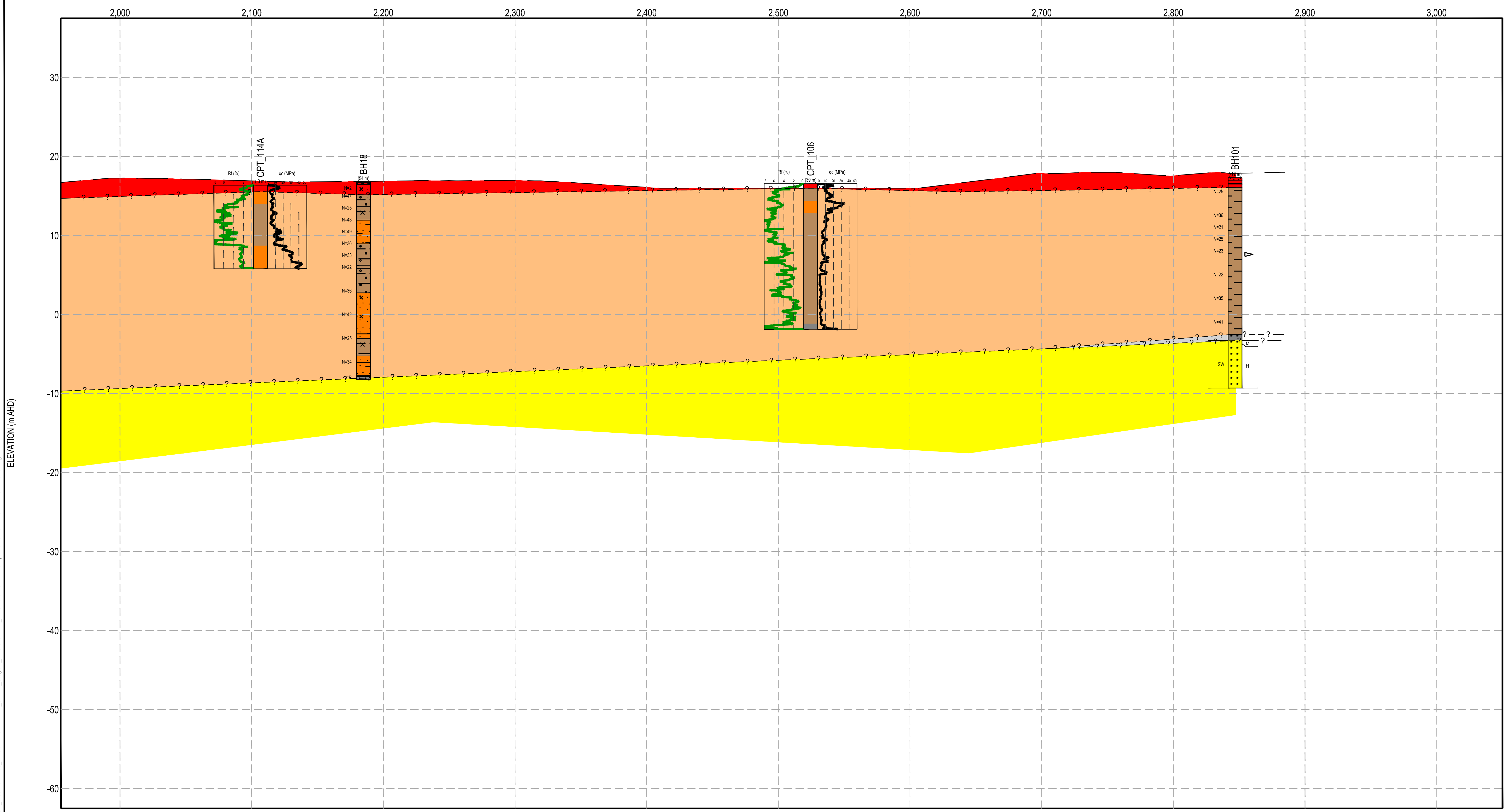
CONSULTANT

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

TITLE
INFERRED SUBSURFACE SECTION B - B' SHEET 2 OF 3

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A027



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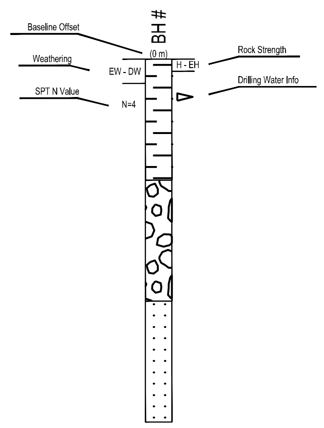


MATERIAL GRAPHIC

- TOPSOIL
- FILL
- Silty SAND
- Sandy CLAY
- Silty CLAY
- Clayey SAND
- SAND
- SANDSTONE
- CORE LOSS
- GRAVEL
- CLAY

- UNIT 1 - SURFICIAL SOILS
- UNIT 2 - RECENT ALLUVIUM
- UNIT 3 - OLDER ALLUVIUM
- UNIT 3A - DENSE -VERY DENSE SAND
- UNIT 3B - VERY STIFF - HARD CLAYS
- UNIT 4A - RESIDUAL SHALE SOIL
- UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
- UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
- UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

CONSULTANT

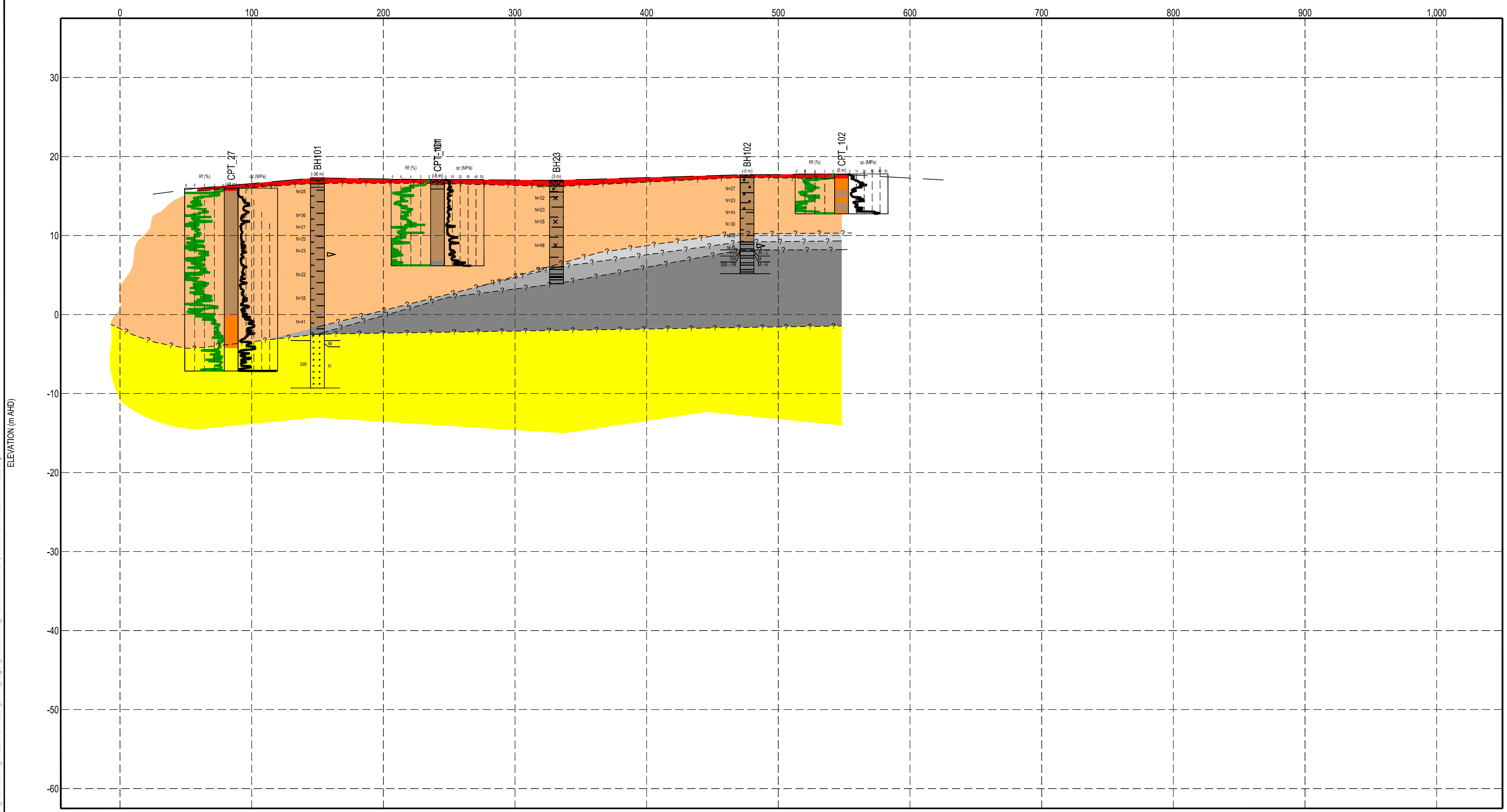
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

TITLE
INFERRED SUBSURFACE SECTION B - B' SHEET 3 OF 3

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A028



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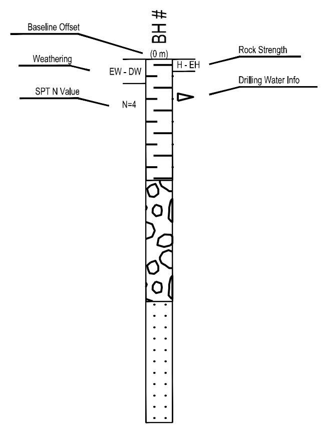


MATERIAL GRAPHIC

TOPSOIL
FILL
Sandy CLAY
Silty CLAY
SHALE
CORE LOSS
SAND
GRAVEL
CLAY
SANDSTONE
Clayey SAND

UNIT 1 - SURFICIAL SOILS
UNIT 2 - RECENT ALLUVIUM
UNIT 3 - OLDER ALLUVIUM
UNIT 3A - DENSE -VERY DENSE SAND
UNIT 3B - VERY STIFF - HARD CLAYS
UNIT 4A - RESIDUAL SHALE SOIL
UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

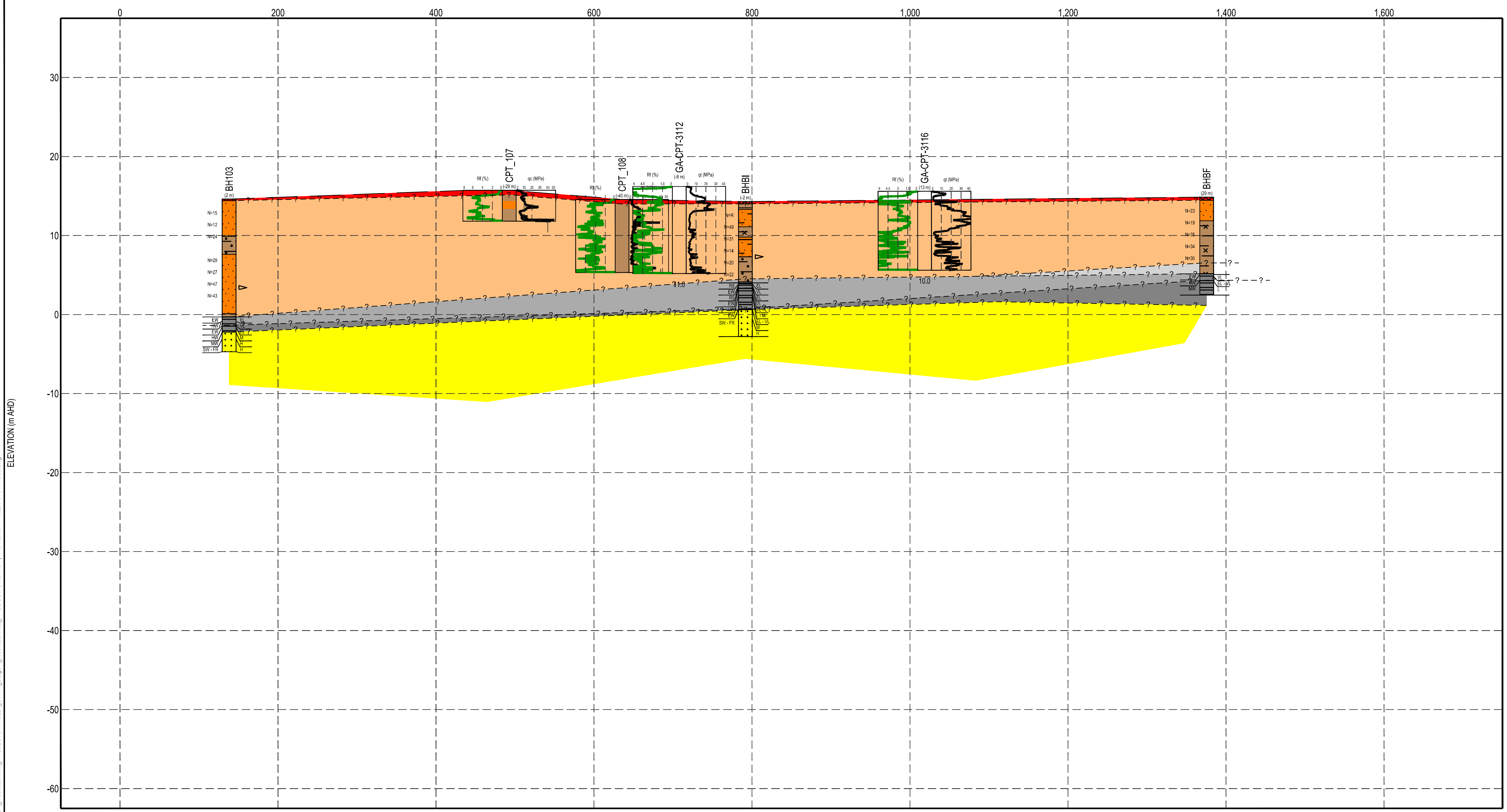
PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

TITLE
INFERRED SUBSURFACE SECTION C - C'

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A029



POST LEGEND

MATERIAL GRAPHIC

TOPSOIL
CORE LOSS
FILL
Clayey SAND
SAND
SHALE
Silty CLAY
GRAVEL
Sandy CLAY
SANDSTONE
Sandy Silty CLAY
CLAY

UNIT 1 - SURFICIAL SOILS
UNIT 2 - RECENT ALLUVIUM
UNIT 3 - OLDER ALLUVIUM
UNIT 3A - DENSE -VERY DENSE SAND
UNIT 3B - VERY STIFF - HARD CLAYS
UNIT 4A - RESIDUAL SHALE SOIL
UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

1:500 METRES
1:6,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

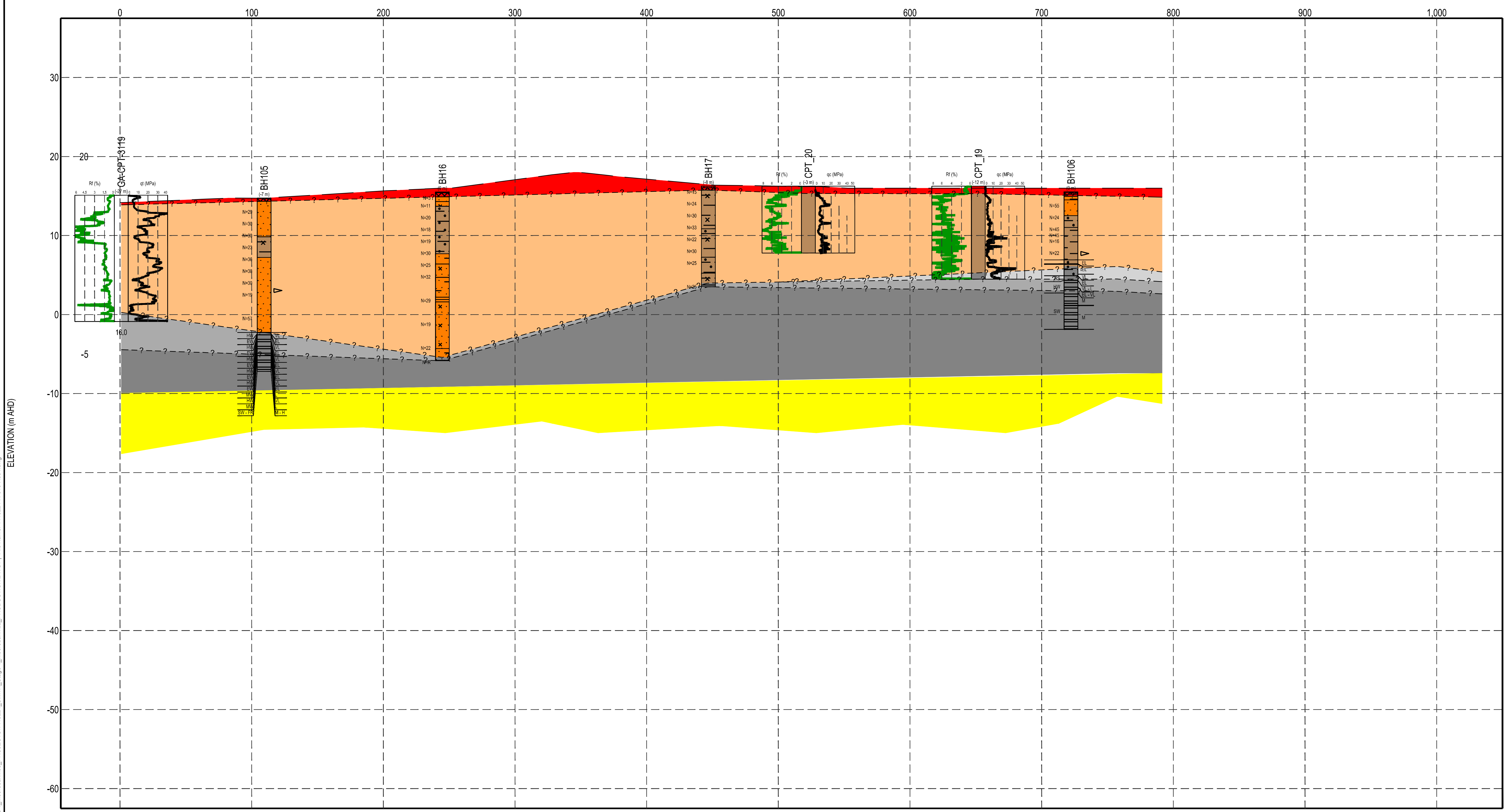
CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

TITLE
INFERRED SUBSURFACE SECTION D - D'

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A030



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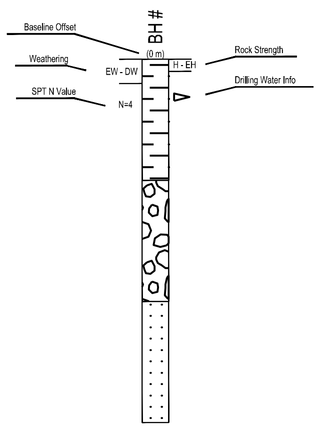


MATERIAL GRAPHIC

TOPSOIL
FILL
SAND
Silty SAND
Sandy CLAY
Clayey SAND
SHALE
Silty CLAY
CLAY
CORE LOSS

UNIT 1 - SURFICIAL SOILS
UNIT 2 - RECENT ALLUVIUM
UNIT 3 - OLDER ALLUVIUM
UNIT 3A - DENSE -VERY DENSE SAND
UNIT 3B - VERY STIFF - HARD CLAYS
UNIT 4A - RESIDUAL SHALE SOIL
UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

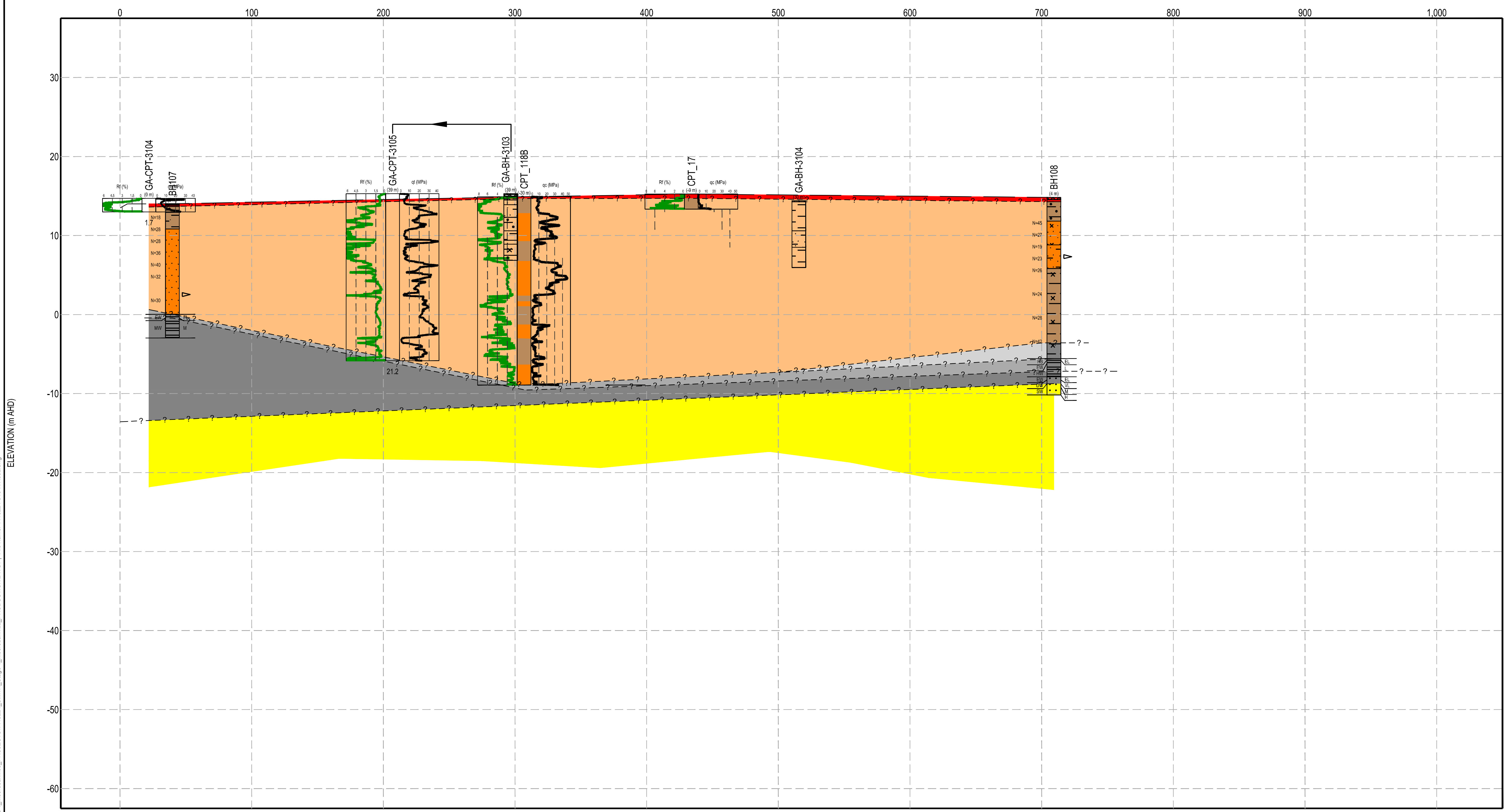
CONSULTANT

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

TITLE
INFERRED SUBSURFACE SECTION E - E'

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A031



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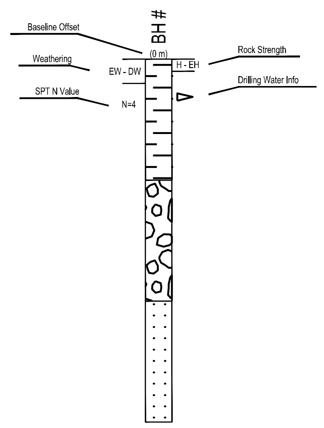


MATERIAL GRAPHIC

- SAND
- Clayey SAND
- Sandy CLAY
- CLAY
- SHALE
- FILL
- Silty CLAY
- Silty SAND
- SANDSTONE

- UNIT 1 - SURFICIAL SOILS
- UNIT 2 - RECENT ALLUVIUM
- UNIT 3 - OLDER ALLUVIUM
- UNIT 3A - DENSE -VERY DENSE SAND
- UNIT 3B - VERY STIFF - HARD CLAYS
- UNIT 4A - RESIDUAL SHALE SOIL
- UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
- UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
- UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

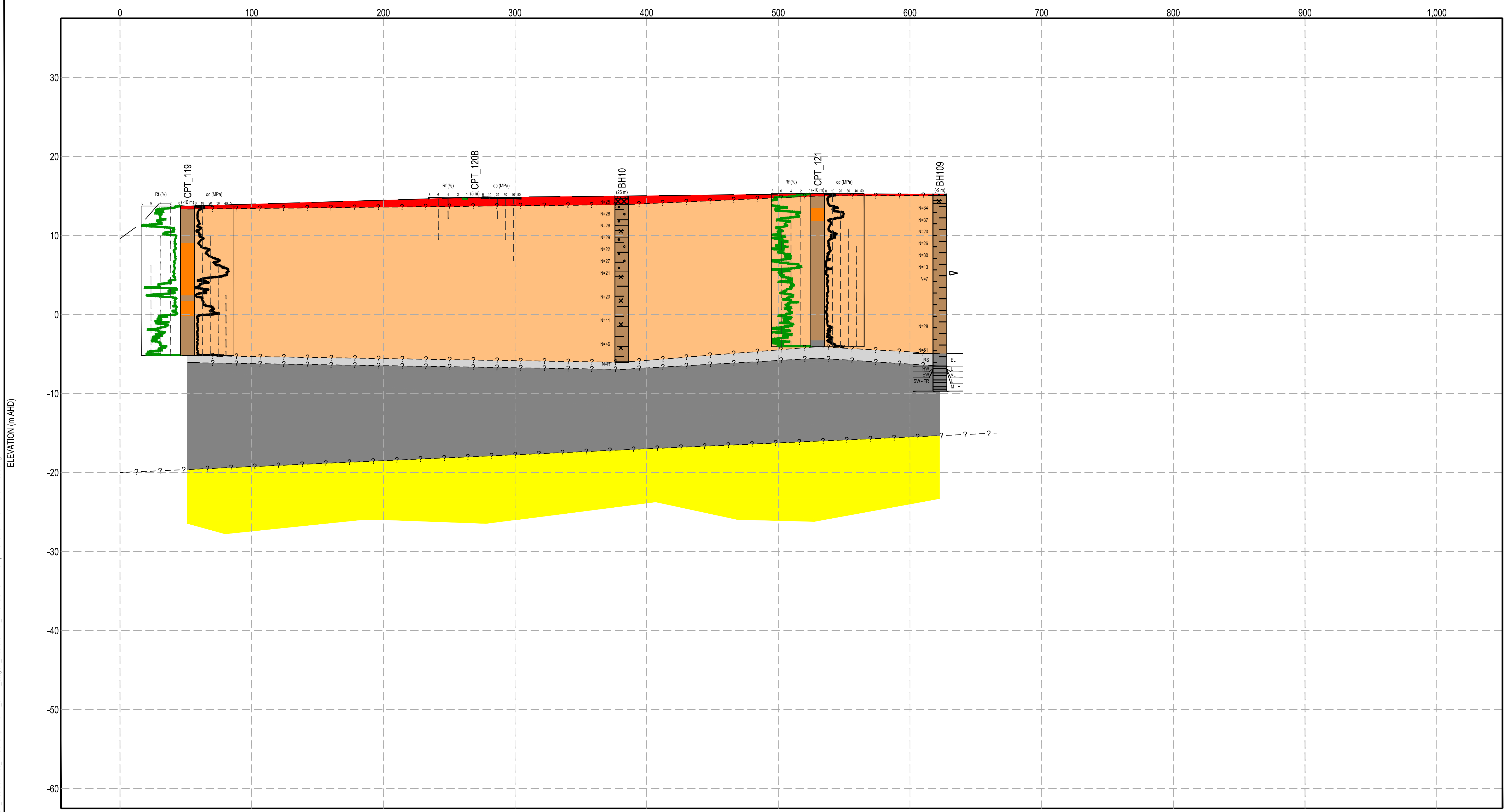
PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

TITLE
INFERRED SUBSURFACE SECTION F - F'

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A032



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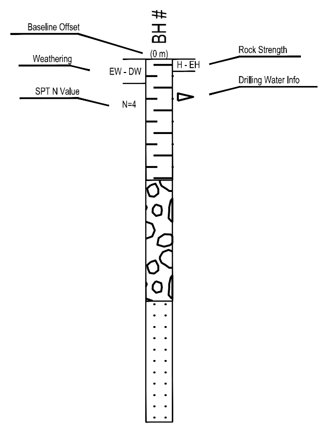


MATERIAL GRAPHIC

- TOPSOIL
- FILL
- Sandy CLAY
- Silty CLAY
- SHALE
- CLAY
- SAND

- UNIT 1 - SURFICIAL SOILS
- UNIT 2 - RECENT ALLUVIUM
- UNIT 3 - OLDER ALLUVIUM
- UNIT 3A - DENSE -VERY DENSE SAND
- UNIT 3B - VERY STIFF - HARD CLAYS
- UNIT 4A - RESIDUAL SHALE SOIL
- UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
- UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
- UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT	PROJECT
SYDNEY INTERMODAL TERMINAL ALLIANCE	MPW GEOTECHNICAL SITE INVESTIGATION

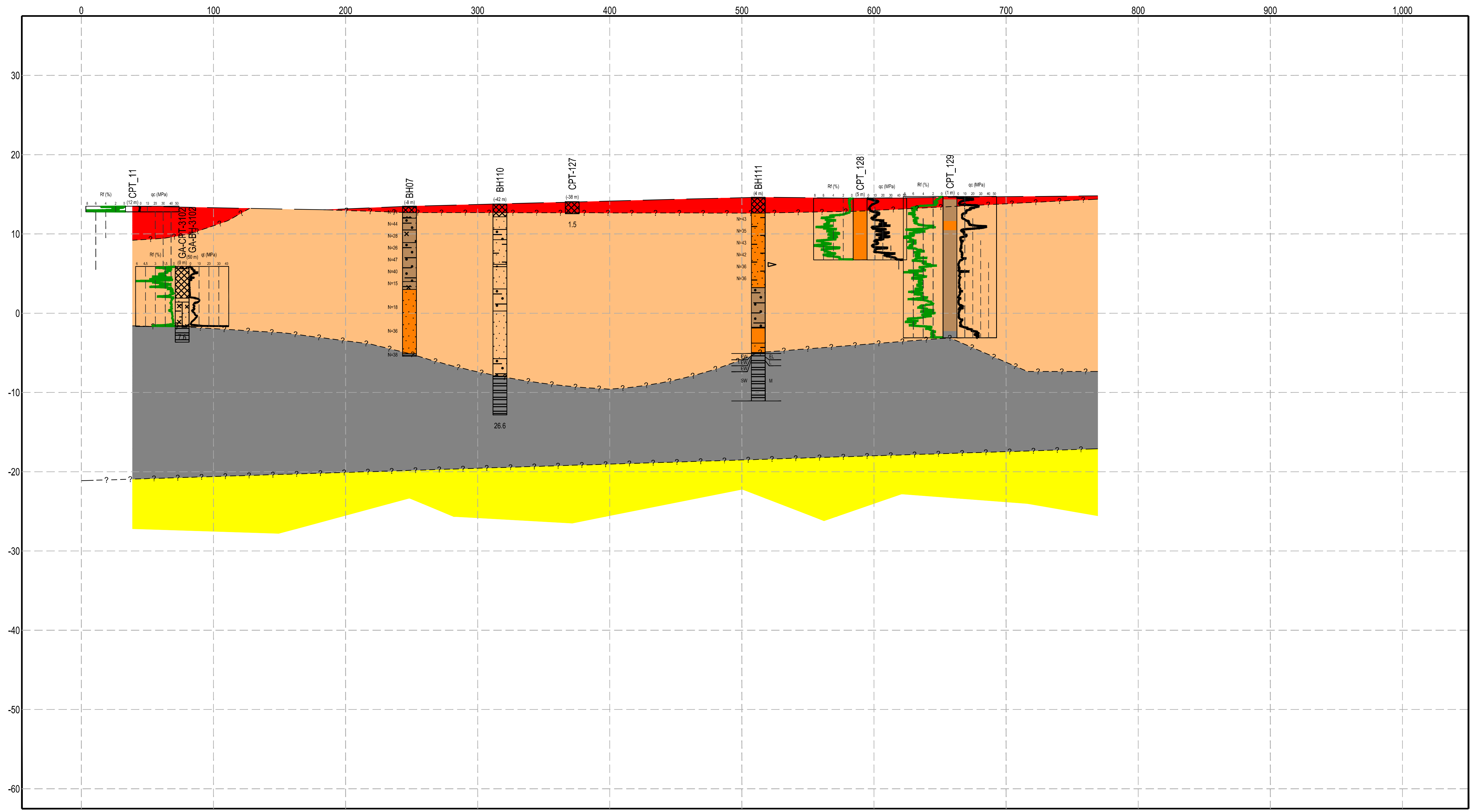
CONSULTANT: Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

TITLE
INFERRED SUBSURFACE SECTION G - G'

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A033

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3
25 mm



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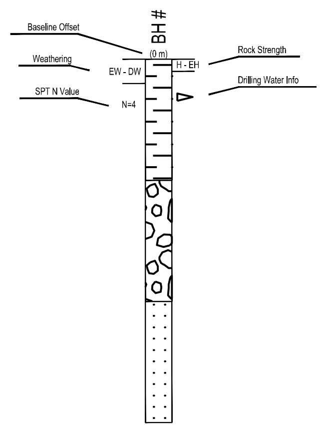


MATERIAL GRAPHIC

- TOPSOIL
- FILL
- Silty CLAY
- Sandy CLAY
- Sandy SILT
- SAND
- Clayey SAND
- CORE LOSS
- SHALE
- CLAY

- UNIT 1 - SURFICIAL SOILS
- UNIT 2 - RECENT ALLUVIUM
- UNIT 3 - OLDER ALLUVIUM
- UNIT 3A - DENSE -VERY DENSE SAND
- UNIT 3B - VERY STIFF - HARD CLAYS
- UNIT 4A - RESIDUAL SHALE SOIL
- UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
- UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
- UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

PROJECT
MPW
GEOTECHNICAL SITE INVESTIGATION

CONSULTANT

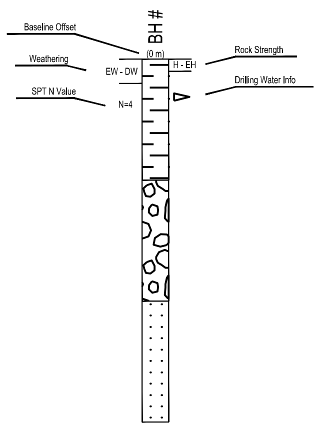
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	EJJ
DESIGN	JDM
REVIEW	NRS
APPROVED	BJF

TITLE
INFERRED SUBSURFACE SECTION H - H'

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	2	A034

POST LEGEND



MATERIAL GRAPHIC

- TOPSOIL
- SAND
- CORE LOSS
- Silty SAND
- FILL
- Silty CLAY
- SHALE
- Gravelly SAND
- CLAY
- Clayey SAND
- ASPHALTIC CONCRETE

- UNIT 1 - SURFICIAL SOILS
- UNIT 2 - RECENT ALLUVIUM
- UNIT 3 - OLDER ALLUVIUM
- UNIT 3A - DENSE -VERY DENSE SAND
- UNIT 3B - VERY STIFF - HARD CLAYS
- UNIT 4A - RESIDUAL SHALE SOIL
- UNIT 4B -EXTREMELY LOW TO LOW STRENGTH SHALE
- UNIT 4C - SHALE OF MEDIUM STRENGTH OR HIGHER
- UNIT 5 - MITTAGONG / HAWKESBURY SANDSTONE + ASSOCIATED RESIDUAL SOILS

0 10 20
1:500 METRES

0 50 100
1:3,000 METRES

CLIENT SYDNEY INTERMODAL TERMINAL ALLIANCE		PROJECT MPW GEOTECHNICAL SITE INVESTIGATION	
CONSULTANT Golder Associates	YYYY-MM-DD: 22016-09-02	TITLE **INFERRED SUBSURFACE SECTION I - I'**	
	PREPARED: EJJ		
	DESIGN: JDM		
	REVIEW: NRS	PROJECT No.: 1416224	REPORT: 016 - R
	APPROVED: BJF	Rev.: 2	FIGURE: A035

Path: \\golder.gds\gap\Sydney\Geomatics\SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)\SIMTA_Stage 1_Moorebank\99_PROJECTS\1416224_SIMTA_Stage 1_Moorebank\02_PRODUCTION\DWG\ | File Name: 1416224-030-R-A037.dwg

LEGEND

TOPSOIL THICKNESS CONTOURS (m)

- 0.05
- 0.1
- 0.15
- 0.20
- 0.25
- 0.30
- 0.35
- 0.40
- 0.45
- 0.50

TOPSOIL THICKNESS OBSERVED

APPROXIMATE SITE BOUNDARY

NOTES

1. THE APPROXIMATE SITE BOUNDARY REPRESENTS THE SPATIAL EXTENT OF THE GOLDER GEOTECHNICAL AND GEOCHEMICAL PROJECT.

nearmap

IMAGE DATED 30-09-2014
SOURCED WITH PERMISSION FROM NEARMAP ON 19-11-2014
IMAGE GEOREFERENCED BY GOLDER AND INTENDED FOR INDICATIVE PURPOSES ONLY
www.nearmap.com.au

0 250 500

1:10,000 METRES

CLIENT

THE TACTICAL GROUP

PROJECT

MPW GEOTECHNICAL SITE INVESTIGATION

TITLE

GEOTECHNICAL INTERPRETIVE REPORT: TOPSOIL THICKNESS CONTOURS (UNIT 1A)

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
DESIGNED	-
PREPARED	NRS / EJJ
REVIEWED	JDM
APPROVED	JDM

PROJECT NO.	REPORT	REV.	FIGURE
1416224	016	2	A036

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25 mm 0

LEGEND

- Anthropogenic Fill (confirmed)
- Anthropogenic Fill (potential)
- Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Post Phase 2 ESA project.

REFERENCE

1. Aerial Photography Copyright NearMap Pty Ltd.

0 75 150 300 450 600 750
Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: ANTHROPOGENIC FILL MATERIALS

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A037

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F037.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4
25mm

LEGEND

Fill Thickness Contour (m)

- 0.4
- 0.8
- 1.2
- 1.6
- 2

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: FILL THICKNESS CONTOURS (UNIT 1C)

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	**A038**

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F038.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

25mm

LEGEND

Top of Rock (mAHD)

- 15
- -10
- -5
- 0
- 5
- 10

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.

REFERENCE

1. Aerial Image sourced from Nearmap.

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: TOP OF ROCK CONTOURS (TOP OF UNITS 4B AND 5B)

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRS
APPROVED	NRS

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	**A039**

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F039.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

0 25mm

LEGEND

Acid Sulfate Soil Risk

- High Risk Sediments
- Low Risk above 4m
- No Risk

Approximate Site Boundary

NOTES

1. The Approximate Site Boundary represents the spatial extent of the Golder Geotechnical and Geochemical project.
2. Acid Sulfate Soils Risk data sourced from the Office of Environment and Heritage (OEH).

REFERENCE

1. Aerial Photography Copyright NearMap Pty Ltd.
2. Acid Sulfate Soils Risk Data copyright NSW Department of Premier and Cabinet, Office of Environment and Heritage (OEH).

0 75 150 300 450 600 750 Metres

REFERENCE SCALE: 1:15,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 56

Path: J:\geo\2014\1416224_SIMTA_Stage 1_Moorebank\Technical Docs\GIS\Project\016-Rev1\1416224_016_Rev1_F040.mxd

CLIENT
THE TACTICAL GROUP

PROJECT
MPW GEOTECHNICAL SITE INVESTIGATION

TITLE
GEOTECHNICAL INTERPRETIVE REPORT: ACID SULPHATE SOIL MAP

CONSULTANT

Golder Associates

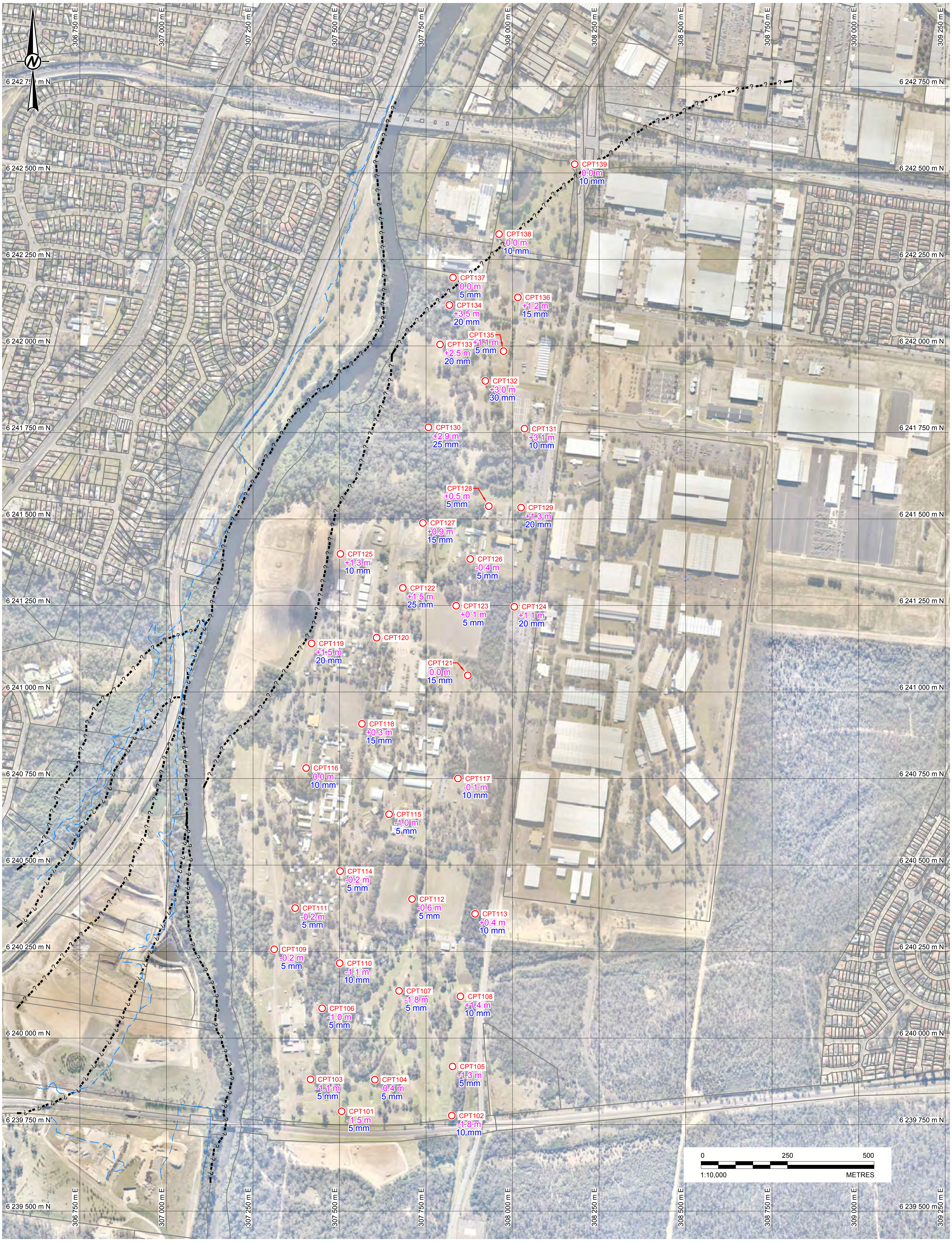
YYYY-MM-DD	2016-09-02
PREPARED	KJS
DESIGN	-
REVIEW	NRM
APPROVED	NRM

PROJECT	DOCUMENT	Rev.	FIGURE
1416224	016	2	A040

25mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4

Path: \\golder.gds\gap\Sydney\Geomatics\SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)\SIMTA_Stage 1_Moorebank\99_PROJECTS\1416224_SIMTA_Stage 1_Moorebank\02_PRODUCTION\DWG\ | File Name: 1416224-016-R-A041.dwg



IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25 mm

LEGEND

1.5 m	CHANGE IN GROUND LEVEL
10 mm	ESTIMATED SETTLEMENT

ASSUMPTIONS

1. SLAB LOADING OF 40 KPa ASSUMED.
2. FOOTING LOADS WERE EXCLUDED.
3. 1-D SETTLEMENT CALCULATION BASED ON CONSTRAINED MODULUS INFERRED AT CPT LOCATIONS.

CLIENT
SYDNEY INTERMODAL TERMINAL ALLIANCE

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-02-17
PREPARED	EJJ
DESIGN	JDM
REVIEW	JDM
APPROVED	JDM

PROJECT
MOOREBANK INTERMODAL TERMINAL
GEOTECHNICAL AND GEOCHEMICAL SITE INVESTIGATION

TITLE
ESTIMATED SETTLEMENTS UNDER 40KPa SLAB LOADING

PROJECT No.	REPORT	Rev.	FIGURE
1416224	016 - R	0	A041

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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Golder Associates

APPENDIX E

SEDIMENT BASIN SIZING SHEET

1. Erosion Hazard and Sediment Basins

Site Name: MPE

Site Location: MOOREBANK

Precinct/Stage: STAGE 2

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	B3	B4	B5A	B5B	B6	B8	
Total catchment area (ha)	7.8	3.28	19.6	25.8	50.94	26.91	
Disturbed catchment area (ha)	7.8	3.28	19.6	25.8	50.94	26.91	

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D	D	D	D	From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D	D	D	D	Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5	5	5	See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85	85	85	85	85	85	
x-day, y-percentile rainfall event (mm)	32.2	32.2	32.2	32.2	32.2	32.2	
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	10.9	10.9	10.9	10.9	10.9	10.9	

RUSLE Factors

Rainfall erosivity (*R*-factor)	2580	2580	2580	2580	2580	2580	Auto-filled from above
Soil erodibility (*K*-factor)	0.075	0.075	0.075	0.075	0.075	0.075	RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	300	300	300	300	300	300	
Slope gradient (%)	1	1	1	1	1	1	
Length/gradient (*LS*-factor)	0.27	0.27	0.27	0.27	0.27	0.27	
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64	0.64	0.64	0.64	0.64	0.64	See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	68	68	68	68	68	68	
Soil Loss Class	1	1	1	1	1	1	See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	53	53	53	53	53	53	Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	68	29	172	226	446	236	See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	1607	676	4039	5317	10498	5546	See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	1675	705	4211	5543	10944	5782	

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

APPENDIX F

CPESC Certification

6 DEC 2020

Our Ref: 19018

Tracey Davey
Environmental Manager
Tactical Group

Dear Ms Davey

Re: SSD 7709: Moorebank Precinct West Stage 2 (MPW Stage 2)

Condition of Approval B29 for SSD7709 provides;

B29. Prior to commencement of construction, the Applicant must prepare a **Soil and Water Management Plan** (SWMP) in accordance with the requirements of *Managing Urban Stormwater - Soils and Construction Volume 1 (Landcom 2004)* and submit it to the Planning Secretary for approval. The SWMP must be certified by a Certified Professional in Erosion and Sediment Control (CPESC) that it is fit for purpose, addresses the constraints posed by site conditions and complies with statutory requirements. The CPESC must have demonstrated experience in the identification, management and mitigation of erosion and sedimentation in dispersive and non-cohesive soils and be approved by the Planning Secretary.

I have reviewed the following document;

Soil and Water Management Plan (SWMP) Moorebank Logistic Park Precinct West (Co13455.07-03_DRAFT9.rpt)

I certify the SWMP and confirm that it is fit for purpose, addresses the constraints posed by site conditions and complies with statutory requirements.

Please contact me if you require further information.

Sincerely

Carl Vincent
Principal
ErSed Environmental Pty Ltd
Certified Professional in Erosion and Sediment Control (CPESC #2385)

APPENDIX G

Monthly Rainfall Erosivity

Monthly Rainfall Erosivity Factor

Liverpool (Whitlam Centre, 1981-2001)

data extracted from bom.gov.au

MFI Calculation				
	Monthly rainfall (p)	Total Annual Rainfall (P)	p^2/P	
January	88.1	876.2	8.86	
February	98.4	876.2	11.05	
March	90.2	876.2	9.29	
April	103.1	876.2	12.13	
May	73.1	876.2	6.10	
June	54.8	876.2	3.43	
July	48.2	876.2	2.65	
August	63.0	876.2	4.53	
September	46.4	876.2	2.46	
October	59.8	876.2	4.08	
November	82.0	876.2	7.67	
December	67.6	876.2	5.22	
		TOTAL	**77.46**	**81.33**
			MFI=Σp^2/P	R=1.05*MFI

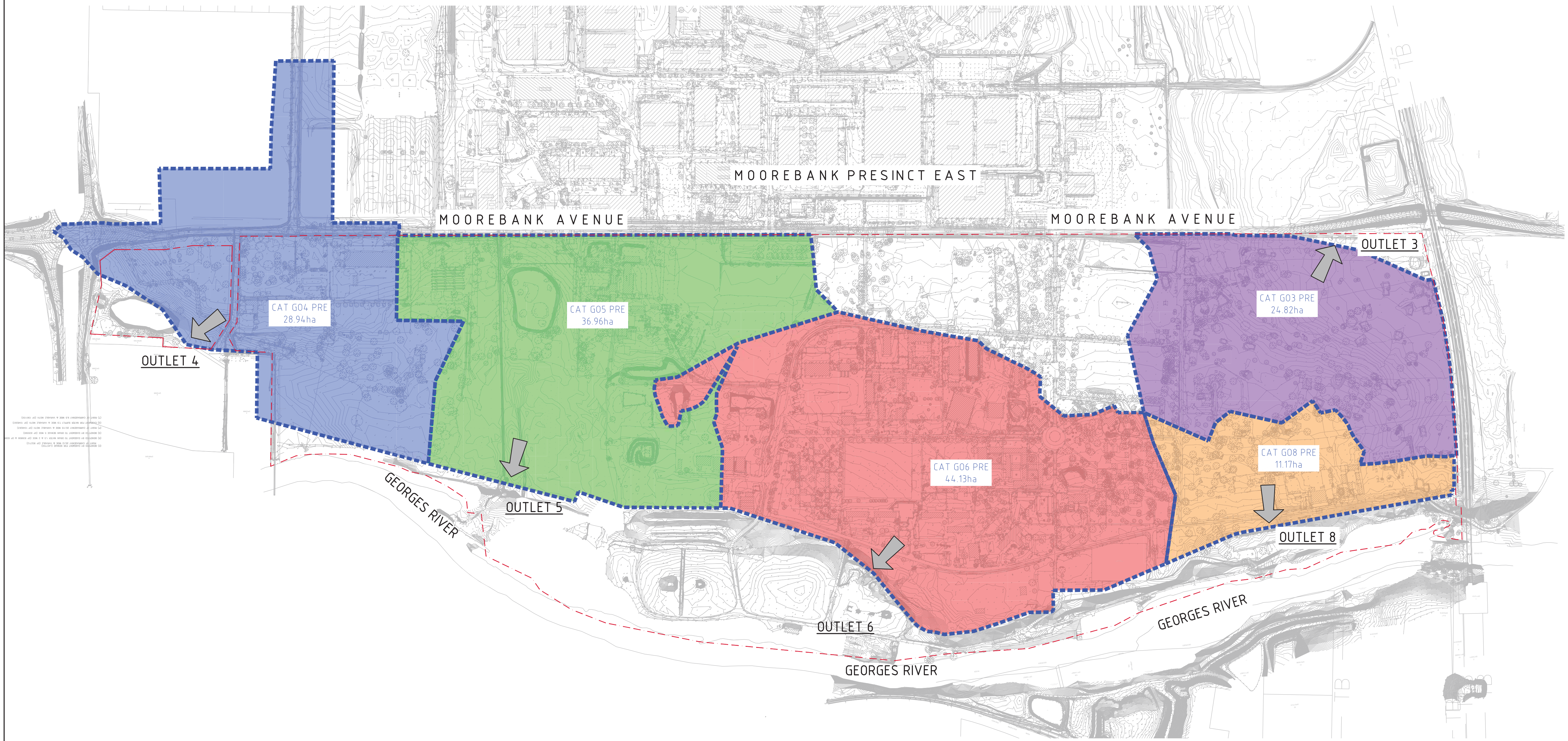
APPENDIX H

COSTIN ROE CONSULTING CATCHMENT DRAWINGS

LEGEND:
LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON A PLAN OF SURVEY '115804500 REV.22' BY 'CARDNO' DATED 12/10/2017.

- MPW SITE BOUNDARY
- CATCHMENT AREA
- STORMWATER DISCHARGE POINT



STORMWATER CATCHMENT PLAN - PRE DEVELOPMENT
1:3000 SCALE

30m 0 50 100 150 200 250 300m
1:3000 SCALE AT A0 SHEET SIZE

FOR POST-APPROVALS

AMENDMENTS	DATE	ISSUE
ISSUED FOR POST APPROVALS	29.11.19	B
PRELIMINARY ISSUE ONLY	16.07.19	A

DEVELOPER: MOOREBANK LOGISTICS PARK, QUBE

ARCHITECT: REIDCAMPBELL — Architecture, Interiors, Project Management

PROJECT MANAGER: TACTICAL GROUP

PROJECT: PRECINCT INFRASTRUCTURE WORKS WEST
MOOREBANK AVENUE, MOOREBANK

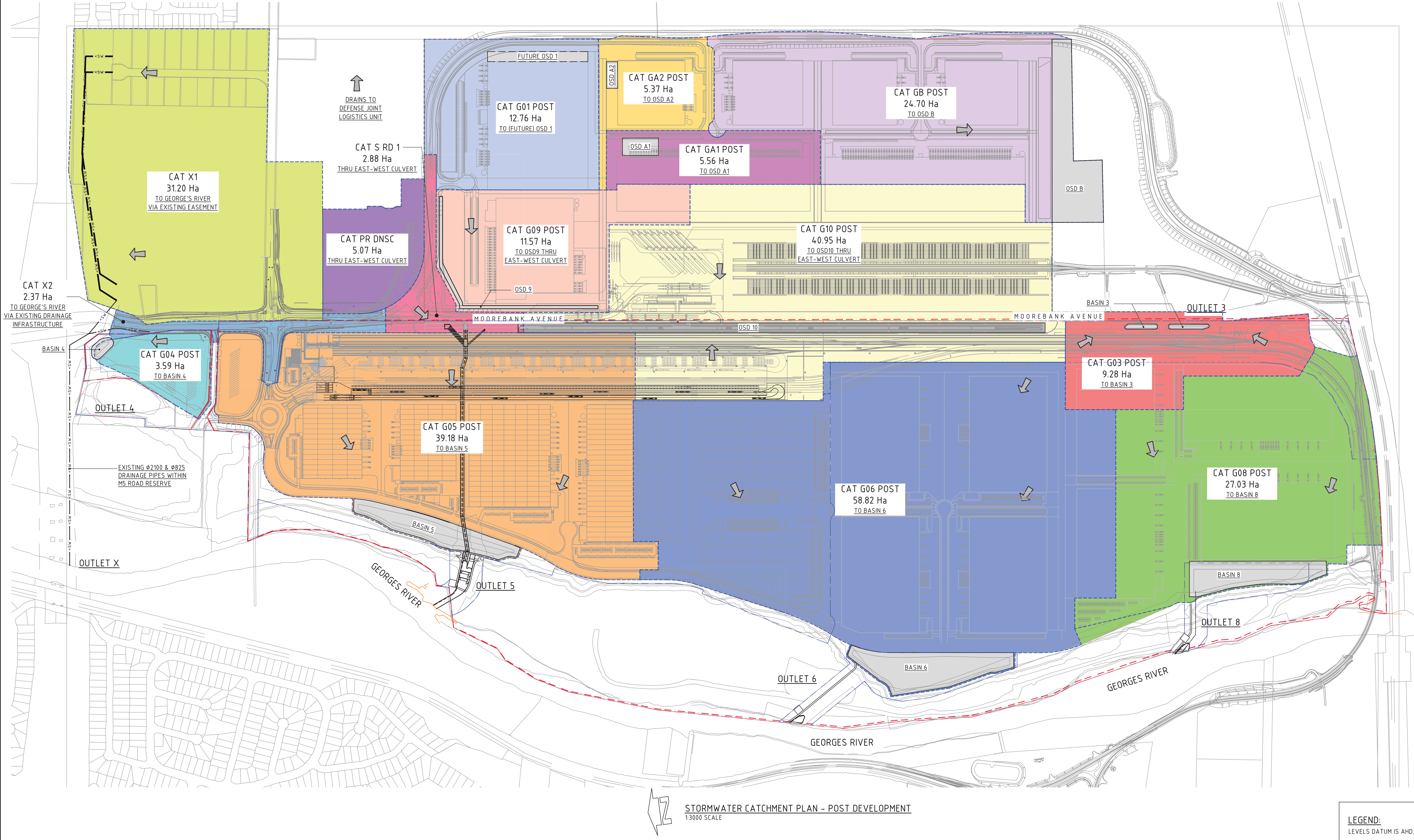
DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0420

Costin Roe Consulting Pty Ltd.
Consulting Engineers ACN 003 696 446
Level 1, 8 Windmill Street
Walsh Bay, Sydney NSW 2000
Tel: (02) 9251-7699 Fax: (02) 9241-3731
email: mail@costinroe.com.au ©

Costin Roe Consulting
PRECISION | COMMUNICATION | ACCOUNTABILITY

DRAWING TITLE: STORMWATER CATCHMENT PLAN PRE DEVELOPMENT

DRAWING No: PIWW-COS-CV-DWG-0420 — ISSUE: B



STORMWATER CATCHMENT PLAN - POST DEVELOPMENT

1:3000 SCALE

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON A PLAN OF SURVEY '115804500 REV.22' BY 'CARDNO' DATED 12/10/2017.

- MPW SITE BOUNDARY
- OPERATIONAL BOUNDARY
- CATCHMENT AREA
- FLOW DIRECTION

30m 0 50 100 150 200 250 300m

1:3000 SCALE AT A0 SHEET SIZE

FOR POST-APPROVALS

AMENDMENTS	DATE	ISSUE
ISSUED FOR POST-APPROVALS	29.11.19	E
PRELIMINARY ISSUE ONLY	18.10.19	D
PRELIMINARY ISSUE ONLY	04.10.19	C
PRELIMINARY ISSUE ONLY	06.09.19	B
PRELIMINARY ISSUE ONLY	16.07.19	A

DEVELOPER: MOOREBANK LOGISTICS PARK, QUBE

ARCHITECT: REIDCAMPBELL

PROJECT MANAGER: TACTICAL GROUP

PROJECT: PRECINCT INFRASTRUCTURE WORKS WEST
MOOREBANK AVENUE, MOOREBANK

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	AUG 19	M.W.	A0	AS SHOWN	PIWW-COS-CV-DWG-0421

Costin Roe Consulting Pty Ltd.
Consulting Engineers ACN 003 696 446
Level 1, 8 Windmill Street
Walsh Bay, Sydney NSW 2000
Tel: (02) 9251-7699 Fax: (02) 9241-3731
email: mail@costinroe.com.au ©

Costin Roe Consulting

PRECISION | COMMUNICATION | ACCOUNTABILITY

DRAWING TITLE: STORMWATER CATCHMENT PLAN POST DEVELOPMENT

DRAWING No: PIWW-COS-CV-DWG-0421

ISSUE: E

APPENDIX I
NSW EPA ENVIRONMENTAL LICENCE NUMBER: 21054

Environment Protection Licence

Licence Details	
Number:	21054
Anniversary Date:	04-June

Licensee
QUBE RE SERVICES (NO.2) PTY LIMITED
LEVEL 27/45 CLARENCE STREET
SYDNEY NSW 2000

Premises
MOOREBANK PRECINCT
NOT APPLICABLE
MOOREBANK NSW 2170

Scheduled Activity
Crushing, grinding or separating
Extractive activities

Fee Based Activity	**Scale**
Crushing, grinding or separating	> 100000-500000 T annual processing capacity
Extractive activities	> 500000-2000000 T annual capacity to extract or process

Region
Metropolitan - Sydney Industry
Level 13, 10 Valentine Ave
PARRAMATTA NSW 2150
Phone: (02) 9995 5000
Fax: (02) 9995 6900
PO Box 668
PARRAMATTA NSW 2124

Environment Protection Licence

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 (“the Act”) and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act);
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

The EPA publication "A Guide to Licensing" contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

QUBE RE SERVICES (NO.2) PTY LIMITED
LEVEL 27/45 CLARENCE STREET
SYDNEY NSW 2000

subject to the conditions which follow.

1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

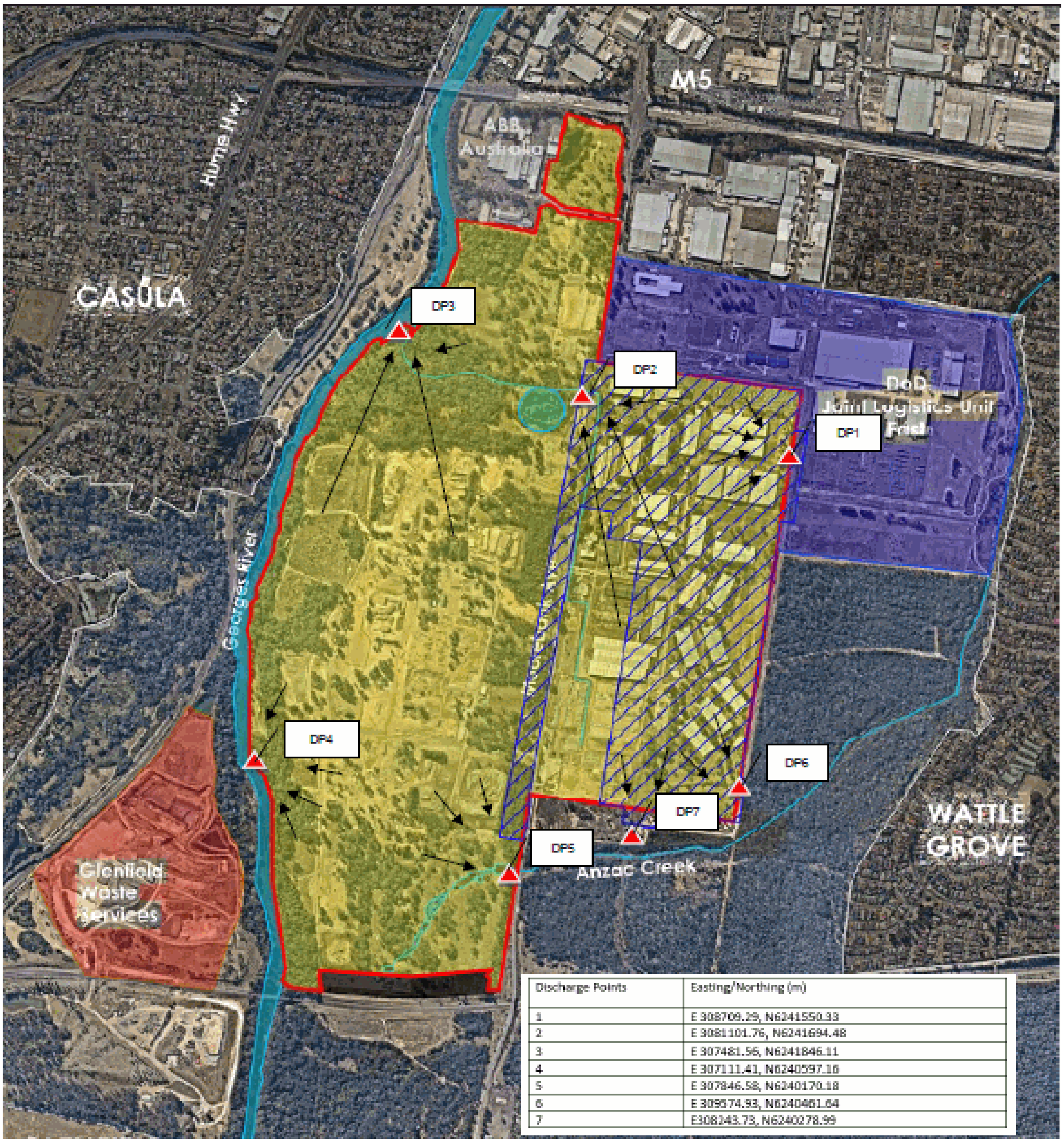
Scheduled Activity	Fee Based Activity	Scale
Crushing, grinding or separating	Crushing, grinding or separating	> 100000 - 500000 T annual processing capacity
Extractive activities	Extractive activities	> 500000 - 2000000 T annual capacity to extract or process

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
MOOREBANK PRECINCT
NOT APPLICABLE
MOOREBANK
NSW 2170
LOT 1 DP 1048263, LOT 100 DP 1049508, PART LOT 1 DP 1197707, PART LOT 2 DP 1197707
PREMISES IS DEFINED ON APPENDIX D LOCALITY AND PORTION OF THE PREMISES PLAN – MOOREBANK PRECINCT EPL PLAN VARIATION NO.2 (DOC19/505751-2)

A2.2 The premises location is shown on the map below.



A3 Other activities

A3.1 This licence applies to all other activities carried on at the premises, including:

Ancillary Activity
Bulk earthworks "cut and fill"
Importing fill
Road construction

A4 Information supplied to the EPA

A4.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

A5 Other administrative conditions

A5.1 Scheduled activities authorised by this licence are limited to where the following approvals under the Environmental Planning and Assessment Act 1979 have been granted, and activities are carried out in accordance with the relevant consent conditions.
1. MP10_0193 Moorebank Intermodal Precinct East - Concept Plan Modification (MOD 2) - approved 31/01/2018;
2. SSD 6766 Moorebank Intermodal Precinct East - Stage 1 - approved by court 12/09/2017;
3. SSD 7628 Moorebank Intermodal Precinct East - Stage 2 -approved 31/01/2018;
4. SSD 5066 Moorebank Intermodal Precinct West - Concept Proposal & Stage 1 Early Works - approved 03/06/2016.

Note: Where any of the above documents have multiple versions and/or where any inconsistency between versions arises, the most recent document applies to the extent of any inconsistency.

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

P1.1 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identi-fication no.	Type of Monitoring Point	Type of Discharge Point	Location Description

1	DP1 Moorebank Precinct East	DP1 Moorebank Precinct East	DP1 on Appendix D Locality and portion of the Premises Plan – Figure 01 Moorebank Precinct EPL Plan Variation No.1Moorebank Precinct EPL 21054 Variation No.1 for MPE Stage 2. (DOC19/304548)
2	DP2 Moorebank Precinct East	DP2 Moorebank Precinct East	DP2 on Appendix D Locality and portion of the Premises Plan – Figure 01 Moorebank Precinct EPL Plan Variation No.1Moorebank Precinct EPL 21054 Variation No.1 for MPE Stage 2. (DOC19/304548)
3	DP3 Moorebank Precinct West	DP3 Moorebank Precinct West	DP3 on Appendix D Locality and portion of the Premises Plan – Figure 01 Moorebank Precinct EPL Plan Variation No.1Moorebank Precinct EPL 21054 Variation No.1 for MPE Stage 2. (DOC19/304548)
4	DP4 Moorebank Precinct West	DP4 Moorebank Precinct West	DP4 on Appendix D Locality and portion of the Premises Plan – Figure 01 Moorebank Precinct EPL Plan Variation No.1Moorebank Precinct EPL 21054 Variation No.1 for MPE Stage 2. (DOC19/304548)
5	DP5 Moorebank Precinct West	DP5 Moorebank Precinct West	DP5 on Appendix D Locality and portion of the Premises Plan – Figure 01 Moorebank Precinct EPL Plan Variation No.1Moorebank Precinct EPL 21054 Variation No.1 for MPE Stage 2. (DOC19/304548)
6	DP6 Moorebank Precinct East	DP6 Moorebank Precinct East	DP6 on Appendix D Locality and portion of the Premises Plan – Figure 01 Moorebank Precinct EPL Plan Variation No.1Moorebank Precinct EPL 21054 Variation No.1 for MPE Stage 2. (DOC19/304548)
7	DP7 Moorebank Precinct East	DP7 Moorebank Precinct East	DP7 on Appendix D Locality and portion of the Premises Plan – Moorebank Precinct EPL Plan Variation No.2 (DOC19/505751-2)

3 Limit Conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Concentration limits

L2.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.

L2.4 Water and/or Land Concentration Limits

POINT 1,2,3,4,5,6,7

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	Visible				0
pH	pH				6.5-8.5
TSS	milligrams per litre				50
Turbidity	nephelometric turbidity units				25

POINT 3,4,5

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Perfluorohexane sulphonate (PFHxS)	micrograms per litre				0.7
Perfluorooctane sulphonate (PFOS)	micrograms per litre				0.7
Perfluorooctanoic acid (PFOA)	micrograms per litre				5.6

Note: PFHxS and PFOS must not exceed a total combined concentration limit of 0.7 micrograms per litre

L2.5 The total suspended solids and turbidity limits specified under Condition L2.4 for the discharge points identified as EPA licence discharge points 1, 2, 3, 4, 5, 6 and 7 do not apply when the discharge occurs solely as a result of rainfall measured at the premises which exceeds;
- a total of 24.4 millimetre of rainfall over any consecutive 5 day period.

Note: A 24.4mm rainfall depth is defined by the publication Managing Urban Stormwater: Soils and Construction (Landcom 2004) as the rainfall depth in millimetres for a 80th percentile 5 day rainfall events for the Liverpool area.

L2.6 The concentration limit for Total Suspended Solids (TSS) and turbidity under condition L2.4 for licence discharge points 1, 2, 3, 4, 5, 6 and 7 is deemed not to have been breached where:

(a) the sample complies with the turbidity limit at the time of the discharge; and
(b) the EPA is advised within three (3) working days of completion of the TSS testing, of any TSS results above the licence limit.

Note: The purpose of this condition is to expedite the assessment and subsequent discharge of the clarified water from the sediment basins.

L3 Waste

L3.1 The licensee must not cause, permit or allow any waste to be received at the premises, except the wastes expressly referred to in the column titled “Waste” and meeting the definition, if any, in the column titled “Description” in the table below.
Any waste received at the premises must only be used for the activities referred to in relation to that waste in the column titled “Activity” in the table below.
Any waste received at the premises is subject to those limits or conditions, if any, referred to in relation to that waste contained in the column titled “Other Limits” in the table below.
This condition does not limit any other conditions in this licence.

Code	Waste	Description	Activity	Other Limits
NA	General or Specific exempted waste	Waste that meets all the conditions of the resource recovery exemption under Clause 91 and Clause 92 Protection of the Environment Operations (Waste) Regulation 2014	As specified in each particular resource recovery exemption	

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.

This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner.

O3 Effluent application to land

O3.1 Wastewater application must not occur in a manner that causes surface runoff.

O3.2 Spray from wastewater application must not drift beyond the boundary of the premises or into a watercourse.

O3.3 The quantity of wastewater applied to the utilisation area(s) must not exceed the capacity of the utilisation area(s) to effectively utilise the wastewater.

Note: *For the purpose of this condition, "effectively utilise" includes the ability of the soil to absorb the nutrient, salt, hydraulic load and organic material without causing harm to the environment.*

Note: *For the purpose of this condition "utilisation area(s)" include all areas within the premises where wastewater from the sediment basin(s) is applied:*

(a) for the purpose of dust suppression; and
(b) where water is discharged to vegetation for the purpose of maintaining the biodiversity offset area(s).

O4 Processes and management

O4.1 All chemicals, fuels and explosives must be handled and stored in a bunded area which complies with the specifications of the relevant Australian Standard and legislative requirements.

O4.2 Contingency and emergency management plans must be developed and implemented for the spill of any chemical and fuel.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Water and/ or Land Monitoring Requirements

POINT 1,2,3,4,5,6,7

Pollutant	Units of measure	Frequency	Sampling Method
pH	pH	Monthly during discharge	Grab sample
Total suspended solids	milligrams per litre	Monthly during discharge	Grab sample
Turbidity	nephelometric turbidity units	Monthly during discharge	Grab sample

POINT 3,4,5

Pollutant	Units of measure	Frequency	Sampling Method
Perfluorohexane sulphonate (PFHxS)	micrograms per litre	Monthly during discharge	Grab sample
Perfluorooctane sulphonate (PFOS)	micrograms per litre	Monthly during discharge	Grab sample
Perfluorooctanoic acid (PFOA)	micrograms per litre	Monthly during discharge	Grab sample

M3 Testing methods - concentration limits

M3.1 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 The preceding two conditions do not apply until August 2018, 3 months after the date of the issue of this licence.

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:

1. a Statement of Compliance,
2. a Monitoring and Complaints Summary,
3. a Statement of Compliance - Licence Conditions,
4. a Statement of Compliance - Load based Fee,
5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan,
6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
7. a Statement of Compliance - Environmental Management Systems and Practices.

At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee:
a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect *EPA* or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

R1.7 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
a) the licence holder; or
b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R2 Notification of environmental harm

R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
a) where this licence applies to premises, an event has occurred at the premises; or
b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
a) the cause, time and duration of the event;
b) the type, volume and concentration of every pollutant discharged as a result of the event;
c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

G2 Signage

G2.1 The location of EPA point number(s) 1, 2, 3, 4, 5, 6 and 7 must be clearly marked by signage that indicates the point identification number used in this licence and be located as close as practically possible to the point.

8 Special Conditions

E1 Crushing, Grinding or Separating Activities

E1.1 Prior to the commencement of the crushing, grinding or separating activities, the licensee must prepare an assessment report that identifies any risks related to the processing and on-site reuse of the materials being processed (the material);
The risk assessment must consider:
a. the potential for contamination of the material from the storage, handling or use of industrial or hazardous chemicals, waste or asbestos containing materials over the history of the use of the site; and
b. the potential for ongoing exposure and adverse impacts on human health or the environment during processing or on-site reuse.

E1.2 The assessment report detailed in Condition E1.1 must be prepared by a Certified Environmental Practitioner (CEnvP) – Site Contamination. The assessment report must be submitted to the Director Sydney Industry at metro.regulation@epa.nsw.gov.au prior to the commencement of the Scheduled Activity.

E1.3 Crushing, grinding or separating activities authorised by this licence may not commence until the licensee has been provided with confirmation from the Site Auditor, that the material to be processed is suitable for processing and reuse on the site.

Note: In condition E1.3 Site Auditor means the NSW EPA accredited contaminated site auditor appointed to prepare any Site Audit Report or Site Audit Statement required by any condition of consent under approvals referred to in condition A5.

E2 Extractive Activities

E2.1 Extractive activities authorised by this licence may not commence until the licensee has been provided with confirmation from the Site Auditor, that the area to be excavated is suitable for reuse on the site.

Note: In condition E2.1 Site Auditor means the NSW EPA accredited contaminated site auditor appointed to prepare any Site Audit Report or Site Audit Statement required by any condition of consent under approvals referred to in condition A5.

E3 Schedule of Works

E3.1 The Licensee must provide a written estimate of the date of commencement, duration, location and volume of scheduled activities authorised under this licence in the following 24 months. The written estimate must be provided with the annual return required by Condition R1 and must include plans of the location the activities are to be carried on.

Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environmen t Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder describe d at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 mo nths. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non - putrescible), special waste or hazardous waste

Ms Erin Barker

Environment Protection Authority

(By Delegation)

Date of this edition: 04-June-2018

End Notes

2	Licence varied by notice	1571681 issued on 18-Apr-2019
3	Licence varied by notice	1582348 issued on 01-Aug-2019

APPENDIX J

APPLICANTS FINAL COMPILATION OF MITIGATION MEASURES (FCMM's)

FINAL COMPILATION OF MITIGATION MEASURES

The MPW Stage 2 Environmental Impact Statement ((MPW Stage 2 EIS) Arcadis, 2016) identified a range of environmental impacts and recommended management and mitigation measures to avoid, remedy or mitigate these impacts (refer to Section 22 of the MPW Stage 2 EIS).

These mitigation measures were revised as part of the MPW Stage 2 Response to Submissions Report ((MPW Stage 2 RtS), Arcadis, 2017) in response to the following:

- Submissions received during the public exhibition period
- To address the amendments to the Proposal
- To incorporate additional mitigation measures from the MPW Concept RtS where necessary.

Subsequent to the submission of the MPW Stage 2 RtS to the NSW Department of Planning and the Environment (DP&E), DP&E have requested that we provide a consolidated list of mitigation measures, including measures in the response to DP&E issues (as requested in the *Moorebank Precinct West – Response to Submissions and outstanding information* letter (DP&E request), issued on 28 August 2017). In response to the DP&E request, a review of the following documentation has been undertaken:

- *Preliminary Construction Environmental Management Plan* (Arcadis, 2016), provided as Appendix I of the MPW Stage 2 EIS
- *Preliminary Construction Traffic Management Plan* (Arcadis, 2016), provided at Appendix M of the MPW Stage 2 EIS
- *Preliminary Operational Traffic Management Plan* (Arcadis, 2016), provided at Appendix M of the MPW Stage 2 EIS
- *Noise and Vibration Impact Assessment* (Wilkinson Murray, 2016), provided at Appendix N of the MPW Stage 2 EIS
- *Preliminary Construction Air Quality Management Plan* (Ramboll Environ, 2016), provided at Appendix O of the MPW Stage 2 EIS
- Revised mitigation measures provided in Section 8 of the MPW Stage 2 RtS
- *Stockpile Management Protocol,* provided at Appendix L of the MPW Stage 2 RtS
- *Environmental Works Method Statement*, provided at Appendix M of the MPW Stage 2
- *Moorebank Precinct West (MPW) Stage 2 (SSD 7709) Response to Submissions* letter, issued to NSW DP&E (dated 31 August 2017).

As part of this review, the mitigation measures have been updated to include information that was previously presented within these management plans, appended to both the MPW Stage 2 EIS and RtS. No additional information, that was not previously submitted to DP&E, has been included in these mitigation measures.

This cumulative presentation of mitigation measures supersede those previously provided in Section 8 of the MPW Stage 2 RtS.

For ease of reference, words deleted as part of this review are shown in *~~italic strike through~~* and words inserted are shown in <u>*underlined italics*</u>.

The revised mitigation measures represent the Final Compilation of Mitigation Measures (FCMM) for the MPW Stage 2 Proposal and are provided in Table 1 below.

Pre-construction activities for the Amended Proposal would be undertaken in the areas shown in Figure 1 and is relevant to mitigation measure No. 0A only (refer to Table 1).

The construction and operational activities included within the Amended Proposal have been separated into components based on their functional relationship and include the following:

- IMT – IMT and associated development including, but not limited to, container handling and storage, truck access, processing and holding areas, rail sidings and associated infrastructure, administration area and ancillary components (container washdown and de-gassing area and main site road and roundabout).
- Rail link connection – including, but not limited to, the rail sidings and access tracks.
- Warehousing – including, but not limited to, warehousing and attached offices, container storage areas, car parking, truck loading/unloading areas and vehicle manoeuvring, access roads and the freight village.
- Moorebank Avenue intersection -including, but not limited to, Moorebank Avenue/Anzac Road and Moorebank Avenue/Bapaume Road intersection works.
- Site infrastructure – including but not limited to, construction works such as tree clearing, earthworks, construction and operation of the perimeter road, east west channel, OSDs, utilities.

Figure 2 and Figure 3 outlines these components of the Amended Proposal provided in Table 1.

The 'implementation stage' column of Table 1 indicates the timing as to when the specific mitigation measures would be implemented. For example, a CEMP might be prepared prior to construction, but would not be 'implemented' until the construction phase.

For this Final Compilation of Mitigations Measures, the following definitions apply to the terms used in the implementation phase column:

- Detailed design - works and design progression prior to construction of the associated permanent physical works for the Amended Proposal
- Pre-construction phase – initial stage of physical works for the Amended Proposal, which are not included within the definition of construction and within Works period A
- Construction phase – during construction of all permanent physical works for the Proposal (Works periods B - G)
- Operation phase - either prior to, or during, operation of the Amended Proposal.

Figure 1 Pre-construction activities

Figure 2 Site infrastructure

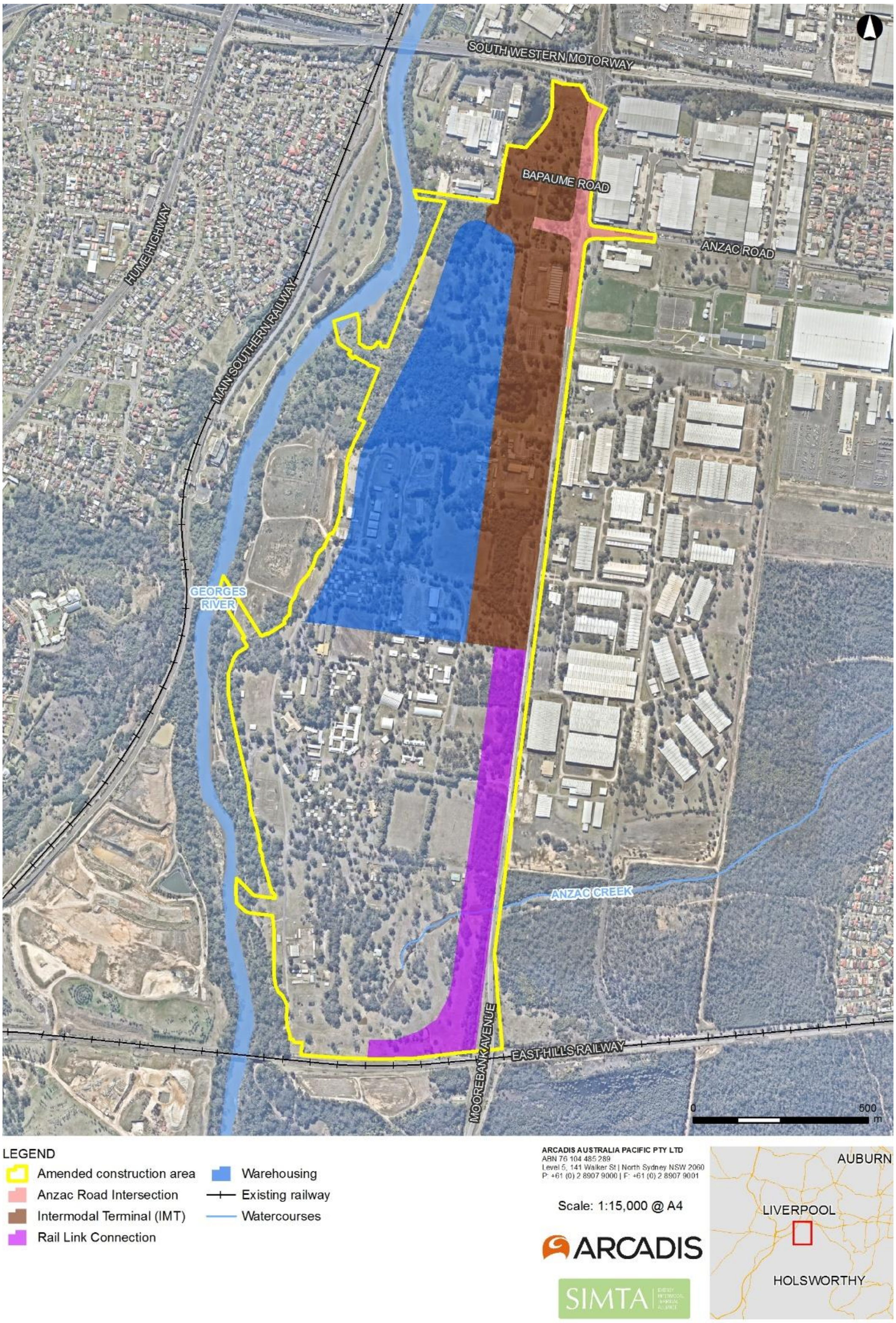


Figure 3 Key operational components

Table 1 Final Compilation of Mitigation Measures – MPW Stage 2 Proposal

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
0.	**General environmental management**						
0A	Pre-construction works would be undertaken subject to the preparation of an Environmental Work Method Statement (EWMS) or equivalent. Pre-construction works include the following: ▪ survey; acquisitions; or building/ road dilapidation surveys; fencing; investigative drilling, excavation or salvage ▪ minor clearing or translocation of native vegetation that does not comprise any EECs ▪ establishment of site compounds and construction facilities ▪ installation of environmental mitigation measures ▪ utilities adjustment and relocation that do not present a significant risk to the environment, as determined by the Environmental Representative ▪ other activities determined by the Environmental Representative to have minimal environmental impact ▪ All works as described in Works period A in section 4 of this EIS ▪ Stockpiling within the areas denoted for pre-construction stockpiling within Figure 1 of this document, in accordance with the stockpile management protocol.	Pre-Construction	Y	Y	Y	Y	Y
0B	The Construction Environmental Management Plan (CEMP), or equivalent, for the Proposal would be based on the PCEMP (Appendix I of this EIS), and include the following preliminary management plans: ▪ Preliminary Construction Traffic Management Plan (PCTMP) (Appendix M of the EIS)	Construction	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Air Quality Management Plan (Appendix O of the EIS) ▪ Erosion and Sediment Control Plans (ESCPs) and Bulk Earthworks Plans, within the Stormwater Drainage Design Drawings (Appendix R of the EIS) As a minimum, the CEMP would include the following sub-plans: ▪ Construction Traffic Management Plan (CTMP) ▪ Construction Noise and Vibration Management Plan (CNVMP), prepared in accordance with the Interim Construction Noise Guideline ▪ Cultural Heritage Assessment Report/Management Plan ▪ Construction Air Quality Management Plan ▪ Construction Soil and Water Management Plan (SWMP), prepared in accordance with Managing Urban Stormwater, 4th Edition, Volume 1, (2004). ▪ Erosion and Sediment Control Plan ▪ Flood Emergency Response and Evacuation Plan ▪ UXO, EO, and EOW Management Plan ▪ Acid Sulfate Soils Management Plan ▪ Bushfire Management Strategy ▪ Community Information and Awareness Strategy. ▪ Flora and Fauna Management Plan (FFMP) ▪ Groundwater Monitoring Program (GMP) ▪ Stockpile Management Protocol						
0C	The Operational Environmental Management Plan (OEMP), or equivalent, for the Proposal would be based on the following preliminary management plans	Operation	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Preliminary Operational Traffic Management Plan (POTMP) (Appendix M of the EIS) ▪ Air Quality Management Plan (Appendix O of the EIS) ▪ Erosion and Sediment Control Plans (ESCPs) and Bulk Earthworks Plans, within the Stormwater Drainage Design Drawings (Appendix R of the EIS) As a minimum, the OEMP would include the following sub-plans ▪ Operational Traffic Management Plan (OTMP) ▪ Operational Noise and Vibration Management plan (ONVMP) ▪ Air Quality Management Plan ▪ Flooding and Emergency Response Plan (FERP) ▪ Groundwater Monitoring Program ▪ Long term Environmental Management Plan (LTEMP) ▪ Pollution Incident Response Management Plan (PIRMP), including Spill Management Procedure, prepared under the EPA's Environmental Guidelines: Preparation of Pollution Incident Response Management Plans (EPA, 2012) ▪ Fire Safety and Evacuation Plan ▪ Community Information and Awareness Strategy. ▪ Flora and Fauna Management Plan ▪ Emergency Vehicle Response Plan						
0D	The construction and/or operation of the Proposal may be delivered in a number of stages. If construction and/or operation is to be delivered in stages a Staging Report would be provided to the Secretary prior to commencement of the initial stage of construction and updated prior to the commencement of each stage as that stage is identified. The Staging Report would identify the progressive installation of site	Construction and operation	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	infrastructure and services, as appropriate to the progressive development of the Proposal.						
0E	*The Proposal is not anticipated to include any works within the Georges River. Should works be required within the Georges River consultation with the Department of Primary Industries (Crown Lands) would be undertaken.*	*Construction*	*N*	*N*	*N*	*N*	*Y*
1.	**Traffic and Transport**						
1A	A Construction Traffic Management Plan (CTMP) would be prepared based on the Preliminary Construction Traffic Management Plan (Appendix M of the EIS), detailing management controls to be implemented to avoid or minimise impacts to traffic, pedestrian and cyclist access, and the amenity of the surrounding environment. The following key initiatives would be included in the CTMP: ▪ Review of speed restrictions along Moorebank Avenue and additional signposting of speed limitations ▪ Restriction of haulage routes through signage and education to ensure, where possible, that construction vehicles do not travel through nearby residential areas to access the Proposal site, in particular Moorebank (Anzac Road) or the Wattle Grove residential areas ▪ Inform local residents (in conjunction with the Community Information and Awareness Strategy) of the proposed construction activities and road access restrictions that the construction traffic must adhere to and establish communication protocols for community feedback on issues relating to construction vehicle driver behaviour and construction related matters ▪ Installation of specific warning signs at entrances to the construction area to warn existing road users of entering and exiting construction traffic	Construction	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Establishing pedestrian walking routes and crossing points ▪ Distribution of day warning notices to advise local road users of scheduled construction activities ▪ Installation of appropriate traffic control and warning signs for areas identified where potential safety risk issues exist ▪ The promotion of car-pooling for construction staff and other shared transport initiatives during the pre-construction phase ▪ <u>Facilitating emergency vehicle access to the site</u> ▪ Management of the transportation of materials to maximise vehicle loads and therefore minimise vehicle movements ▪ Minimising the volumes of construction vehicles travelling during peak periods ▪ Maintaining access to neighbouring properties, in particular the ABB site ▪ Monitoring of traffic on Moorebank Avenue during peak construction periods to ensure that queuing at intersections does not unreasonably impact on other road users.						
1B	A Road Safety Audit would be undertaken on Cambridge Avenue to identify potential traffic safety risks from the Proposal (in consideration of background traffic) and determine appropriate mitigation.	Construction	N	N	N	N	Y
1C	Moorebank Avenue/Anzac Road/Proposal site intersection would be upgraded to include a four-leg intersection as shown in Appendix G of the EIS. The funding of this intersection upgrade would be clarified through discussions with SIMTA and Roads and Maritime.	Operation	Y	Y	Y	Y	<u>*N*</u>
1D	The Operational Traffic Management Plan would be prepared based on the Preliminary Operational Traffic Management Plan (Appendix M of the EIS) and include the following key initiatives: ▪ Heavy vehicle route management	Operation	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Safety and amenity of road users and public ▪ Congestion management on Moorebank Avenue ▪ Road user delay management ▪ Information signage, distance information and advance warning systems ▪ Driver code of conduct ▪ Incident management ▪ Traffic monitoring.						
1E	Consultation with TfNSW would be conducted regarding the provision for active transport to/from the Proposal site and along the internal perimeter road, as part of detailed design for the Proposal.	Operation	N	N	N	Y	N
1F	Bicycle and end of trip facilities would be provided in accordance with the City of Sydney Section 3 – General Provisions.	Operation	Y	N	Y	N	N
1G	Consultation would be undertaken with relevant bus provider(s) regarding the potential to extend the 901 bus service (or equivalent) and additional bus stops with the aim of maximising public transport accessibility to and within the Proposal site.	Operation	Y	Y	Y	N	N
1H	Importation of fill to site during construction of the Proposal is to not exceed a total of 22,000 m^3 of material per day. This limit is to be further reduced by an amount equivalent to any fill being imported to the MPE Stage 2 Proposal (SSD 7628) on the same day such that the combined importation of fill to the Proposal site and MPE site does not exceed 22,000 m^3 on any given day.	Construction	N	N	N	N	Y
1I	During operation, emergency vehicle access would be managed through an Emergency Vehicle Response Plan developed for the Proposal in consultation with the NSW Police Force, NSW Fire Brigade, NSW Rural Fire Service and the Ambulance Service of NSW, where appropriate.	Operation	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
2.	**Noise and Vibration**						
2A	A Construction Noise and Vibration Management Plan (CNVMP), or equivalent, would be prepared for the Proposal in accordance with the Interim Construction Noise Guideline (or equivalent), and would give consideration to Revised Environmental Mitigation Measures (REMMs) 5A – 5B (of the MPW Concept Plan Approval (SSD 5066)).	Construction	Y	Y	Y	Y	Y
2B	The ambient noise monitoring surveys undertaken within Casula, Wattle Grove and Glenfield would be continued throughout the construction and operation of the Proposal (with annual reporting of noise results up to two years beyond the completion of the Proposal).	Construction and operation	Y	Y	Y	Y	Y
2C	In the event of any noise or vibration related complaint or adverse comment from the community, noise and ground vibration levels would be investigated. Remedial action would be implemented where feasible and reasonable.	Construction and operation	Y	Y	Y	Y	Y
2D	~~*A noise wall would be installed along a portion of the western boundary of the Proposal site in the general location identified in Figure 7-1 of the Noise Impact Assessment (Appendix N of the EIS). The height, extent, and staged implementation of the noise wall would be confirmed, based on further noise modelling undertaken during detailed design.*~~ ~~*Should the detailed design solution require a staggered noise wall, the final noise wall would be designed to provide the appropriate level of noise attenuation to minimise operational noise impacts on nearby noise- sensitive receivers, where practicable.*~~ *Noise mitigation measures would be implemented to affected residential receivers at Casula which are subject to noise impacts above the established noise criteria. These mitigation measures could include (but are not limited to) attenuation at the receiver (i.e. treatment of dwellings) and/or attenuation at the source (i.e installation*	*Construction and* operation	Y	N	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	of a noise wall on the Proposal site). The need for the selection of noise mitigation measures, and timing for implementation, would be subject to noise monitoring during operations and further modelling to be undertaken following the commencement of operations. Provision has been made for a noise wall in the event that it is deemed necessary during operations.						
2E	Best practice noise mitigation measures would be implemented for the operational phase of the Proposal including: ▪ Noise monitoring (refer to mitigation measures 2B and 2C above) ▪ A gate appointment system would be implemented to minimise truck loading/unloading wait times and resultant queueing. Trucks would be turned away from facility if arriving too early ▪ Truck marshalling lanes would be included to minimise congestion and queueing ▪ The provision of information signs and communication of MPW idle reduction policy.	Operation	Y	Y	Y	N	N
2F	Management of vibration impacts to Kitchener House. In the event that plant items to be used for construction identified in Table 12 of the Noise Technical Memorandum (refer to Appendix D of this RtS) are proposed to be operated within their respective “Cosmetic Damage” safe working distances from Kitchener House, then attended vibration monitoring would be conducted at Kitchener House to verify that the ‘safe’ vibration level is not exceeded. If exceedances are approached, the work should cease immediately, and alternative construction methods should be used.	Construction	Y	N	N	Y	Y
2G	*SIMTA would restrict port shuttle locomotives that do not meet the noise requirements of Environment Protection Licences (EPLs) 3142 and 12208 from entering the MPW Stage 2 rail link.*	*Operation*	*N*	*Y*	*N*	*N*	*N*

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
3.	**Air Quality**						
3A	A Construction Air Quality Management Plan would be prepared based on the Air Quality Management Plan (Appendix O of the EIS) and include the following key initiatives: Procedures for controlling/managing dust: ▪ Clearing, site preparation and excavation: – Deploy water carts periodically during construction to ensure exposure areas and topsoils/subsoil are kept moist. – Work practices would be modified to manage/control dust by limiting clearing, stripping and spoil handling during periods ofadverse weather (hot, dry and windy conditions) and when dust is seen leaving the site. – The extent of clearing of vegetation and topsoil would be limited to the designated footprint required for construction and appropriate staging of any clearing. ▪ Demolition of existing structures – Where possible, materials and structures would be dampened using water sprays prior to demolition. During adverse weather (hot, dry and windy conditions), consideration would be given to modify demolition activities when dust is seen leaving the site. Special consideration, including boundary monitoring would need to be given to the demolition of buildings containing asbestos in accordance with relevant guidelines and legislation. ▪ Haulage and heavy plant and equipment movements – Water carts would be operated on all unsealed internal roadways and travel routes. – All vehicles on-site would be confined to a designated route with a speed limit of 30km/hr enforced.	Construction	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	– Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips. – Dirt track-out should be managed using shaker grids and / or wheel cleaning. Dirt that has been tracked onto public roads would be cleaned as soon as practicable. – All trucks delivering fill or leaving the site with spoil material would have their load covered. ▪ Wind erosion – Wind erosion from exposed ground would be limited by avoiding unnecessary vegetation and topsoil clearing and limiting to the minimum footprint required. – Wind erosion from temporary stockpiles would be limited by minimising the number of work faces on stockpiles and through temporary stabilisation (compaction of surface, water sprays, seeding, veneering). Roles, responsibilities and reporting requirements: ▪ During construction, environmental management would be the responsibility of the construction contractor. The Construction Manager (CM) would be responsible for the day to day construction activities of the Proposal site, including the implementation of dust controls. Construction dust monitoring: ▪ Visual checks would be made daily and reported on an environmental inspection report. The visual checks would: – Inspect and report on excessive dust being generated at source (wheel generated dust, scrapers/graders, dozers, excavators, wind erosion). – Inspect and report on water cart activity and effectiveness. – Inspect and report on dust leaving the site.						

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	– Non-conformance (dust leaving the site) would be reported immediately to the CM or management. ▪ Contingency measures for dust control where standard measures are deemed ineffective.						
3B	Vehicle movements would be limited to designated entries and exits, haulage routes and parking areas.	Construction	Y	Y	Y	Y	Y
3C	Best practice air quality mitigation measures would be implemented for the operational phase of the Proposal including: Locomotives ▪ Ensure locomotives are well maintained in accordance with the manufacturer's specification or relevant operational plan. Update maintenance plans to include a requirement to consider air emissions and where possible improve air emission performance at next overhaul/upgrade (for SIMTA operational fleet) ▪ Ultra Low Emitting Switch Locomotives would be considered during the procurement process, having regard to technical, logistical and financial considerations ▪ Anti-idle policy and communication / training for locomotive operators ▪ Unnecessary idling avoided through driver training and site anti-idle policy ▪ Driver training for fuel efficiency.	Operation	Y	Y	N	N	N
	Container Handling ▪ New reach stackers to achieve emissions performance equivalent to US EPA Tier 3 / Euro Stage IIIA standards ▪ Unnecessary idling avoided through driver training and site anti-idle policy		Y	N	N	N	N

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Mitigation measures</th><th rowspan="2">Implementation stage</th><th colspan="5">Applicability</th></tr>
<tr><th>IMT</th><th>Rail link connection</th><th>Warehousing</th><th>Moorebank Ave intersection</th><th>Site infrastructure</th></tr>
<tr><td></td><td>▪ Equipment with smoky exhausts (more than 10 seconds) should be stood down for maintenance.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>Trucks
▪ Gate appointment system, truck marshalling lanes and rejection of trucks that arrive early to minimise wait times and queuing
▪ Development of an anti-idle policy and communication through the provision of information signs
▪ Unnecessary idling avoided through driver training and site anti-idle policy
▪ Loading and unloading coordinated to minimise truck trip distances as they travel through site.</td><td></td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td></tr>
<tr><td>3F</td><td>The Air Quality Management Plan (Appendix O of the EIS), would be further progressed and incorporated into the OEMP for the Proposal. In accordance with the AQMP the following key aspects would be addressed in the OEMP:
▪ Implementation and communication of anti-idling policy for trucks and locomotives
▪ 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.</td><td>Operation</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td></tr>
<tr><td>3G</td><td>SIMTA would restrict port shuttle locomotives from entering the MPW Stage 2 rail link, that do not meet the following air emissions standards:
<table>
<tr><th>Locomotive Type</th><th>Standard</th><th>Periodic Improvements</th><th>Ultimate Outcome</th></tr>
<tr><td>Existing locomotives</td><td>Operated with diesel particulate emissions less</td><td>Any overhauls of existing locomotives after the</td><td>All existing locomotives to comply with 7</td></tr>
</table></td><td>Operations</td><td>Y</td><td>Y</td><td>N</td><td>N</td><td>N</td></tr>
</table>

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<tr><td></td><td><table>
<tr><td></td><td>than 0.30 grams per kilowatt hour</td><td>commencement of operations</td><td>years of operation</td></tr>
<tr><td>New locomotives</td><td>Operated with diesel particulate emissions less than 0.27 and NOx emissions of less than 7.37 grams per kilowatt hour.</td><td>Any new locomotives ordered after the commencement of operations</td><td>N/A</td></tr>
<tr><td></td><td>Operated with diesel particulate emissions less than 0.13 and NOx emissions of less than 7.37 grams per kilowatt hour.</td><td>Any new locomotives ordered after 5 years of the commencement of operations</td><td>N/A</td></tr>
</table></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td colspan="7">Biodiversity</td></tr>
<tr><td>4A</td><td>Following detailed design and before construction, detailed flora and fauna mitigation measures would be developed and presented as part of the CEMP. These detailed measures would incorporate the measures listed below.
The CEMP would address:
▪ general impact mitigation
▪ staff/contractor inductions
▪ vegetation clearing protocols including identification of exclusion zones
▪ pre-clearing surveys and fauna salvage/translocation
▪ rehabilitation and restitution of adjoining habitat
▪ weed control
▪ pest management</td><td>Construction</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>Y</td></tr>
</table>

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ monitoring. The CEMP would include clear objectives and actions for the Proposal including how to: ▪ minimise human interferences to flora and fauna ▪ minimise vegetation clearing/disturbance ▪ minimise impact to threatened species and communities ▪ minimise impacts to aquatic habitats and species ▪ undertake flora and fauna monitoring at regular intervals.						
4B	Vegetation clearing would be restricted to the construction footprint with sensitive areas, outside of this footprint, clearly identified as vegetation exclusion zones.	Pre-construction and Construction	Y	Y	Y	Y	Y
4C	The vegetation exclusion zones would be marked on maps, which would be prepared by the contractor/s, and would also be marked on the ground using high visibility fencing (such as barrier mesh).	Pre-construction and Construction	Y	Y	Y	Y	Y
4D	A suitably qualified ecologist would accompany clearing crews to ensure disturbance is minimised and to assist in relocating any native fauna to adjacent habitat.	Construction	Y	Y	Y	N	Y
4E	The following procedures would be implemented to minimise fauna impacts from vegetation clearance: ▪ A staged habitat removal process would be developed and would include the identification and marking of all habitat trees in the area ▪ Where reasonable and feasible, clearing of hollow-bearing trees would be undertaken in March and April when most microbats are likely to be active (not in torpor) but are unlikely to be breeding or caring for young, and when threatened hollow-bearing tree dependent birds in the locality are also unlikely to be breeding	Construction	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Pre-clearing surveys would be conducted 12 to 48 hours before vegetation clearing to search for native wildlife (e.g. reptiles, frogs, Cumberland Land Snail) that can be captured and relocated to the retained riparian vegetation of the Georges River corridor ▪ Vegetation would be cleared from a 10 m radius around habitat trees to encourage animals roosting in hollows to leave the tree. A minimum 48 hour waiting period would allow animals to leave ▪ After the waiting period, standing habitat trees would be shaken (where safe and practicable) under the supervision of an ecologist to encourage animals roosting in hollows to leave the trees, which may then be felled, commencing with the most distant trees from secure habitat ▪ Felled habitat trees would either be immediately moved to the edge of retained vegetation, or left on the ground for a further 24 hours before being removed from the construction area, at the discretion of the supervising ecologist ▪ All contractors would have the contact numbers of wildlife rescue groups and would be instructed to coordinate with these groups in relation to any animal injured or orphaned during clearing.						
4F	Within areas of high quality intact native vegetation proposed to be removed: ▪ Topsoil (and seedbank) would be collected from native vegetation that are to be permanently cleared and used in the revegetation of riparian areas ▪ Where feasible and reasonable native plants in areas that are to be permanently cleared would be relocated and transplanted in riparian areas identified for rehabilitation	Construction	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
4G	Relocation of fauna to adjacent retained habitat would be undertaken by a suitably qualified ecologist during the supervision of vegetation removal.	Construction	Y	Y	Y	Y	Y
4H	An ecologist would supervise the drainage of any waterbodies on the Proposal site and would relocate tortoises and frogs to the edge of the Georges River and/or the existing pond at the northern end of the Proposal site. Native fish (e.g. eels) that are endemic to the Sydney area would be translocated from drained ponds/dams on the site to natural waterways and pest fish would be euthanised on ice. If non-endemic native species are encountered on site, DPI Fisheries would be consulted to determine the best location to translocate this species.	Construction	Y	Y	Y	N	Y
4I	The design of temporary site fencing and any overhead powerlines would consider the potential for collision by birds and bats and minimise this risk where practicable.	Detailed design & Pre-construction, construction	Y	Y	Y	Y	Y
4J	The potential for translocation of threatened plant species as individuals or as part of a soil translocation process would be considered during the detailed development of the EWMS and CEMP.	Detailed design, construction and construction	Y	Y	Y	N	Y
4K	Important habitat elements (e.g. large woody debris) would be moved from the construction area to locations within the conservation area which would not be cleared during the Proposal, or to stockpiles for later use in vegetation/habitat restoration.	Pre-construction and Construction	Y	Y	Y	N	Y
4L	Winter-flowering trees would be preferentially planted in landscaped areas of the Proposal site to provide a winter foraging resource for migratory and nomadic nectar-feeding birds and the Grey-headed Flying-fox.	Detailed design, Pre-construction and Construction	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
4M	Erosion and sediment control measures such as silt fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality. The erosion and sediment controls to be included to avoid, minimise and mitigate against the potential for construction of the Proposal to result in erosion and sedimentation impacts will be determined in consideration of the erosive potential of locally occurring soils, and the characteristics of the clean general fill to be imported as part of construction of the Proposal.	Pre-construction and Construction	Y	Y	Y	Y	Y
4N	Opportunities for planting of detention basins with native aquatic emergent plants and fringing trees would be explored in the detailed design of the Proposal and, if practicable, implemented so that they would provide similar habitat in the medium term to that lost through the removal of existing basins.	Detailed design and construction	Y	Y	N	N	Y
4O	The CEMP (or equivalent) would include detailed measures for minimising the risk of introducing weeds and pathogens for construction related vehicles and equipment.	Construction	Y	Y	Y	Y	Y
4P	The CEMP and OEMP for the Proposal would consider and have reference to the weed removal and riparian vegetation restoration undertaken within parts of the Georges River corridor under the MPW Concept Approval (identified within the Biodiversity Offset Package for the MPW Project).	Construction and operation	N	N	N	N	Y
4Q	The detailed design process would consider the potential groundwater impacts on groundwater-dependent ecosystems. In most cases, these impacts, if evident, would be mitigated at the design phase.	Detailed design and construction	Y	Y	Y	N	Y
4R	The OEMP would include a biodiversity monitoring program designed to detect operational impacts of the Georges River riparian corridor (within the offset site).	Operation	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
4S	Ongoing monitoring of macroinvertebrate communities would be undertaken prior to, during and following construction upstream and downstream of the potential impacts at the proposed basin outlets in the Georges River and reference locations to assist in identifying any changes in aquatic communities.	Pre-construction, construction and operation	Y	Y	Y	N	Y
4T	The proposed stormwater basin outlets would be designed to minimise biodiversity impacts by incorporating native revegetation and fauna habitat features as far as possible.	Detailed design	Y	Y	Y	N	Y
4U	The native vegetation and connectivity values in the proposed basin outlets would be monitored to ensure that fauna passage is maintained.	Construction and operation	Y	Y	Y	N	Y
4V	During operation, both threatened and non-threatened species of frogs and reptiles may be at risk of injury or mortality. Controls such as fencing would be put in place to keep land-based fauna away from the operating terminals.	Operation	Y	Y	Y	N	Y
4W	A monitoring program would be developed and implemented to measure the performance of revegetation activities in the Georges River riparian zone and associated conservation area.	Construction and operation	Y	Y	Y	N	Y
5.	**Stormwater and Flooding**						
5A	A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be prepared for the Proposal. The SWMP and ESCPs would be prepared in accordance with the principles and requirements of the Blue Book and based on the Preliminary ESCPs provided in the Stormwater and Flooding Assessment Report (refer to Appendix R of the EIS). The following aspects would be addressed within the SWMP and ESCPs: ▪ Minimise the area of soil disturbed and exposed to erosion	Construction	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Priority should be given to management practices that minimise erosion, rather than to those that capture sediment downslope or at the catchment outlet ▪ Divert clean water around the construction site or control the flow of clean water at non-erodible velocities through the construction area ▪ Provision of boundary treatments around the perimeter of construction areas to minimise the migration of sediment offsite ▪ Permanent or temporary drainage works (in particular OSDs) would be installed as early as practical in the construction program to minimise uncontrolled drainage and associated erosion ▪ Stockpiles would be located away from flow paths on appropriate impermeable surfaces, to minimise potential sediment transportation. Where practicable, stockpiles would be stabilised if the exposed face of the stockpile is inactive more than ten days, and would be formed with sediment filters in place immediately downslope ▪ Disturbed land would be rehabilitated as soon practicable ▪ The wheels of all vehicles would be cleaned prior to exiting the construction site where excavation occurs to prevent the tracking of mud. Where this is not practical, or excessive soil transfer occurs onto paved areas, street cleaning would be undertaken when necessary. ▪ A requirement to inspect all permanent and temporary erosion and sedimentation control works prior to and post rainfall events and prior to closure of the construction area. Erosion and sediment control structures must be cleaned, repaired and augmented as required. ▪ Where required, sediment basins and their outlets would be designed to be stable in the peak flow from at least the 10-year						

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	ARI time of concentration event. Sediment basins should be sized to accommodate the 5 day, 80th percentile storm event, with sufficient size and capacity to manage Type F soils. Sediment basins must be regularly cleaned to maintain the design capacity. Prior to discharge from sediment basins, water would be tested for the following parameters to identify construction impacts: – pH – Turbidity / TSS – Oil and grease. ▪ Sediment fences are to be provided around the perimeter of the site to ensure no untreated runoff leaves the site, and around the existing and proposed drainage channels to minimise sediment migration into waterways and sediment basins ▪ The following management measures would be implemented during works in and adjacent to Georges River to mitigate potential impacts on water quality during OSD channel construction: – All reasonable efforts would be taken to program construction activities during periods when flood flows are not likely to occur – The construction site, on completion of construction works, would be left in a condition that promotes native revegetation – The management principles outlined in Managing Urban Stormwater (Landcom 2004) for sites with high erosion potential would be implemented.						
5B	Proposal site exits would be fitted with hardstand material, rumble grids or other appropriate measures to limit the amount of material transported offsite.	Construction	Y	Y	Y	Y	Y
5C	The following measures would be considered during the development of construction methodology for the Proposal to mitigate flooding impacts:	Construction	N	N	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ For all site works, provide temporary diversion channels around temporary work obstructions to allow low and normal flows to safely bypass the work areas ▪ Locate site compounds, stockpiling areas and storage areas for sensitive plant, equipment and hazardous materials above an appropriate design flood level, outside of the PMF extent at the northern section of the construction area, to be determined based on the duration of the construction work.						
5D	To minimise potential flood impacts during construction of the Proposal, the following measures would be implemented and documented in the SWMP: ▪ The existing site catchment and sub-catchment boundaries would be maintained as far as practicable ▪ To the extent practicable, site imperviousness and grades should be limited to the extent of existing imperviousness and grades under existing development conditions ▪ Smaller detention storages that provide adequate rainfall runoff mitigation during partial construction/site development would be considered. ▪ Temporary structures used to convey on site run-off during construction would be designed to accommodate flows during prolonged or intense rainfalls. The existing stormwater conduit conveying flows from Moorebank Avenue to the Georges River would be assessed to ensure it is adequate to accommodate run-off from the construction area.	Construction	N	N	Y	Y	Y
5E	A Flood Emergency Response and Evacuation Plan, or equivalent, would be prepared and implemented for the construction phase of the Proposal to allow work sites to be safely evacuated and secured in	Construction	N	N	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	advance of flooding occurring at the Proposal site. The plan would be prepared in consultation with the State Emergency Service.						
5F	Stormwater quality improvement devices would be designed to meet the performance targets identified in the Stormwater and Flooding Environmental Assessment (Appendix R of the EIS), and civil design drawings. Maintenance of the bio-retention structures would be in accordance with the maintenance requirements set out in Gold Coast City Council's Water Sensitive Urban Design Guidelines 2007 and would be included in the OEMP.	Operation	Y	Y	Y	N	Y
5G	Operational water quality monitoring is to be carried out and included in the OEMP with the objective of maintaining or improving existing water quality.	Operation	Y	Y	Y	N	Y
5H	A Flood Emergency Response Plan (FERP) would be prepared and implemented for the operational phase of the Proposal. The FERP would take into consideration, site flooding and broader flood emergency response plans for the Georges River floodplains and Moorebank area. The FERP would also include the identification of an area of safe refuge within the Proposal site that would allow people to wait until hazardous flows have receded and safe evacuation is possible. The FERP would be prepared in consultation with the State Emergency Service.	Operation	Y	Y	Y	Y	Y
5I	Stockpile sites established during construction are to be managed in accordance with stockpile management principles set out in Appendix L of this RtS. Mitigation measures within the Stockpile Management Protocol include: ▪ In order to accept fill material onto site, material characterisation reports/certification showing that the material being supplied is VENM/ENM must be provided.	Construction	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Each truck entering the MPE Stage 2 Proposal site will be visually checked and documented to confirm that only approved materials that are consistent with the environmental approvals are allowed to enter the site. ▪ Only fully tarped loads are to be accepted by the gatekeeper. ▪ Environmental Assurance of imported fill material will be conducted to confirm that the materials comply with the NSW EPA Waste Classification Guidelines and the Earthworks Specification for the MPW site. The frequency of assurance testing will be as nominated by the Environmental assuror/auditor. ▪ All trucks accessing the site for the purpose of clean general fill importation would enter and exit via the existing main MPE Stage 2 site access located in the North-west of the MPE site from Moorebank Avenue. ▪ Ingress and egress to the stockpiling areas would be arranged so that the reversing of trucks within the site is minimised. ▪ Stockpiles would not exceed ten-metres in height from the final site levels, with battered walls at gradients of 1V:3H For any stockpile heights greater than 4 m, benching would be implemented. ▪ For any stockpile heights greater than 4 m, benching would be implemented. ▪ Where reasonable and feasible, and to minimise the potential for erosion and sedimentation of stockpile(s), stockpile profiles would typically be at angle of repose (the steepest angle at which a sloping surface formed of loose material is stable) with a slight concave slope to limit the loss of sediments off the slope, or through the profile and the formation of a toe drain. ▪ The top surface of the stockpile(s) would be slightly sloped to avoid ponding and increase run off.						

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Topsoil stockpiles would be vegetated to minimise erosion. ▪ Stockpiles would be protected from upslope stormwater surface flow through the use of catch drains, berms, or similar feature(s) to divert water around the stockpile(s). ▪ A sediment control device, such as a sediment fence, berm, or similar, would be positioned downslope of the stockpile to minimise sediment migration. ▪ Any water seepage from stockpiles would be directed by toe drains at the base of the stockpiles toward the sediment basins or check dams and away from the emplacement or extraction working face. ▪ Newly formed stockpiles would be compacted (sealed off) using a smooth drum roller at the end of each working day to minimise water infiltration. ▪ Haul roads would be located alongside the stockpile to the work/tipping area. As per best practice, the catchment area of haul roads for surface water runoff would be approximately 2530 m lengths, facilitated by the provision of spine drains which would convey water from the haul road to toe drains at the base of the stockpile, and then to sediment basins. ▪ Temporary sediment basins would be established in accordance with the ESCP prepared for the site. ▪ Stockpiling of clean fill material is to be carried out during Works Period A (pre-construction) and Works Period D (bulk earthworks). ▪ Any imported clean general fill material that would be subject to stockpiling within the Proposal site for more than a 10-day period without being worked on, would be subject to stabilisation works, to minimise the potential for erosion. ▪ Where the material being stockpiled is less coarse or has a significant component of fines then surface and slope stabilisation						

No.	Mitigation measures	Implementation stage	Applicability				
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	would be undertaken. Methods for slope stabilisation may include one or a combination of the following: – Application of a polymer to bind material together – Application of hydro-seed or hydromulch – Covering batters with mulch to provide ground cover. – Covering batters with geofabric – Use of a simple sprinkler system for temporary stockpiles, including use of radiating sprinkler nozzles to maintain fine spray over exposes surfaces. – Other options identified by the Contractor. ▪ Topsoil stockpiles would be seeded with a grass/legume or nitrogen fixing species (such as acacia) to assist in erosion control and reduce loss of beneficial soil nutrients and micro-organisms.						
5J	Gross pollutant traps would be provided at basin inlets for all permanent basins during operation.	Construction	N	N	N	N	Y
5K	Hydraulic modelling of OSD outlet channels (using HEC-RAS software) would be undertaken during detailed design, to facilitate the design of the channels and demonstrate their effectiveness with respect to energy dissipation and scour protection elements	Detailed Design	N	N	N	N	Y
6.	**Geology, Soils and Land Contamination**						
6A	The CEMP would identify the actions to be taken should additional contamination be identified during the development of the site (i.e. an unexpected finds protocol), and will address REMM items 8H, 8T, 8U, 8V and 8W (of the MPW Concept Plan Approval (SSD 5066)).	Construction	N	N	N	Y	Y
6B	A site specific Remediation Action Plan (RAP) is not considered to be required for the Proposal. The following documentation would be utilised for the purposes of remediating the site:	Construction	N	N	N	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ The Preliminary Remediation Action Plan (PB, 2014a) ▪ The Validation Plan – Principles (Golder, 2015b) ▪ The Demolition and Remediation Specification (Golder 2015c) ▪ Any other contamination documentation prepared for the remediation activities undertaken for MPW Early Works (Stage 1).						
6C	The CEMP would include the preparation of a site-wide UXO, EO, and EOW management plan (or equivalent) based on the UXO Risk Review and Management Plan (G-Tek, 2016). This plan would be implemented to address the discovery of UXO or EOW during construction, to ensure a safe environment for all staff, visitors and contractors.	Construction	N	N	N	N	Y
6D	An Asbestos in Soils Management Plan (AMP) is to be implemented as part of the CEMP in accordance with the Safe Work NSW requirements, including but not limited to: ▪ the Guidelines for Managing asbestos in or on soil (2014), and ▪ Codes of Practice - How to Safely Remove Asbestos (2011) and How to Manage and Control Asbestos in the Workplace (2011).	Construction	N	N	N	Y	Y
6E	An Acid Sulfate Soils Management Plan (or equivalent) would be prepared as part of the CEMP in accordance with the ASSMAC Assessment Guidelines (1998), for areas identified as being of low or high risk i.e. works within close vicinity of the Georges River (Figure 13-2 of this EIS). In addition, a risk assessment quantifying the risks associated with the volumes of soil to be disturbed, the laboratory results from ASS testing undertaken, the end use of the materials and the proximity to sensitive environments is to be undertaken. All offsite disposal would be in accordance with the NSW Waste Classification Guidelines Part 4: Acid Sulfate Soils (2009).	Construction	N	N	N	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
6F	The existing groundwater monitoring undertaken for the Proposal would continue. A groundwater monitoring program (GMP) would be developed at the conclusion of remediation activities for the Proposal and included as part a Long Term Environmental Management Plan (LTEMP) (to be prepared for approval by the Accredited Site Auditor and in association with the OEMP). The main purpose of the GMP would be to assist in the management of groundwater contamination (particularly PFAS impacts) at the site, and to minimise potential harm to human health and the environment. The GMP would achieve the following objectives: ▪ Establish whether the residual groundwater contamination plume is shrinking, stable, or increasing, and whether natural attenuation and/or migration is occurring according to expectations through line-of-evidence collection ▪ Provide appropriate groundwater investigation levels (GILs) for groundwater contaminants, in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM). Should exceedances be identified, contingency plans for further investigations or remediation would be prepared. ▪ Provide appropriate trigger levels for key contaminants (where available), based on the receptor of interest and identified contaminants ▪ Serve as a compliance program, so that potential impacts to down-gradient receptors are identified before adverse effect occurs (relative to above objectives) ▪ Detect changes in environmental conditions (e.g. hydrogeologic, geochemical or other changes) that may reduce the efficacy of any natural attenuation processes or that could lead to a change in the nature of impact	Pre-construction, construction and operation	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Establish groundwater conditions (i.e. concentrations and/or trends) which indicated that groundwater monitoring could be reduced or ceased and the requirements of the GMP absolved. The monitoring program is to be undertaken for two years post operation of the Proposal to ensure a range of seasonal and river flow variations is assessed. At the completion of the two year period, subject to analysis of results, consideration would be given to whether this monitoring is required to continue. *The approach to PFAS management will be confirmed following further monitoring in consultation with, and the approval of, the NSW EPA Accredited Site Auditor.*						
6G	Findings within the Geotechnical Interpretive Report (Golder, 2016 – Appendix S of the EIS) regarding excavations, earthworks, pavements and structural footings are to be considered during detailed design.	Detailed design	N	N	N	N	Y
6H	At the conclusion of remediation works, a Remediation and Validation Report (RVR) is to be prepared for the Proposal to facilitate the Auditor's review of remediation and validation activities. The RVR is to document the remediation and validation activities completed within specific areas of the Proposal, including: ▪ Information relating to the materials used in the separation layers such as the soil types, geotextile materials, and sealant types etc. (if required) ▪ An as-constructed plan of the site showing the locations, depths and materials of the separation layers installed at the site.	Operation	N	N	N	N	Y
6I	The existing site-wide Long-Term Environmental Management Plan (LTEMP), such as the one established at the completion of Early Works, is to be revised at the completion of the Proposal remediation activities to include protocols for ongoing maintenance and/or	Operation	N	N	N	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	monitoring or any long term remedial/mitigation measures to be implemented following completion of the Site Audit Statement.						
6J	In order to accept fill material onto site, the following will be undertaken: • Material characterisation reports/certification showing that the material being supplied is VENM/ENM must be provided. • Each truck entry will be visually checked and documented to confirm that only approved materials that are consistent with the environmental approvals are allowed to enter the site. Only fully tarped loads are to be accepted by the gatekeeper. Environmental Assurance of imported fill material will be conducted to confirm that the materials comply with the NSW EPA Waste Classification Guidelines and the Earthworks Specification for the MPW site. The frequency of assurance testing will be as nominated by the Environmental assuror/auditor.	Construction	N	N	N	N	Y
6K	The CEMP would include an Earthworks Specification, which would include details on earthworks material criteria, handling and placement requirements, embankment and cutting formation (including foundation, batter and benching requirements), unsuitable material and bridging layer requirements, conformance testing methods and acceptance criteria (e.g. for material acceptance and compaction control).	Construction	N	N	N	N	Y
6L	In areas where placement of fill would occur to final site levels, but hardstand and warehousing is not currently proposed, exposed surfaces would be stabilised using hydroseeding, or the application of a bitumen emulsion or a similar stabilisation method.	Construction	N	N	N	N	Y
7.	**Hazard and risk**						
7A	The following measures would be included in the CEMP (or equivalent) to minimise hazards and risks: ▪ Procedures for safe removal of asbestos	Construction	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Provision for safe operational access and egress for emergency service personnel and workers would be provided at all times ▪ An Incident Response Plan that would include a Spill Management Procedure.						
7B	To minimise the risk of leakages involving natural gas, LNG and flammable and combustible liquids to the atmosphere: ▪ Appropriate standards for a gas reticulation network, including AS 2944-1 (2007) and AS 2944-2 (2007), would be applied ▪ Correct schedule pipes would be used ▪ Fire protection systems would be installed as required ▪ Access to the Proposal site would be restricted to authorised personnel.	Operation	Y	Y	Y	N	N
7C	To minimise the risks of leakage of LNG and flammable liquids during transport: ▪ The transport of dangerous goods by road would comply with the Dangerous Goods (Road and Rail Transport) Act 2008 and the Dangerous Goods (Road and Rail Transport) Regulation 2014 ▪ Contractors delivering the gas would be trained, competent and certified by the relevant authorities.	Operation	Y	Y	Y	N	N
7D	To minimise hazards associated with venting of LNG: ▪ LNG storage would be designed to AS/NZS 1596-2008 standards ▪ Access to the Proposal site would be restricted to authorised personnel ▪ Adequate separation distances to residencies and other assets would be maintained.	Operation	Y	Y	Y	N	N

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
7E	Storage of flammable/combustible liquids would be undertaken in accordance with AS 1940, with secondary containment in place in a location away from drainage paths.	Operation	Y	Y	Y	N	N
7F	Intermodal terminal facility and warehousing staff involved in the transport and handling of dangerous goods would receive training in the contents of the dangerous goods provisions commensurate with their roles and responsibilities. Training is to be provided and records maintained in accordance with the appropriate competent authority (WorkCover NSW).	Operation	Y	Y	Y	N	N
7G	The 190 KL of diesel fuel (combustible liquids of class C) would be stored on site in a separate 97 KL self-bunded container and would be stored away from other flammable materials of class 3PGI, II or III. The manifest threshold quantity under this circumstance is 100 KL for each tank. Refuelling of locomotives is likely to occur on the locomotive shifter, which would catch any spills during the refuelling process. Spill kits would be located in the vicinity of the refuelling location and staff would be trained in the use.	Operation	Y	N	N	N	N
7H	A preliminary risk screening assessment would be undertaken prior to any refuelling activities being undertaken onsite using LPG to ensure compliance with storage requirements (location, tank size and separation distances) under SEPP 33 (specific to the type of fuel to be stored) to maintain acceptable risk levels associated with refuelling procedures.	Operation	Y	N	Y	N	N
7I	The storage and handling of any LPG or LNG stored within warehouses onsite as part of the Proposal must demonstrate compliance with storage requirements in accordance with the Applying SEPP 33 guideline.	Operation	N	N	Y	N	N
8.	**Visual Amenity, urban design and landscape**						

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
8A	The following mitigation measures would be implemented, where reasonable and feasible, to minimise the visual impacts of the Proposal: ▪ Existing vegetation around the perimeter of construction sites would be retained where feasible and reasonable ▪ The early implementation of landscape planting would be considered in order to provide visual screening during the construction of the Proposal ▪ Elements within construction sites would be located to minimise visual impacts as far as feasible and reasonable, e.g. setting back large equipment from site boundaries ▪ Construction lighting, on both ancillary facilities and plant and equipment, would be designed and located to minimise the effects of light spill on surrounding sensitive receivers, including residential areas and the proposed conservation area ▪ Design of site hoardings would consider the use of artwork or project information ▪ Regular maintenance would be undertaken of site hoardings and perimeter areas including the prompt removal of graffiti ▪ Re-vegetation/landscaping would be undertaken progressively ▪ Where required for construction works, cut-off and directed lighting would be used and lighting location considered to ensure glare and light spill are minimised.	Construction	Y	Y	Y	Y	Y
8B	The following mitigation measures would be implemented, where reasonable and feasible, for the landscaping of the Proposal: ▪ Use of species that are local to the area ▪ Use of trees to provide a uniform canopy cover within vegetated areas	Operation	Y	Y	Y	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Use of local species as understory planting to support and enhance local habitat values ▪ Use of seeds collected within the local area for planting to reinforce the genetic integrity of the region, where possible.						
8C	The following initiatives would be implemented for mitigation of light spill: ▪ Lighting would be designed to minimise impacts on surrounding existing and future residents and the proposed conservation zone ▪ The use of shields on luminaire lighting to minimise brightness effects would be considered ▪ Asymmetric light distribution-type floodlights would be selected as part of the proposed lighting design (i.e. the light is directed specifically to the task with minimal direct light spill to the surrounding area) ▪ Low reflection pavement surfaces would be considered to reduce brightness ▪ The quantity of light and energy consumption in parts of the Proposal site that are not active would be minimised, while retaining safe operation.	Detailed design and operation	Y	Y	Y	N	Y
9.	**Indigenous Heritage**						
9A	The scar portions of MA6 & MA7 would be removed by a qualified arborist and relocated to the TLALC property at Thirlmere, or a suitable area identified in consultation with Registered Aboriginal Parties (RAPs). The trees should be mounted and housed in a weather protected structure. All costs associated with the removal, relocation and housing of the trees would be covered by the Proponent. The relevant RAP would be responsible for the maintenance of the housing once established.	Construction	N	N	N	N	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
9B	Staged salvage excavation of selected areas should be conducted as part of the Proposal, in consultation with RAPs. These stages include: ▪ Part 1 would involve dispersed pits placed along transects within the Terrace PAD and the tertiary terrace (between MA10 and MA14 – refer to Figure 16-2 of this EIS). ▪ Part 2 would involve open area salvage excavation, targeting the artefact concentrations identified by NOHC at MA10 and MA14, as well as any additional artefact concentrations identified during Part 1.	Construction	N	N	N	N	Y
9C	Where changes are made to the Proposal and areas not assessed by this report or previous reports (NOHC 2014, NOHC Sept 2014, AHMS 2015) are to be impacted, further Aboriginal heritage investigation and consultation should take place.	Construction	Y	Y	Y	Y	Y
9D	An Aboriginal Cultural Heritage Assessment Report (ACHAR) (also known as a Cultural Heritage Management Plan) would be prepared as part of the CEMP for the Proposal and would outline ongoing management/ mitigation measures relating to MA6 and MA7.	Construction	N	N	N	N	Y
9E	An unexpected finds procedure would be included in the ACHAR and in place for the construction phase of the Proposal.	Construction	N	N	N	Y	Y
9F	If suspected human remains are located during any stage of the construction works, work would stop immediately and the NSW Police and the Coroner's Office should be notified. The Office of Environment and Heritage, RAPs and an archaeologist would be contacted if the remains are found to be Aboriginal.	Construction	N	N	N	Y	Y
9G	Consultation with RAPs would continue throughout the life of the Proposal, as necessary. Ongoing consultation with RAPs would take place throughout the reburial of retrieved artefacts and in the event of the discovery of any unexpected Aboriginal objects.	Pre-Construction, construction and operation	N	N	N	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
10.	**Non-Indigenous Heritage**						
10A	Naming of roads would consider previous School of Military Engineering (SME) street names.	Detailed Design	Y	Y	Y	N	Y
10B	Naming of buildings and roads (in addition to above) would consider commemoration of significant events and individuals related to the Moorebank Cultural Landscape.	Detailed Design	Y	Y	Y	N	Y
10C	An unexpected finds protocol (or equivalent), including a stop works procedure, would be included within the CEMP. If unexpected finds are identified during works, the stop works procedure would be followed and a suitably qualified archaeological consultant would be engaged to assess the significance of the finds and the NSW Heritage Council notified. In this instance, further archaeological work or recording may be required.	Construction	Y	Y	Y	Y	Y
11.	**Greenhouse Gas**						
11A	The following mitigation measures would be implemented, where reasonable and feasible, for management of GHG emissions as part the operation of the Proposal: ▪ Energy efficiency design aspects would be incorporated wherever practicable to reduce energy demand ▪ Fuel efficiency of the operation plant/equipment would be assessed prior to selection, and where practical, equipment with the highest fuel efficiency and which uses lower GHG intensive fuel (e.g. biodiesel) would be used ▪ Energy-efficient guidelines for operational work would be considered and implemented where appropriate and regular maintenance of equipment would be undertaken to maintain fuel efficiency	Detailed design	Y	Y	Y	N	N

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Methods to reduce losses from industrial processes (refrigerants and SF6) would be investigated during detailed design ▪ Consideration would be given to undertake further investigation and implementation of cost negative abatement opportunities ▪ Investigate and, where possible, implement key performance indicators (KPIs) for plant efficiency and GHG intensity. The mitigation measures, management strategies and abatement opportunities presented in this report would be reviewed and considered where appropriate for incorporation into the OEMP.						
11B	The following initiatives would be implemented, where reasonable and feasible, for mitigation of GHG emissions during construction: ▪ Construction works would be planned to minimise double handling of materials ▪ Construction/transport plans would be incorporated within the CEMP to minimise the use of fuel during construction ▪ Fuel efficiency of the construction plant/equipment would be assessed prior to selection, and where practical, equipment with the highest fuel efficiency and which uses lower GHG intensive fuel (e.g. biodiesel) would be used ▪ On-site vehicles would be fitted with exhaust controls in accordance with the Protection of the Environment Operations (Clean Air) Regulation 2010, as required and appropriate. ▪ Regular maintenance of equipment would be undertaken to maintain good operations and fuel efficiency ▪ Where practicable, trucks removing waste from the site or bringing materials to the site would be filled to the maximum amount allowable, depending on the truck size and load weight, to reduce the number of traffic movements required	Construction	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ The mitigation measures, management strategies and abatement opportunities (Section 18 of this EIS) would be reviewed and considered where appropriate for incorporation into the CEMP.						
12.	**Waste**						
12A	The following mitigation measures would be implemented as part of the CEMP (or equivalent) for waste management: ▪ Characterisation of construction waste streams in accordance with the NSW Waste Classification Guidelines ▪ Management of any identified hazardous waste streams ▪ Procedures to manage construction waste streams, including handling, storage, classification, quantification, identification and tracking ▪ Mitigation measures for avoidance and minimisation of waste materials ▪ Procedures and targets for re-use and recycling of waste materials.	Construction	Y	Y	Y	Y	Y
12B	The following mitigation measures would be implemented as part of the OEMP (or equivalent) for waste management: ▪ Addressing waste management requirements and goals in staff inductions ▪ Providing staff access to documentation outlining the facility's waste management requirements ▪ Locating recycling bins in kitchen areas beside general waste bins to prevent contamination of recycling ▪ Positioning paper recycling bins close to printer / photocopying equipment	Detailed design and operation	Y	Y	Y	N	N

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ Establishing bays or containers for recyclable waste generated through de-stuffing ▪ Minimising general waste bins at desks but providing adequate container and paper recycling to encourage sorting of recyclables ▪ Providing adequate bin storage for the expected quantity of waste. ▪ Waste management planning incorporating principles of the waste hierarchy ▪ Selection of materials used in operations with recycled content, low embodied energy and durability ▪ Appropriate areas shall be provided for the storage of waste and recyclable material ▪ Standard signage on how to use the waste management system and what materials are acceptable in the recycling would be posted in all waste collection and storage areas ▪ All waste shall be collected regularly and disposed of at licensed facilities ▪ An education programme and on-going monitoring for training personnel to properly sort and transport waste into the right components and destinations.						
12C	Container disposal units would be provided in the area around the diesel re-fuelling station to dispose of used spills kits. These containers would be taken for disposal at an appropriately licensed facility.	Operation	Y	N	Y	N	N
13.	**Bushfire**						
13A	The following actions would be considered for implementation, where reasonable and feasible, for mitigation of bushfire risk during construction:	Construction	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
	▪ A bushfire management strategy, or equivalent, would be prepared as part of the CEMP for the construction phase. The strategy would include: – Emergency response plans and procedures – All site offices and temporary buildings would have a minimum setback of 10 m to bushfire prone areas – All site offices would be accessible via access roads suitable for firefighting appliances similar to NSW Rural Fire Service category 1 tankers.						
13B	The following mitigation measures would be implemented during the operation of the Proposal: ▪ A bushfire management strategy, (including a fire safety and evacuation plan) or equivalent, would be prepared as part of the OEMP ▪ Management of the landscaped areas within the Proposal site would be undertaken to maintain minimum dry fuels loads ▪ The width, as required, of the Rail link connection would be maintained in a low fuel state ▪ Protocols would be developed for the monitoring of train access/egress during high – catastrophic fire weather days, if required and in accordance with the bushfire management strategy.	Operation	Y	Y	Y	N	Y
14.	**Socio-economic**						
14A	A community information and awareness strategy would be included in the CEMP and would outline measures to maintain communication with the community and all relevant stakeholders throughout the construction process of the Proposal.	Construction	Y	Y	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability				
			IMT	Rail link connection	Warehousing	Moorebank Ave intersection	Site infrastructure
14B	The Operational Environmental Management Plan (OEMP) would include measures to engage with stakeholders and to manage and respond to feedback received during the operation of the Proposal.	Operation	Y	Y	Y	N	Y
14C	Security at the Proposal site would include: ▪ Fencing around the perimeter of the Proposal site, and potentially the Rail link connection, which is envisaged to include palisade fencing and chain-link fencing along the Moorebank Avenue boundary and chain-link at other location ▪ A controlled site access system including electronic truck processing ▪ A controlled circuit television (CCTV) security system at key locations including site entrances and along boundaries ▪ An integrated telecommunications system which involves connection to all main buildings and structures.	Operation	Y	Y	Y	N	N
14D	Written notification would be provided to potentially affected and adjoining land owners prior to commencement of site operations. The manner of notification would be confirmed in the final OEMP for the Proposal.	Operation	Y	Y	Y	N	Y
14E	Measures to engage with stakeholders and to manage and respond to feedback received during operation of the Proposal, including via a complaints register would be provided in the OEMP for the Proposal	Operation	Y	Y	Y	N	Y
15.	***Urban Heat Island Effect***						
15A	*In addition to features included in the current design, the following mitigation measures (where feasible and reasonable) would be implemented to reduce the potential for urban heat island effects:* ▪ *Solar panels on roofs of warehousing.* ▪ *Cool roofs (selection of materials higher albedo ratings (ratio of irradiance reflected to the irradiance received)).*	*Operation*	*N*	*N*	*Y*	*N*	*Y*