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Manildra – Port Kembla
Bulk Liquid Terminal

Acid Sulfate Soils Management Plan

Client Reference No. 30013038-R03
Prepared for: Manildra Group Pty Ltd
6 May 2022

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This report is confidential and is provided solely for the purposes of documenting an Acid Sulfate Soils Management Plan for Part of Lot 6 DP1236743 and Part of Lot 2 DP 1182823 Foreshore Road, Port Kembla. This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited ("SMEC") and Manildra Group Pty Ltd, under which SMEC undertook to perform a specific and limited task for Manildra Group Pty Ltd. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

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The findings of this this report are the result of methodologies used in accordance with normal practices and standards. We consider that they represent a reasonable interpretation of the general conditions of the Site at the time they were assessed and at the time of writing this report, but under no circumstances, can it be considered that these findings represent the actual state of the Site in all areas.

In preparing this report, current guidelines for assessment and management of acid sulfate soils were followed. This work has been conducted in good faith in accordance with SMECs understanding of the client's brief and general accepted practice for environmental consulting.

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Executive Summary

Manildra Group Pty Ltd (Manildra) is proposing to construct an ethanol storage facility and pipeline located on Part of Lot 6 DP1236743 and Part of Lot 2 DP 1182823, Foreshore Road, Port Kembla NSW (herein known as 'the Site').

This report presents the Acid Sulfate Soils Management Plan (ASSMP) prepared by SMEC Australia Pty Ltd (SMEC) in support of the State Significant Development application for the proposed redevelopment of Manildra - Port Kembla Bulk Liquid Terminal. This report is written to address the Secretary Environmental Assessment Requirements (SEARs) (and additional Council requirements) and specifically to provide advice for the proposed earthworks activities at the Site during construction. The Site is currently leased by Manildra from NSW Ports.

SMEC previously undertook a Preliminary Geotechnical and Contamination Investigation (main terminal) and Targeted Site Investigation (pipeline route) which included an assessment of the presence of acid sulfate soils. Acid sulfate soils were assessed to be present at the Site main terminal within natural estuarine soils beneath the fill and aeolian soil layers. Due to potential for disturbance during development of the main terminal, SMEC recommended an ASSMP be prepared for the management of acid sulfate soils during construction stage. Along the pipeline route, SMEC assessed that acid sulfate soils (if present) beneath the Site are unlikely to be intersected based on depth of proposed disturbance and therefore no further assessment or management measures are required.

Based on preliminary development details provided by Manildra, SMEC consider that the main development activities which could impact upon ASS are localised deep excavations for installation of stormwater features (including gross pollutant trap, underground storage tank) and linear excavation for installation of stormwater utilities.

This ASSMP includes proposed mitigation measures for excavations, treatment, reuse, dewatering and water quality monitoring during works which are likely to disturb ASS. An overview of the key roles and responsibilities for the implementation of the ASSMP are also provided.

Groundwater table drawdown can occur from excavation dewatering and affect acid sulfate soils as they can be exposed to oxygen and oxidise. This ASSMP considers dewatering activities will be required for installation of the proposed underground storage tank (Excavation 1), noting a dewatering strategy is current being assessed by SMEC. The dewatering strategy includes modelling to assess the radius of influence based on proposed rate of dewatering, characteristics of the surrounding aquifer and the required depth of sheet piling to minimise effects of groundwater drawdown in areas surrounding the excavation. Dewatering via 'sump and pump' techniques for relatively short duration are likely to be used, as compared to alternative dewatering techniques.

SMEC note that if retention systems such as sheet piles that limit impacts from drawdown are not used, then to address impacts of deeper dewatering, a further assessment of the implications of dewatering on ASS would need to be carried out. Where the results of assessment indicate further control measures beyond those described in this ASSMP, then an addendum will be required specifying the additional control measures during deep dewatering.

A standalone Groundwater Assessment and Management Report (*pending completion at the time of writing this ASSMP*) is being prepared to address SEARs requirements noting this would include further details on a construction water quality monitoring programme to comply with the planning conditions and NSW Ports specific requirements (refer to Section 11 Water Quality and Stormwater of Port Kembla Development Code – June 2021). An outline of water quality monitoring requirements is provided to be consistent with the National Acid Sulfate Soils Guidance pertaining to dewatering of acid sulfate soils in shallow groundwater environments.

1. Introduction

1.1 General

Manildra Group Pty Ltd (Manildra) is proposing to construct an ethanol storage facility and pipeline located on Part of Lot 6 DP1236743 and Part of Lot 2 DP 1182823 Foreshore Road, Port Kembla NSW (herein known as 'the Site'). The Site locality is shown on Figure 1, Appendix A.

The proposed development will consist of installation of six above ground storage tanks, associated bunds and features, construction of a new proposed bridge crossing, a gravity retaining wall adjacent the existing stormwater channel, installation of buried stormwater infrastructure including an underground storage tank and two stormwater treatment devices, construction of service road and driveway pavements, drainage and grading features. Earthworks activities associated with the development are expected to include deep excavations for stormwater infrastructure, a network of linear utilities trenches and foundation excavations for gravity retaining wall, and shallow site recontouring and timber driven piles beneath bridge and tank structures. The development includes construction of a new pipeline route connecting to existing Jetty No. 4. The Site layout is shown on Figure 2, Appendix A.

This report presents the Acid Sulfate Soils Management Plan (ASSMP) prepared by SMEC Australia Pty Ltd (SMEC) in support of the State Significant Development application for the proposed redevelopment of Manildra - Port Kembla Bulk Liquid Terminal. This report is written to address the Secretary Environmental Assessment Requirements (SEARs) (and additional Council requirements) and specifically to provide advice for the proposed earthworks activities at the Site during construction. The Site is currently leased by Manildra from NSW Ports. The scope of works was carried out in general accordance with SMEC's Fee Proposal (ref: 1042321-P01 Rev1 dated 15/09/2021) and subsequent variation (ref: 30013038-V04 Rev 1 dated 16/02/2022).

1.2 Project background

SMEC has previously undertaken investigations at two portions of the Site (identified herein as 'main terminal' and 'pipeline route') to fulfil the planning process and requirements of NSW Ports Development Code, pertaining to acid sulfate soils assessment information for the proposed design. These include:

- Preliminary Geotechnical and Contamination Investigation (main terminal) in March 2021 (SMEC, 2021a, ref: 30013038-R01)
- Targeted Site Investigation (pipeline route) in April 2022 (SMEC, 2022, ref: 30013038-R05).

The Preliminary Geotechnical and Contamination Investigation (SMEC, 2021a) included an assessment of the presence of acid sulfate soils using soil sampling and analysis. Acid sulfate soils (ASS) were assessed to be present at the Site of the main terminal within natural estuarine soils beneath the fill. Due to potential disturbance during development of the main terminal, SMEC (2021a) recommended an ASSMP be prepared for the management of ASS during construction stage. SMEC (2021a) recommended that an ASSMP be prepared to manage site development activities where these soils are to be intersected via excavation or if dewatering will occur which could lower the water table and expose soils to oxidation. It is expected this would mainly apply to areas of deeper localised excavations associated with stormwater pipework, underground tank and gross pollutant traps. In areas where driven piles are used and essentially no ASS are brought to the surface, then minimal to no construction stage acid sulfate soil assessment and management would be required.

The Targeted Site Investigation along the pipeline route, included a review of desktop information and subsurface observations. The investigation concluded that acid sulfate soils (if present) beneath the Site are unlikely to be intersected based on the depth of proposed disturbance and therefore no further assessment or management measures are required.

1.3 ASSMP Requirement

This ASSMP is required to be prepared by a suitably qualified person in accordance with the NSW Acid Sulfate Soil Manual (1998) to fulfil the planning process and requirements of NSW Ports Development Code.

Specifically, Manildra were required to address the following specific requirements:

- Port Kembla Development Code – June 2016: 'For all development an assessment of PASS[1] present on site is to be undertaken as part of the application for development. Where PASS could be encountered, mitigation measures are to be undertaken.' (NSW Ports, 2016, pp 29)
- Wollongong City Council –Application DE-2021/185: 'The EIS should be accompanied by an Acid Sulfate Soils Management Plan prepared in accordance with the Acid Sulfate Soils Manual, or alternatively, a preliminary assessment of the proposed works prepared in accordance with the Acid Sulfate Soils Manual indicating that an Acid Sulfate Soils Management Plan is not required for the works.' (Wollongong City Council, 21 December 2021).

This ASSMP specifically addresses mitigation and management of ASS, including Actual Acid Sulfate Soils (AASS) and Potential Acid Sulfate Soils (PASS). It is intended to act as a guide for construction planning, as ASS mitigation relies on co-operation from staff and sub-contractors in relation to ensuring preventative and treatment measures are being implemented and that awareness is maintained.

SMEC note that there are more recent national and interstate guidelines that build upon the NSW Acid Sulfate Soil Manual (1998) and where considered relevant these have also been utilised.

1.4 Project objectives

The overall objectives of the ASSMP are to:

- Describe measures to avoid adverse impacts on the local receptors that may result from disturbance of ASS materials due to construction of the development.
- Achieve compliance with regulatory requirements for the Project as they relate to ASS.

1.5 Scope of work

The ASSMP includes:

- A summary of the Site conditions and surrounding environment
- A summary of acid sulfate soil extent
- Disturbance of ASS
- Construction environmental impacts
- Management procedures (including excavations, treatment, reuse of ASS soils)
- Dewatering and monitoring requirements
- Compliance and reporting requirements.

[1] Potential Acid Sulfate Soil

2. Site information

2.1 Site identification and description

The proposed development is located at Part of Lot 6 DP1236743 and Part of Lot 2 DP 1182823Foreshore Road, Port Kembla, NSW. The Site consists of two portions identified as main terminal and pipeline route as shown on Figure 2, Appendix A.

Figure 1 and Figure 2, Appendix A show the Site locality and Site layout, respectively.

A summary of Site information is presented below in Table 2-1.

Table 2-1 Summary of Site information

Aspect	Details
Title identifier	Part of Lot 6 DP1236743 and Part of Lot 2 DP 1182823 (pipeline route only)
Address	Foreshore Road, Port Kembla NSW
Area	Main terminal Manildra supplied drawings showing a Site area of approximately 2.3ha (which excludes the stormwater channel). It is noted that the stormwater channel (approx. 0.14ha) is excluded from the lease. For Site description purposes, the Site has been divided into the three portions shown below on Figure 2-1 including: • Western portion – Areas west of the stormwater channel (0.83ha) • Central portion – A centrally located area east of the stormwater channel (0.44 ha) differentiated by a historical property boundary • Eastern portion – An easterly located area east of the stormwater channel (1.02 ha). Pipeline route Manildra supplied drawings showing a proposed linear pipeline route of approximately 460m between the main terminal and Jetty No. 4 west to east with a 4m corridor along the route. The pipeline route occupies an area of approximately 0.18 ha.
Zoning	The Site is located within Port Kembla state significant precinct in NSW. The State Environmental Planning Policy (Three Ports) 2013 is the principal environmental planning instrument applying to the Site.
Current Land use	Main terminal The Site currently consists of vacant industrial land previously used for storage of miscellaneous maritime/port equipment. An open concrete lined stormwater channel passes through the Site, which discharges to the Port Kembla Outer Harbour immediately north of the Site (but does not form part of the lease area). A relatively large crushed or coarse fill stockpile up to about 11m high above current land platform level currently occupies most of the eastern portion of the Site. The coarse fill stockpile appears to comprise largely coarse sandstone boulders up to about 1m diameter. Pipeline route The pipeline route part of the Site is currently unused part of industrial foreshore land in the vicinity of harbour jetty operations.
Proposed land use	The proposed land use is for a bulk liquid (beverage grade ethanol) storage facility and product pipeline route as described further in Section 3.1
Surrounding land use	Main terminal The Site is presently surrounded by: • Remaining NSW Ports foreshore land on Lot 6 (west) currently containing several large soil stockpiles • Foreshore Road (south), then beyond this and further south various industrial facilities including:

Aspect	Details
	– Ixom (sulfuric acid plant) – Cleanaway waste recycling facility – Morgan Cement International Pty Ltd (cement manufacturing and grinding facility) • Other former industrial facilities such as the former copper smelter and fertiliser production facilities • Remaining stockpiled material and vacant land on Lot 6 (east) • Port Kembla Outer Harbour shoreline (north). Pipeline route The Site is surrounded by: • Vacant foreshore land, a sandstone stockpile and paved road to former jetty No. 3 on Part of Lot 6 • Vacant foreshore land, training conference centres, marine compounds/equipment stores and paved road/carparking areas on Part of Lot 2 • An acid production pipeline route bisects the Site (Chainage 390m) and diverts in similar alignment towards Jetty No. 4 (Chainage 390m to 460m) • Port Kembla Outer Harbour shoreline is north approximately between 5m and 25m from the centreline of the pipeline route.



Figure 2-1 Site portions for description purposes – Main terminal

2.2 Previous reports

Background information contained in this ASSMP was sourced from the following previous reports:

- SMEC Australia Pty Ltd (2021a) Preliminary Geotechnical and Contamination Investigation, Part of Lot 6 DP1236743 Foreshore Road, Port Kembla, prepared for Manildra Group Pty Ltd, ref: 30013038-R01, Revision 2, dated 05 May 2021
- SMEC Australia Pty Ltd (2021b) Detailed Site Investigation, Part of Lot 6 DP1236743 Foreshore Road, Port Kembla, prepared for Manildra Group Pty Ltd, ref: 30013038-R04, Revision 1, dated 22 December 2021
- SMEC Australia Pty Ltd (2022) Targeted Site Investigation – Pipeline Route, Part of Lot 6 DP1236743 and Part of Part of Lot 2 DP 1182823, Foreshore Road, Port Kembla, prepared for Manildra Group Pty Ltd, ref: 30013038-R05, Revision 1, dated 02 May 2022

A summary of relevant information from these reports are included in this ASSMP. SMEC (2021a) also previously undertook a review of several environmental reports pertaining to the Site and nearby surrounding areas. Reference should be made to the original reports for further detailed information.

2.3 Site information

Relevant Site information is summarised in Table 2-2 below.

Table 2-2 Site information

Aspect	Description
Topography	Main terminal The Site terrain appears to have been filled and levelled with a surface elevation between 3.5-4.5m AHD. The Site surface is predominantly hardstand granulated slag material except for a concrete slab present in the central portion of the Site, and some localised grassed terrain. Other features of the Site include: • A large rock stockpile with steep batters (to a height of approximately +14m AHD) within the eastern portion • East and west of the channel there are localised steep slopes down to the edges of the concrete lined stormwater channel (approximately +2m AHD) • A fill embankment is noted west of the stormwater channel approximately 1.5m to 2m above top of the stormwater channel, indicating the Site terrain appears to have been filled and levelled. Pipeline route Based on survey carried out by Masters Surveying (Drawing 64146-2), the Site is relatively flat with some slight undulations at elevations ranging between 2.9m AHD (Chainage 90) and 4.3m AHD (Chainage 340m).
Vegetation	Main terminal The Site contains a stand of mature trees on the southern Site boundary adjacent to Foreshore Road. Sparsely scattered trees were noted elsewhere, noting most of the Site is hardstand gravel and pavements with some patches of exotic grass vegetation. Pipeline route Except some minor areas of grass coverage, the Site is mainly hardstand gravel and pavements with little or no vegetation.
Geology	The 1:100,000 scale geological series sheet of Wollongong to Port Hacking indicates that the Site is underlain by Quaternary quartz and lithic fluvial sand, silt and clay which most likely will overlay either or both the rock formations of: • The Dapto Latite Member, comprising of a melanocratic coarse grained to porphyritic latite • The Budgong Sandstone formation, comprising red-brown and grey volcanic sandstones. Reference to previous drilling in the area of Port Kembla Outer Harbour indicates that the Site is likely underlain by the Budgong Sandstone Formation. However, the Site is also located very close to

Aspect	Description
	the boundary between the overlying Dapto Latite and it is possible that some Dapto Latite could be encountered in some parts of this Site particularly towards the southern portion of the Site.
Soil Landscape	Reference to the 1:100,000 Soil Landscape Series Sheet for Central and Eastern NSW (OEH 2019) indicates the Site is within the disturbed terrain soil landscape.
Acid Sulfate Soil	Reference to ASS risk mapping (NSW Government eSPADE, accessed 23/03/2021) indicates that the Site is located within areas mapped as 'disturbed terrain' with an unknown probability of ASS occurrence. Risk map guidance indicates *that 'disturbed terrain may include filled areas, which often occur during reclamation of low-lying swamps for urban development. Other disturbed terrain includes areas which have been mined or dredged or have undergone heavy development or construction of dams or levees. Soil investigations are required to assess these areas for acid sulfate potential.*' Figure 3, Appendix A shows the acid sulfate soils risk mapping for the Site and surrounding areas. The map indicates the following: Main terminal • The Site western, central and eastern portion is primarily underlain by disturbed terrain (X) at an elevation (2) of 2 to 4m AHD • A relatively smaller northern portion of the Site identifies disturbed terrain (X) at an elevation (1) of 1 to 2m AHD. From preliminary investigation by SMEC (2021a), acid sulfate soils were assessed to be present at the main terminal portion of the Site within relatively thin layers of natural estuarine soils beneath the fill. Further consideration and management of acid sulfate soils was recommended where these soils are to be intersected via excavation or if dewatering will occur which could lower the water table and expose soils to oxidation. Pipeline route • Between Chainage 0 to 180m, the Site is underlain by disturbed terrain (X) at an elevation (2) of 2 to 4m AHD • Between Chainage 180 to 430m, the Site is underlain by disturbed terrain (X) at an elevation (2) of greater than 4m AHD. Based on the Site topography and proposed disturbance depths (refer to Section 1.3), excavations depths were assessed as: • Base level 1.9 to 2.6m AHD (Above ground section of pipeline route - Shallow concrete footings, approximately 1m deep) • Base level 2.3 to 3.3m AHD (Underground section of pipeline route – Cut and cover trenching, approximately 1.8m deep). At these earthworks' levels, acid sulfate soils (if present) within the Site area were assessed to be greater than the depth of proposed disturbance.
Groundwater	Main terminal Based on previous groundwater monitoring that has occurred at the Site, groundwater depths beneath the Site were historically recorded typically between 1.5m and 3.0m below ground surface with an inferred groundwater flow in a north-easterly direction towards Port Kembla Outer Harbour. Groundwater depths and directions may vary based on Site specific conditions, including tidal influences. A search of the Department of Water and Energy Online Database [accessed 22 March 2021] was carried out to identify registered groundwater bores within the vicinity of the Site. The search indicated multiple registered bores are within industrial properties for monitoring purposes located within 500m of the Site including: • One registered bore (GW114085) located 100m south of the Site (within Morgan Cement International property) • Greater than 50 registered bores between 300m and 600m south of the Site (former Port Kembla Copper Smelter) • Six registered bores 450m south-east of the Site (Vesuvius manufacturing facility.

Aspect	Description
	Pipeline route Based on Site topography, the depth of groundwater along the pipeline route is expected to be at depths between 2-3m below ground level based on the proximity to the open harbour environment. Groundwater within the Site area is assessed to be greater than the depth of proposed disturbance.
Surface Water	Main terminal Surface water at the main terminal Site is likely to infiltrate into Site soils or shed as runoff partly to Foreshore Road (south), partly to Port Kembla harbour (north) and partly into the adjacent open concrete lined drain (west). The open drain receives stormwater from upslope areas offsite and runs through the Ixom sulfuric acid plant as an open drain, and underground beyond, including through the former copper smelter land further upslope. Pipeline route Surface water runoff from the Site (pipeline route) is likely to shed from hardstand areas directly towards Port Kembla harbour. At asphalt paved areas (Chainage 320 to 460m), surface water runoff is expected to enter urban stormwater drainage pits and pipework prior to discharge at the harbour.
Contamination	From previous investigations by SMEC (2021a, 2021b and 2022), contamination was identified in soils and groundwater beneath the site including: • Soil recorded elevated concentrations of heavy metals (including lead and arsenic) within fill and underlying natural soils at four test locations (TP5, TP6, TP13,TP14 and TP23 – main terminal) and one test location (BH06 – pipeline route) exceeding human health investigation levels for the proposed industrial land use. Depths of contamination appeared to be within fill/natural clayey soils (typically between 1m bgl and 2.2m bgl) except at one location (TP13) where elevated lead concentrations were recorded within natural sand at a depth of at least 3.0 mbgl (TP13) suggesting deeper lead impact in this area. • The results of two groundwater monitoring events in March and October 2021 recorded elevated concentrations of heavy metals (including cadmium, copper, lead, nickel and zinc) and ammonia which exceeded adopted groundwater investigation levels for protection of marine aquatic ecosystems at the 95% species protection level. Existing soil contamination issues at the Site will be managed under the Remedial Action Plan (ref: 30013038-R02, Rev 1, dated 06 May 2022). A standalone Groundwater Assessment and Management Report (*pending completion at time of this ASSMP*) is being prepared to address SEARs requirements and would include further details on a construction water quality monitoring programme be carried out to comply with the planning conditions and NSW Ports specific requirements (refer to Section 11 Water Quality and Stormwater of Port Kembla Development Code – June 2021).

2.4 Acid sulfate soils

Acid sulfate soil (ASS) materials are naturally occurring soil and sediment, distinguished from other soil or sediment materials by having properties and behaviour that have either:

1. Been affected considerably by the oxidation of Reduced Inorganic Sulfur (RIS) (principally the mineral iron pyrite), or
2. The capacity to be affected considerably by the oxidation of their RIS constituents.

The factor common to all ASS materials is that RIS components have either had, or may have, a major influence on the properties or behaviour of these soil materials. These soils are typically found in low-lying coastal areas and saline inland areas; however, they have been identified in a wide range of environmental settings.

Acid sulfate soil materials include Potential acid sulfate soils (PASS or sulfidic soil materials) and Actual acid sulfate soils (AASS or sulfuric soil materials). These are often found in the same profile, with AASS overlying PASS. In summary:

- Potential acid sulfate soils (PASS) are soil materials which contain RIS such as pyrite. The field pH of these soils in their undisturbed state is usually more than pH 4 and is commonly neutral to alkaline (pH 7–9). These soil

materials are invariably saturated with water in their natural state. Their texture may be peat, clay, loam, silt or sand and is often dark grey in colour and soft in consistence, but these materials may also exhibit colours that are dark brown, or medium to pale grey to white.

- Actual acid sulfate soils (AASS) are soil materials which contained RIS such as pyrite that have undergone oxidation. This oxidation results in low pH (that is pH less than 4) and often a yellow (jarosite) and/or orange to red mottling (ferric iron oxides) in the soil profile. Actual ASS contains Actual Acidity, and commonly also contains RIS (the source of Potential Sulfuric Acidity) as well as Retained Acidity (Ref: Sullivan *et al*, 2018).

2.5 Acid sulfate soil extent

2.5.1 Subsurface conditions

The subsurface soil conditions across the Site have been summarised by SMEC (2021a, 2021b and 2022) with five main lithological units, summarised below.

Unit 1	Fill, which is divided into the following main subunits – Unit 1A (Filling Cemented slag), Unit 1B (General fill) within the main terminal, Unit 1C (Stockpile fill) over the eastern portion, Unit 1D (Inferred location of PAH contamination) localised in the western portion. Along the pipeline route, fill consisted of topsoil, Unit 1A (Cemented slag) and Fill (variable)
Unit 2	Aeolian Sands consisting typically of poorly graded, fine to coarse grained sand with some black carbonaceous and dark grey clay laminations, moist to wet. Prior to land reclamation, these materials are inferred to have been deposited in a combination of beach and dune environments. This unit is inferred to be generally in a loose to medium dense condition.
Unit 3	Estuarine soils (sand and clay) high plasticity, firm and loose to medium dense, fine to coarse grained sand with some black carbonaceous and dark grey clay laminations, moist to wetter than the plastic limit. Estuarine clays were typically encountered as a relatively thin layer (typically less than 0.3m thick) from depths of 1.2m bgl, whereas estuarine sands were typically encountered beyond depths of 2.4 m bgl.
Unit 5	Residual Soil which is clay/gravelly clay/sandy clay derived from in-situ weathered latite. The consistency of this unit ranges from very stiff to hard. This unit tends to grade from residual soil to extremely weathered rock with increasing depth.
Unit 6	Extremely weathered rock, consisting of extremely to distinctly weathered Latite.

Appendix C includes copies of engineering logs prepared by SMEC from previous investigations. Previous investigation borehole/test pit locations are shown within Figure 2, Appendix A.

2.5.2 Previous ASS laboratory soil data

SMEC (2021a) previously carried out soil sampling and testing to assess the potential for ASS within two suspected units based on geological origin; Unit 2 (Aeolian sands) and Unit 3 (Estuarine soils). SMEC assumed that less than 500m^3 of soils would be disturbed requiring a minimum of three boreholes to meet sample densities outlined in the National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual (Sullivan *et al*, 2018). SMEC carried out soil sampling for ASS from a combination of test pits and boreholes used during the geotechnical investigation. These included:

- 13 test pitting locations (including TP01 to TP08, TP010 to TP13) with sampling to depths up to 3.5m bgl
- 2 boreholes (BH5 and BH7) with sampling to depths up to 7.65m bgl for acid sulfate soil testing.

Soil sampling locations for ASS are shown on Figure 4, Appendix A. SMEC consider a sufficient number of sampling locations were carried out to assess the Site considering the expected scale disturbance (refer to Section 3.3.2). The findings showed ASS were present at the Site within relatively thin layers of natural estuarine soils beneath the fill.

SMEC (2021b and 2022) undertook Site investigations via boreholes/test pits without sampling for ASS, noting these included relevant observations of subsurface observations.

Table B1, Appendix B includes a copy of laboratory summary table for ASS test results. Soil analytical results were assessed against the criteria in Table 3-3. The results of Chromium Reducible Sulfur (S_{CR}) testing confirmed PASS were likely to be present within:

- A relatively thin estuarine layer (Unit 3) described as dark grey/grey sandy clay/clay, encountered within TP10 and TP13 at depths between 1.9-2.2 m bgl. A similar layer of dark coloured clayey soils (typically less than 0.3m thick) was also encountered but not sampled at similar depths in other test pits (including at least TP3, TP7,TP14 and TP27*). *TP27 was excavated during subsequent DSI (SMEC, 2021b).
- Deeper estuarine sand layers (Unit 3) described as pale grey, medium to coarse grained sand encountered within BH5 and BH7 at depths of 6.0-6.45m bgl and 7.2-7.65 m bgl. Relatively high acid neutralising capacity was noted within these sands, suggesting the potential ASS may be self-buffering. Acid neutralising capacity can only be taken into consideration where this measure has been corroborated by other data (for example, slab incubation data) that demonstrates the soil material does not experience acidification during complete oxidation under field conditions.

The upper natural layers inferred to be Unit 2 (Aeolian sands) in origin (described as pale brown, fine to coarse grained) were not considered to be ASS, noting concentrations of chromium reducible sulfur were negligible (typically below laboratory detection limits) and net acidity did not exceed action criteria.

Table 2-3 below presents the range of values recorded for the respective units.

Table 2-3 ASS analytical result ranges.

Unit	Titratable Actual Acidity (TAA) (moles H+/t)	Chromium Reducible Sulfur (S_{CR}) (%w/w S)	Net Acidity (excl. acid neutralising capacity) (moles H+/t)
Unit 2 (Aeolian)	<2	<0.005 – 0.01	<5 - 8
Unit 3 (Estuarine - clay)	<2 - 940	0.52 – 2.80	1270 - 1702
Unit 3 (Estuarine - sand)	<2	0.009 – 0.052	8 - 35

2.5.3 ASS Extent

SMEC (2021a) previously recommended that further consideration and management of ASS should be implemented during Site development where the above soils are to be intersected via excavation or if dewatering will occur which could lower the water table and expose soils to oxidation.

Due to the expected reduced scale of the soil earthworks (refer to Section 3.3.2), delineation of ASS lateral extents was not assessed as part of SMEC's preliminary investigation. For the purposes of this ASSMP, the inferred extents of ASS have been assessed from previous investigation findings as follows:

- Horizontally: Site wide within the extent of works
- Vertically: At depths greater than 1.2m below ground level (m bgl) within estuarine clays and sands (Unit 3). Previous survey shows the top of Unit 3 (Estuarine soils) is expected to be in the general range of about +1.2 mAHD to 0 mAHD.

Figure 4, Appendix A shows the previous soil test locations and depths where criteria were exceeded.

2.5.4 Groundwater

Baseline groundwater quality and levels were assessed at the main terminal Site during two previous groundwater monitoring events; one in March 2021 during the preliminary investigation (SMEC, 2021a) and an additional groundwater monitoring event in October 2021.

During one or both rounds, contamination laboratory testing of groundwater samples was carried out at three wells (OHMW28, OHMW20 and SMW01) for potential contaminants of concern and additional 'baseline' monitoring parameters including:

- Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn)

- TRH, BTEX, PAH Phenols
- OCP, OPP, PCB
- Volatile halogenated compounds (VHCs)
- Nitrogen (ammonia, nitrate, nitrite)
- Reactive phosphorus
- Hardness, Total Dissolved Solids (TDS)
- Major cations (calcium, magnesium, potassium, sodium)
- Major anions (chloride, sulphate and fluoride)
- Alkalinity
- Dissolved heavy metals (aluminium, arsenic, cadmium, chromium (total), copper, iron, lead, mercury, nickel, selenium and zinc)
- Total heavy metals (aluminium, manganese and iron)
- Per and poly fluoro alkyl substances (PFAS)

Table B2, Appendix B includes a laboratory summary table for groundwater samples.

Groundwater table drawdown can occur from excavation dewatering and affect ASS as they can be exposed to oxygen and oxidise. The following is noted relevant to this ASSMP:

- Field measurements (water level, pH, specific electrical conductivity, temperature, redox potential and dissolved oxygen) were undertaken during both rounds. Table 2-4 below includes a summary of relevant field measurements during both groundwater monitoring events
- During monitoring events, each groundwater well appeared to recharge relatively quickly during purging and sampling
- Relatively lower electrical conductivity (between 1890 and 2960µs/cm) was recorded within groundwater well locations SMW01 and OHMW28 as compared with relatively higher conductivity (between 14,224 and 22,800µs/cm) at OHMW20
- Depths to standing water level appeared relatively consistent between monitoring rounds, noting:
  - 10 March 2021: SWL recorded 2.07m bgl (SMW01), 2.38m bgl (OHMW20) and 1.77m bgl (OHMW28). No apparent odours or sheens were noted during groundwater development and sampling
  - 21 October 2021: SWL recorded 2.11m bgl (SMW01), 2.44m bgl (OHMW20) and 1.86m bgl (OHMW28). In October, a distinct 'rotten egg' odour was noted during sampling at OHMW20 and OHMW28.
- Field pH values were recorded between 6 and 7 and appeared to be consistent between monitoring rounds (change by less than 0.5 pH unit).

Table 2-4 Groundwater field measurements

Groundwater monitoring event	Standing water level		pH - field	EC – field
	Depth (m bgl)	Depth (m AHD)		µS/cm
10 March 2021	1.77 to 2.38 m bgl	0.50 to 0.64 m AHD	6.46 to 6.82	2019 to 14,224 (OHMW20)
21 October 2021	1.86 to 2.44 m bgl	0.45 to 0.55 m AHD	6.38 to 6.75	1,890 to 22,800 (OHMW20)

2.6 Groundwater wells

Twelve existing groundwater monitoring wells are onsite (including six historic wells and six new wells installed by SMEC 2021-2022). Eleven wells appear to be still useable for monitoring and one well was damaged and partially buried on side of stockpile inside a drum (Figure 2, Appendix A). Where previous survey was carried out to some of the monitoring wells, a summary of survey details are summarised in Table 2-5 below.

Table 2-5 Summary of groundwater wells onsite

Well no.	Inferred monitoring well ID	Easting	Northing	Reduced Level (m AHD)		Details
				Ground level	Top of well casing	
1	MW316 (note 1)	307769.09	6183022.99	2.54	2.46	Gatic well - Hex-key metal gatic flush with ground surface
2	MW5 (Note 2)	NS	NS	NS	NS	Gatic well – 'Older style' metal gatic flush with ground surface
3	OHMW28 (Note 3)	307778.51	6182987.64	2.41	3.09	Monument Well
4	ID Unknown (Note 4)	307814.26	6183015.20	2.66	3.28	Monument Well
5	OHMW20 (Note 3)	307832.75	6183030.30	2.89	3.89	Monument Well
6	*MW Damaged* (Note 4)	307826.72	6183045.32	3.31	Not surveyed	Monument Well – Well damaged and partially buried on side of stockpile inside drum
7	SMW01	307771.69	6183048.65	NS	3.33	Monument Well
8	SMW02	307889.38	6183043.42	NS	3.63	Monument Well
9	SMW03	307881.90	6183114.52	NS	3.78	Monument Well
10	SMW04	307848.12	6183124.30	NS	3.61	Monument Well
11	SMW05	307825.76	6183134.07	NS	3.58	Monument Well
12	SMW06	307734.25	6183055.70	NS	4.17	Monument Well

Note 1: Well location MW316 was labelled on the well cap, noting this location was not formerly shown on historical monitoring reports.

Note 2: Well locations MW5 was inferred from were inferred from maps within contamination assessment (CMPS&F, 1996).

Note 3: Well location OHMW28 and OHMW20 were inferred from maps within historical groundwater monitoring report (DP, 2009 and SLR, 2011).

Note 4: Remaining well identification remains unknown.

NS – Not surveyed

Gatic well = well finished level with ground surface with a steel gatic type cover

Monument well = well finished above ground surface with a steel monument

3. Environmental Activities, Impacts and Risks

3.1 Proposed development

3.1.1 Main terminal

Manildra propose to lease and redevelop the Site into an ethanol storage facility. Based on information provided by Manildra, the proposed development is expected to comprise:

- Six above ground storage tanks (2.5ML to 5ML capacity for beverage grade alcohol) located inside a raised bunded area, plus two slops tanks
- Demolition of existing bridge and construction of one new proposed bridge crossing over the adjacent stormwater channel to the west, to connect to a service road with Foreshore Road
- A gravity retaining wall installed along the boundary with the stormwater channel (approx. 295m^2) including either side of the proposed bridge. A second possible gravity retaining wall will be installed along the western Site boundary adjacent to the adjoining sewer pump station (offsite)
- New stormwater network including pipework, underground storage tank, two stormwater treatment devices and outlet structures
- Perimeter roadways/pavements
- Firefighting system including foam suppressant system and water supply tanks
- Ancillary features such as substation, workshop and sheds which would be small and single storey.

Figure 2, Appendix A shows the approximate position of proposed Site development features relative to the Site boundaries.

Appendix D includes a copy of the Site plan drawings showing the proposed layout of the development relative to the Site boundaries. Manildra supplied SMEC with a current set of 'tender only' design drawings (20399-C00 to C17, C20 and C21, dated 22/11/2021) prepared by TFA Group Pty Ltd. Relevant details pertaining to earthworks activities are summarised below:

- Site grading and drainage plan (20399-C02 & C03) – A network of proposed stormwater pipework will be installed within linear trenches excavated beneath the ground surface (approximately 0.5m wide by 1m deep). Localised deep excavations are expected for two stormwater treatment devices (estimated 2.5m x 2.5m x 2m deep) will be installed prior to discharge outlets, and an underground storage tank (8m length x 3m diameter) will be installed near the entrance noting depths are expected to be approximately 4.5m below the existing ground level (refer to Figure 5, Appendix A). An open diversion swale would be constructed west of the proposed service road (minimum depth 0.4m deep, including gravel).
- Site pavement plan (20399-C11 and C12) – The Site will comprise mostly paved surfaces including vehicle pavements (heavy and light), structural slabs and bund flooring, spray seal driveway/road, and gravel hardstand layer across the remaining areas of the Site. A narrow strip of land will comprise a landscaped area (approx. 700m^2) along the southern boundary of the Site adjacent to Foreshore Road.
- Site retaining wall plan (20399-C20 & C21) – A gravity retaining wall will be installed along the boundary with the stormwater channel (approx. 220m length) including either side of the proposed bridge and adjacent to the adjoining sewage pumping station lot (refer to Figure 5, Appendix A). Gravity retaining walls will involve linear trench excavation of concrete footing with dimensions (continuous approximately 1.3m wide by 1.0m depth below existing ground level, with multiple concrete backhoe piers 0.45m wide by 2.0m depth below existing ground level).
- Bulk earthworks plan (20399-C07) – Site recontouring will require bulk earthworks activities involving cut (approx. 2,400m^3) and fill (approx. 3,400m^3) with the 1,000m^3 balance to be sourced as imported fill or locally site-won from existing stockpiled material. On the western side of the stormwater channel, earthworks will include shallow 'cut' to 'fill' across the width of the service road portion, a proposed diversion swale and harbour foreshore access ramp, without disturbing remaining unoccupied areas within the Site. Figure 3-1 below shows the approximate layout cut (red) to fill (green).

SMEC understand that timber driven piles will be used for foundations of the tank structures. Except for minor disturbances at the surface, these are expected to result in minimal ground disturbance as soils are displaced laterally to accommodate the pile.

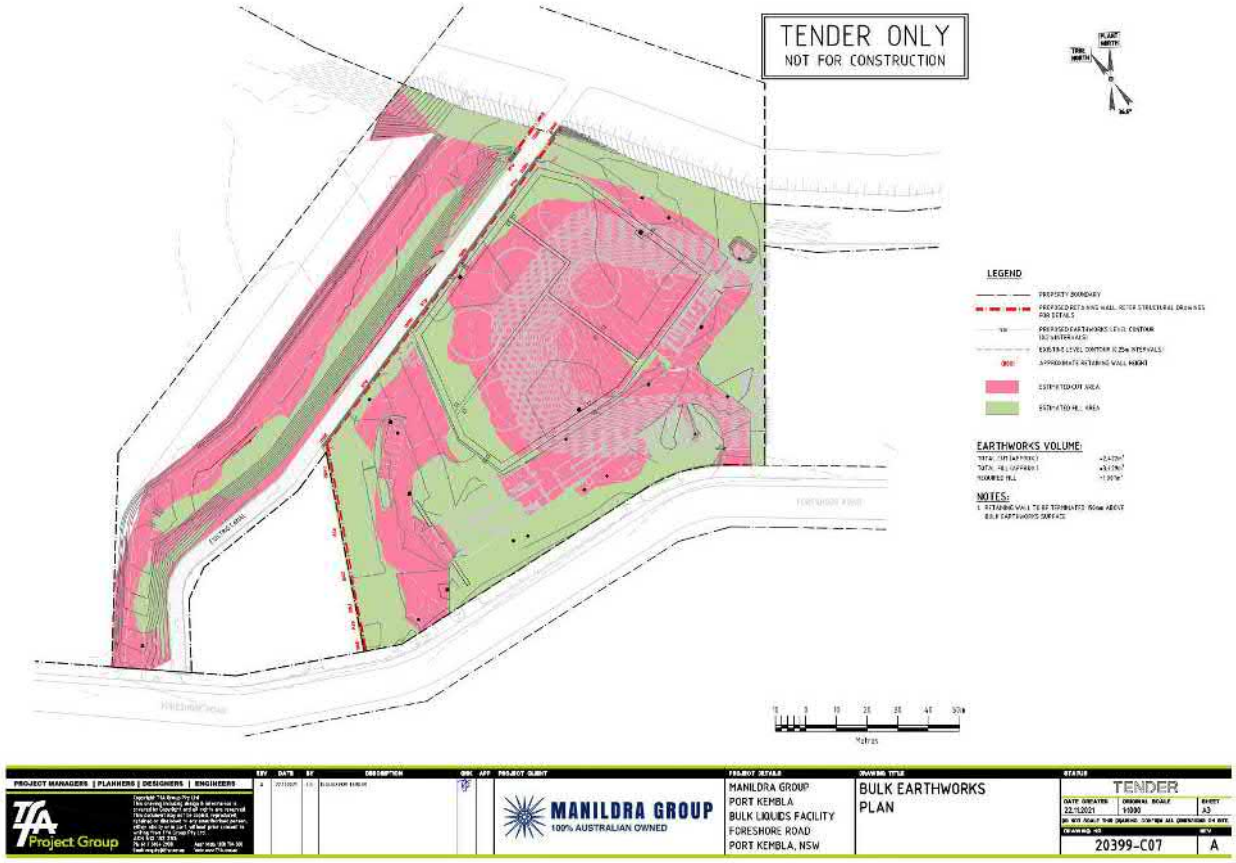


Figure 3-1 Bulk earthworks plan (Drawing ref: 20399-SK108_B, dated 31.08.21 prepared by TFA Group Pty Ltd)

3.2 Pipeline route

The Site boundary extends to the east of the main terminal along a 4m wide easement for construction of a new pipeline route connecting to existing Jetty No. 4, including a parcel of land within Part of Lot 2 DP 1182823 owned by Transport for NSW (TfNSW).

Appendix D includes a copy of the Site plan showing the proposed layout of the development relative to the Site boundaries. Based on the current set of design drawings (20399-DA-P01 to P05, dated 10 March 2022) prepared by TFA Group Pty Ltd., the pipeline route would consist of:

- Approximately 180m above-ground pipeline mounted on footings between the main terminal (Chainage 0m) and a dive thrust block (Chainage 180m). Along this portion, shallow foundation excavations are anticipated to be 1.0m deep (each 0.4m wide x 1.0m length) at regular intervals (roughly every 5-6m spacing)
- Approximately 280m underground pipeline between dive thrust block (Chainage 180m) and Jetty No. 4 (Chainage 460m) – Trench excavations are anticipated to be 1.8m deep by 2.0m wide. Installation is expected to involve 'cut and cover' trenches reusing materials excavated during backfill (minimum 1.2m compacted backfill) and removal of surplus spoil material for reuse/containment within main terminal.

Figure 2, Appendix A shows the proposed layout of the pipeline route (including marking of Chainage 0 to 460m) relative to the Site boundaries.

3.3 Construction Details

3.3.1 Construction Activities

The Project's construction activities can have a direct impact on the environment and can contribute to a larger environmental change.

SMEC consider that the main development activities which could impact upon ASS are localised deep excavation for installation of stormwater features and linear excavation for installation of stormwater utilities.

3.3.2 Expected areas and scale of ASS disturbance

SMEC consider the following expected areas and scale of ASS disturbance based on preliminary drawings provided by Manildra:

- Three localised deeper excavations up to 4.5 m bgl for installation of stormwater treatment devices and an underground storage tank are likely to extend into Unit 3 (Estuarine soils). Based on information supplied to SMEC, preliminary estimated dimensions for excavations include:
  - Excavation 1 – Proposed stormwater treatment unit (approximately 3m x 3m x 4.5m depth)
  - Excavation 2 – Proposed stormwater treatment unit (approximately 3m x 3m x 4.5m depth)
  - Excavation 3 – Proposed underground storage tank (approximately 10m x 5m x 4.5m depth).
- Multiple linear excavations up to 2 m bgl allowing for installation of gravity retaining wall foundations and underground stormwater pipework. Based on information supplied to SMEC, preliminary estimated dimensions for excavations include:
  - Gravity retaining wall excavation - Linear trench excavation (approx. 220m) of concrete footing with dimensions (continuous approximately 1.3m wide by 1.0m depth below existing ground level, with multiple concrete backhoe piers 0.45m wide by 2.0m depth below existing ground level)
  - Stormwater pipework – Linear trench excavation (approx. 600m) are anticipated to be 0.5m wide by 1m depth below existing ground level. Installation is expected to involve 'cut and cover' trenches reusing materials excavated during reburial, excluding surplus spoil material.
- The Bulk Earthworks Plan (Drawing 20399-C07, refer to Appendix D) provided by Manildra show the estimated cut to fill areas during site recontouring, noting the cut depths remain to be confirmed. Based on discussions with Manildra, it is understood the depths are unlikely to extend below 1 m bgl and are therefore unlikely to extend to depths that would intersect ASS. The management measures in this ASSMP would be adopted as a contingency should this occur in relatively localised areas.
- SMEC consider ASS intersected by timber driven piles (bridge and tanks) or steel posts (retaining walls) are not expected to be brought to the surface or require management.

Figure 5, Appendix A shows the indicative locations of deeper excavations. Disturbed spoil containing ASS are expected to be generated from these excavations which are required to be managed. For the purposes of management, it is estimated that the scale of ASS disturbance will be less than 1000 tonnes.

Other activities associated with excavations if they were to intersect ASS, such as ASS loading, transportation and storage and stockpiling, has the potential to generate acid leachate runoff if not properly managed.

Project areas which disturb ASS require management of all disturbed soils in accordance with the procedures outlined in this management plan.

3.3.3 Identifying ASS

In the context of the Site, soils that have previously been identified as ASS are referred to as Unit 3 (Estuarine Soils) in line with the previously developed geological model. Both Estuarine clay and sand will be classified as suspected ASS.

Typically, AASS and PASS would appear as indicated in the photos below from eastern Australian estuarine fine-grained soils. Selected actual site photographs from previous test pit investigations are also included in Photo 3-1 to Photo 3-6.

Actual ASS (pH <4.0)



Potential PASS (pH >4.0)





Photo 3-1 TP13 – Dark grey sandy clay Unit 3 (Estuarine) layer observed at 2.0-2.2m



Photo 3-2 TP13 – Dark grey sandy clay Unit 3 (Estuarine) layer observed at 2.0-2.2m



Photo 3-3 TP14 – Dark grey sandy clay Unit 3 (Estuarine) layer observed at 1.2-1.4m



Photo 3-4 Example of dark grey clayey sand Unit 3 (Estuarine soils) approximately greater than 2.2 m bgl.



Photo 3-5 Example of dark grey clayey sand Unit 3 (Estuarine soils) approximately greater than Unit 1 (fill) and Unit 2 (Aeolian) layers sand



Photo 3-6 TP14 Clayey sand, pale grey Unit 3 (Estuarine soils) approximately greater than 2.4 m bgl.

To supplement preliminary results and visual indicators, field pH screening may also be carried out to assist identifying ASS. The field screening procedure should be carried out as per Appendix A of the National Acid Sulfate Soil Guidance – National Acid Sulfate Soils Sampling and Identification Methods Manual (Sullivan *et al*, 2018). Table 3-1 and Table 3-2 provide guidance on the interpretation of results sourced from Sullivan *et al*, 2018.

Table 3-1 Interpretation of pH_F Ranges

pH Value	Result	Comments
pHF ≤ 4, jarosite not observed in the soil layer/horizon	May indicate an AASS indicating previous oxidation of RIS or may indicate naturally occurring, non-ASS soils	Generally, not conclusive as naturally occurring, non-ASS soils, such as many organic soils (for example peats) and heavily leached soils, often also return pHF ≤ 4
pHF ≤ 4, jarosite observed in the soil layer/horizon	The soil material is an AASS	Jarosite and other iron precipitate minerals in ASS such as schwertmannite require a pH < 4 to form and indicate prior oxidation of RIS
pHF > 7	Expected in waterlogged, unoxidised, or poorly drained soils	Marine muds commonly have a pH > 7 which reflects a seawater (pH 8.2) influence. Oxidation of samples with H_2O_2 can help indicate if the soil materials contain RIS

Table 3-2 Interpretation of pH_{FOX} Results

pH Value and Reaction	Result	Comments
Strong reaction of soil with H_2O_2	Useful indicator of the presence of RIS but cannot be used alone	Organic rich substrates such as peat and coffee rock, and soil constituents like manganese oxides, can also cause a reaction. Care must be exercised in interpreting these results. Laboratory analyses are required to confirm if appreciable RIS is present
pHFOX value at least one unit below field pHF and strong reaction with H_2O_2	May indicate PASS	The difference between pH_F and pH_{FOX} is termed the ΔpH. Generally, the larger the ΔpH the more indicative of PASS. The lower the final pH_{FOX} the better the likelihood of an appreciable RIS content. For example, a change from pH_F of 8 to pH_{FOX} of 7 (that is a ΔpH of 1) would not indicate PASS, however, a unit change from pH_F of 3.5 to pH_{FOX} of 2.5 would be indicative of PASS. Laboratory analyses are required to confirm if appreciable RIS is present
pHFOX < 3, large ΔpH and a strong reaction with H2O2	Strongly indicates PASS	The lower the pH_{FOX} below 3, the greater the likelihood that appreciable RIS is present. A combination of all three parameters – pH_{FOX}, ΔpH and reaction strength – gives the best indication of PASS. Laboratory analyses are required to confirm that appreciable RIS is present
A pH_{FOX} 3–4 and Low, Medium or Strong reaction with H2O2	Inconclusive	RIS may be present; however, organic matter may also be responsible for the decrease in pH. Laboratory analyses are required to confirm the presence of RIS
pH_{FOX} 4–5	Inconclusive	RIS may be present in small quantities, or poorly reactive under rapid oxidation, or the sample may contain shell/ carbonate which neutralises some or all acid produced on oxidation. Equally, the pH_{FOX} value may be due to the production of organic acids with no RIS present. Laboratory analyses are required to confirm if appreciable RIS is present
pH_{FOX} > 5, small or no ΔpH, but Low, Medium or Strong reaction with H2O2	Inconclusive	For neutral to alkaline pH_F with shell or white concretions, the fizz test with 1 M HCl can be used to identify the presence of carbonates. Laboratory analyses are required to confirm if appreciable RIS is present and further testing is required to confirm that effective self-neutralising materials are present

Whilst field screening can be used as a guide, laboratory analysis should be carried out if there is ambiguity, is strongly recommended and required to verify screening results.

Table 3-3 provides the texture-based action criteria that laboratory samples are scrutinised against to determine the requirement for management of spoil material. Where soils containing concentrations at or above the action criteria are disturbed, management of spoil is required. As this project is expected to disturb spoil less than 1,000 tonnes, the two left hand columns should be used.

Table 3-3 Action criteria based on texture and volume of material disturbed

Type of Material		Action Criteria 1- 1000 tonnes disturbed		Action Criteria > 1000 tonnes disturbed	
Texture range (McDonald et al. (1990)	Approx. clay content (%)	Net Acidity*			
		Sulfur trail Net acidity % S-equiv	Acid trail mol H+/tonne	Sulfur trail % S-equiv	Acid trail mol H+/tonne
Fine light medium to heavy clays	> 40	≥ 0.10	≥ 62	≥ 0.03	≥ 18
Medium clayey sand to light clays	5-40	≥ 0.06	≥ 36	≥ 0.03	≥ 18
Coarse and Peats sands to loamy sands	<5	≥ 0.03	≥ 18	≥ 0.03	≥ 18

Table Notes:

**All net acidity values are on oven dried basis and exclude acid neutralising capacity unless this measure has been corroborated by other data, for example slab incubation data*

Source: Sullivan et al, 2018

A suitably experienced environmental consultant should be involved in the project to assist the Contractor identify ASS.

3.4 Construction Environmental Impacts

ASS occur within the Project footprint. The potential impacts from ASS if they are not managed may include:

- Generation of acidity from ASS disturbance
- Export of existing acidity upon disturbance and wetting
- Generation of low pH waters (surface water and groundwater) and potentially elevated dissolved metals
- Impacts on sensitive environments (flora and fauna)
- Potential for soil structural decline
- Potential for infrastructure decline due to aggressivity to structures (corrosion etc)
- Site owner perceptions of the project.

The following sections outline the Project activities during construction that have the potential to impact on ASS in the Site. Management procedures have been developed in order to mitigate these potential impacts and are outlined in Section 4.

3.4.1 Excavations

Deeper excavations up to 4.5m bgl such as proposed stormwater treatment devices (Excavation 1 and 2) and an underground storage tank (Excavation 3) could intersect ASS (locations shown on Figure 5, Appendix A). There is also potential for networks of linear trench excavations during installation of some stormwater pipework and backhoe piers used to found the gravity retaining wall to intersect ASS (refer to drawing in Appendix D). Site recontouring will involve sitewide shallow excavation (typically less than 1m bgl) and therefore intersecting ASS is unlikely.

Potential impacts of excavations due to ASS materials include:

- Excavation of ASS with the immediate ability to export acid and potentially dissolved metals upon wetting
- Excavation of PASS with the potential to generate acid upon exposure to oxygen and acidify
- Exposure of the cut faces of excavations to oxygen and water that may generate additional acidity or mobilise existing acidity
- Water quality reduction due to acid spikes and elevated dissolved metal concentrations
- Long term water quality issues (low pH, elevated total acidity, soluble sulfate, insoluble iron hydroxides and metals, principally Al, Fe, Mn and Zn). This especially applies to shallow drainage cut into ASS. Aesthetically, drains and water appear unclean and stagnant
- Seepage of affected water into the shallow groundwater which may affect a larger initial area of disturbance
- Shallow dewatering for leachate drains, box culverts and discharge of potentially acidic water into adjacent surface water bodies
- Associated water quality impacts on sensitive receptors (flora and fauna)
- Increased aggressivity towards concrete and steel structures that water flows against, and soil sits against. Steel would corrode quicker and the bonding of cement would break down faster to show underlying aggregate and possibly weaken structures over time.

3.4.2 Dewatering

Dewatering would be required for installation of the underground storage tank (Excavation 3) which occurs below groundwater levels (refer to Figure 5, Appendix A). This excavation is expected to be approximately up to 4.5m below the existing ground level, noting standing water levels are expected 1.8 m bgl based on previous groundwater monitoring near this proposed excavation. Dewatering would be required to be relatively ‘short term’ to facilitate excavation, installation/commissioning and backfilling following initial excavation to base depth (estimated between 2-5 days subject to confirmation of installer methods and requirements). Based on discussions with Manildra, temporary shoring/retention of the deep excavations would include sheet piles to reduce the groundwater ingress flowrate and reduce the effects of dewatering to a reduced radius of influence.

A dewatering strategy for Excavation 3 is currently being prepared as part of the Groundwater Assessment and Management Report (*pending completion at the time of this ASSMP*). Manildra has indicated a preliminary estimated duration for each excavation is between 2-5 days (subject to confirmation of installer methods and requirements).The dewatering strategy includes modelling to assess the radius of influence based on proposed rate of dewatering, characteristics of the surrounding aquifer and the required depth of sheet piling to minimise effects of groundwater drawdown in areas surrounding the excavation. Dewatering via ‘sump and pump’ techniques for relatively short duration are likely to be used, as compared to alternative dewatering techniques.

Dewatering is unlikely to be required for remaining installations of gross pollutant traps (Excavation 1 and Excavation 2) which occur below groundwater levels, noting these will be installed as ‘wet installations’ without the need for dewatering. Stormwater pipework excavations are not expected to extend below groundwater levels and do not require dewatering.

Potential impacts of dewatering are similar to those described for ‘Excavations’ (Section 3.4.1) along with the following additional items:

- Draw down of groundwater table below depths of PASS with the potential to generate acid upon exposure to oxygen and acidify
- Uncontrolled discharges of extracted groundwater via stormwater drains affecting surface water quality.

The following is noted in relation to ASS impacts:

- Unit 3 (Estuarine soil) clays/sandy clay were typically encountered at depths greater than 1.2m bgl, as compared to Unit 3 (Estuarine soil) sand encountered typically at depths below 2.4 m mbgl. Clayey soils have a reduced potential to oxidise upon dewatering, as compared to sandy soils (for short term dewatering). The National Acid Sulfate Soils Guidance states '*Sandy soil materials have traditionally been considered to pose a higher risk to soil water and groundwater than clays. This has been largely due to the ability of sands to dewater and oxidise quicker than clays, as well as less buffering capacity if the sands are clean and free of clays and especially carbonate.'* (Shand P. *et al*, 2018, p9)
- Groundwater ingress flowrates are expected to flow rapidly through permeable sandy soils based on previous investigation observations during test pitting and soil types consisting of mainly coarse-grained sandy materials (SMEC, 2021a, 2021b).

Further mitigation and management measures are proposed to manage groundwater drawdown and its effect on nearby ASS (refer to Section 4.5). A construction water quality monitoring programme during dewatering is proposed consistent with National Acid Sulfate Soils Guidance (Sullivan et al 2018c) (refer to Section 4.5).

SMEC note that if retention systems such as sheet piles that limit impacts from drawdown are not used, then to address impacts of deeper dewatering, a further assessment of the implications of dewatering on ASS would need to be carried out. Where the results of assessment indicate further control measures beyond those described in this ASSMP, then an addendum will be required.

4. ASS Management Procedures

4.1 ASS Management Hierarchy

The management associated with projects located within ASS can be grouped into eight key principles described in Table 4-1.

Table 4-1 ASS Hierarchy

Principle Item	Summary of Principle
1	The disturbance of ASS should be avoided wherever possible.
2	Where disturbance of ASS is unavoidable, preferred management strategies are: • Minimisation of disturbance • Neutralisation • Hydraulic separation of sulfides either on its own or in conjunction with dredging • Strategic reburial (re-interment). Other management measures may be considered but must not pose unacceptably high risks.
3	Works should only be performed when it has been demonstrated that the potential impacts of works involving ASS are manageable to ensure that the potential short- and long-term environmental impacts are minimised.
4	The material being disturbed (including in situ ASS) and any potentially contaminated waters associated with ASS disturbance, must be considered in developing a management plan for ASS and/or complying with general environmental due diligence.
5	Receiving marine, estuarine, fresh or brackish waters are not to be used as a primary means of diluting and/or neutralising ASS or associated contaminated waters.
6	Management of disturbed ASS is to occur if the ASS Action criteria is exceeded or reached.
7	Stockpiling of untreated ASS above permanent ground water table with (or without) containment is not an acceptable long-term management strategy. For example, soil that is to be stockpiled, disposed of, used as fill, placed as a temporary or permanent cover on land or in waterways, sold or exported off the treatment site or used in earth bunds, that exceed the Action Criteria should be treated and managed.
8	The following issues should be considered when formulating ASS management strategies: • The sensitivity and environmental values of the receiving environment. This includes the conservation, protected or other relevant status of the receiving environment (e.g. Fish Habitat Area, Marine Park, or protected/threatened species) • Whether ground waters and/or surface waters are likely to be directly or indirectly affected • The heterogeneity, geochemical and textural properties of soil on site • The management and planning strategies of local government and/or state government, including Regional or Catchment Management Plans/Strategies and State and or Regional Coastal Policies/Plans.

The following sections provide environmental management measures to limit adverse impacts to the environment from disturbance of ASS. Disturbed ASS is proposed to be managed through neutralisation.

These mitigation and management measures would be further developed by the Principal Contractor and incorporated into their Construction Environmental Management Plan (CEMP), as required based on their specific works. Further onsite technical advice in relation to previous sampling locations, sample depths and results would be provided by the Environmental Consultant during construction works.

4.2 Excavations

Where excavations occur within or near the inferred extent of ASS, the following steps would be undertaken:

- Identify the location of disturbance against sampling locations and results

- Determine and document the construction activity, maximum depth of excavation and controls
- Determine approximate volume of materials that may be disturbed
- Carry out field screening and/or additional testing as required to confirm ASS extents
- Determine the liming rates required to neutralise all disturbed ASS materials
- To mitigate the impacts on the receiving waterways:
  - Excavations that could intersect ASS should be avoided during/after wet weather conditions when surface water acidity issues may be exacerbated
  - Soil cuttings generated from the excavations should be contained within the vicinity of the excavation
  - Water generated from dewatering the excavations should be contained to prevent runoff into creeks and drainage lines.
- Collect all excavated ASS impacted materials and place in a containment area for treatment
- Apply aglime to temporary excavated faces if ASS is likely to be left exposed, at a rate of 5kg/m^2 to limit acid generation. NB Not applicable for excavations where sheet piles are used
- Monitor any pooled water within the excavation for acidity issues daily is required. Monitoring for water quality parameters should include pH, Electrical Conductivity (EC), Dissolved Oxygen (DO) and turbidity
- Treat any water with acidity issues at rates indicated in the CEMP
- Monitor the disturbed area for any acidity issues.

4.3 ASS Treatment Pad

Due to the scale of excavations, the quantities of disturbed ASS are not expected to exceed 1000 tonnes. For treatment of large volumes of material (>1000 tonnes), neutralisation would be carried out on a designated treatment or liming pad.

All excavated ASS would be stockpiled in a low permeability bunded area capable of containing all materials and associated leachate that may be produced either by seepage (drying) or rainfall.

In summary, the following stockpile construction elements would be implemented:

- Stockpiles would be placed away from creek lines, flow lines, and any other type of water body
- A low permeability dense clay with minimal sand and coarse materials would be used for bunding and base materials
- Clay would be compacted to reduce permeability further and must be a minimum 0.5m thick (compacted)
- A base layer of >80-micron plastic sheeting or geo - synthetic may be used to reduce permeability when suitable fill is unavailable. Alternatively, the base layer may consist of existing hardstand gravel (cemented slag), asphalt or concrete pavements where available
- Bunds must be high enough to contain all materials stockpiled and leave some room at the base for leachate to collect and drain to a low point, discharge point (sump) or attached holding pond
- Where ASS will remain permanently at its treatment location, a ‘guard layer’ of lime should be applied. The minimum guard layer rate beneath any treated-in-place ASS will be 5kg fine aglime per m^2 per vertical metre of fill. Where the highest detected sum of existing and potential acidity is more than 1.0% S-equivalent, the rate will be at minimum 10 kg fine aglime/m^3.

A schematic cross-section of a treatment pad, including a compacted clay layer, guard layer, leachate collection system and containment with bunding is provided in Figure 4-1 and Figure 4-2.

The sketches provided are examples only. Other methods of containing and treating materials may be viable. In all cases, no untreated and monitored leachate should escape the stockpiling area and the placement of the treatment area would be on high ground with minimal potential for run-off into the area. Due regard for sensitive receptors and environmental risk would also be accounted for in design, transport and placement.

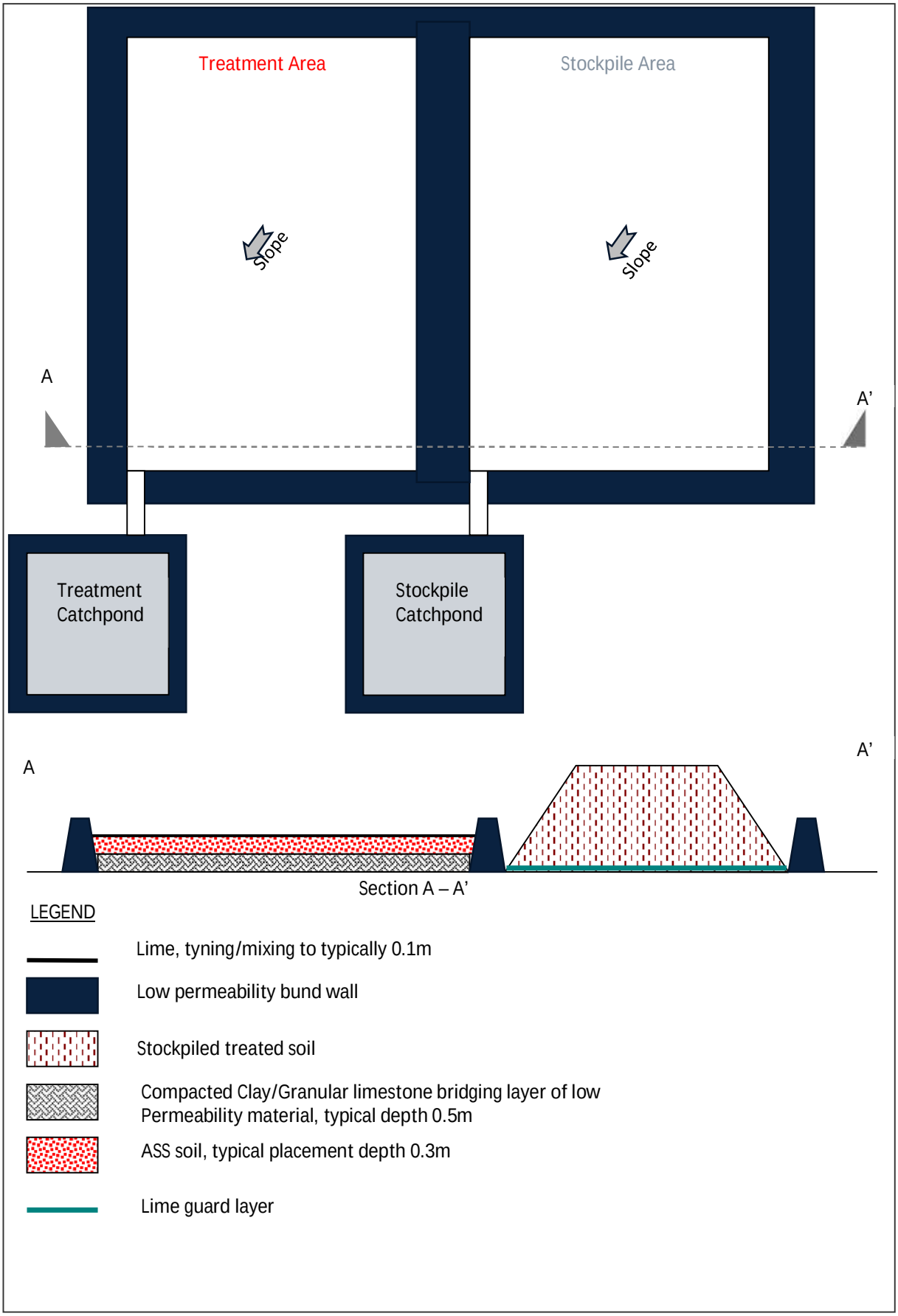


Figure 4-1 Treatment pad design with treatment area and stockpile area

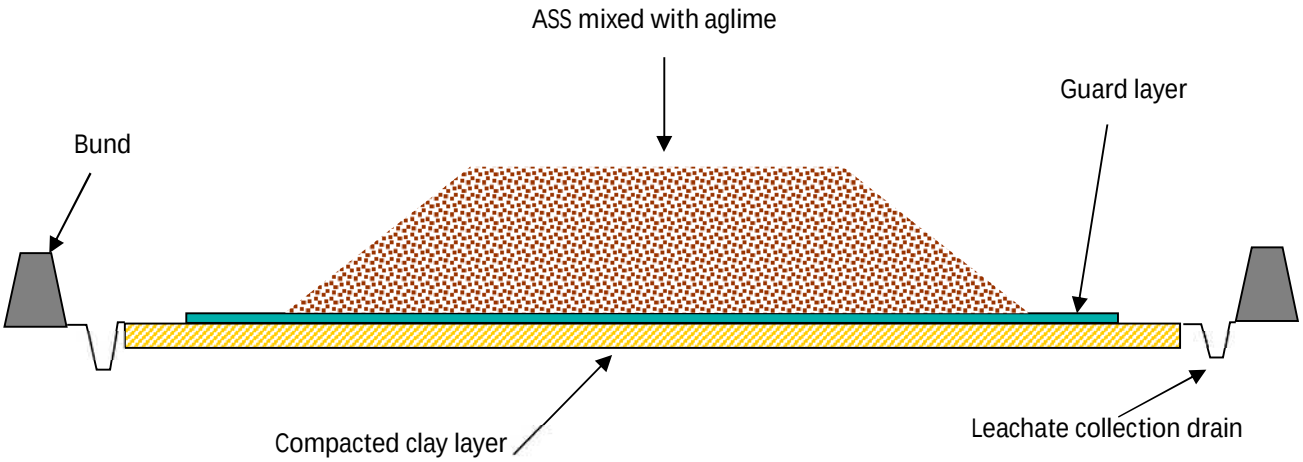


Figure 4-2 Cross section of land applied lime amended ASS





Examples of bunded treatment area for ASS and lime application Ref: Dear et al (2014)

4.3.1 Temporary Stockpiling

Short to medium term stockpiling of ASS would only be undertaken when transport to or treatment in the treatment area is not possible. In this case, stockpiling would be in accordance with Table 4-2.

Table 4-2 Stockpiling of ASS material (Ref: Dear et al (2014)

Type of Material		Maximum Duration of Stockpiling Prior to Treatment
Texture Range	Approx. Clay Content (%)	
Coarse Texture (sands to loamy sands)	<5	Overnight (18 hours)
Medium Texture (sandy loams to light clays)	5-40	2 nights (42 hours)
Fine Texture (medium to heavy clays and silt clays)	>40	3 nights (e.g. weekend – 66hrs)

4.3.2 ASS Neutralisation and Liming Rates

Soils assessed to be ASS which are excavated will require treatment with pure fine lime ($CaCO_3$) at a calculated liming rate. A mixing method that achieves thorough homogeneous mixing of the lime through the soil is to be employed at the Site which may include use of pug mill, special mixing attachments on excavators, rotivators or similar. Where soil

types are not amenable to these methods, mixing of lime by rigorous turning/mixing with an excavator until complete mixing is achieved can be utilised, but not preferred.

Careful tracking of materials is required with clearly designated storage areas defined as follows:

- Storage area for untreated materials – A designated area where materials are stockpiled awaiting treatment (if such area is required)
- Treatment area – A designated area to which materials will be mixed with lime
- Quarantine area – A designated area where materials have been mixed with lime and awaiting validation results.

Preliminary liming rates were assessed based on site specific data obtained during the preliminary investigation (SMEC, 2021a). The liming rate assessment was based on the following:

- The amount of lime to be added was assessed based on the results of laboratory analysis (refer to Table B1, Appendix B) taking into consideration existing acidity, potential acidity, retained acidity, but excluding any existing acid neutralising potential. A minimum factor of safety of 1.5 was applied.
- For disturbances less than 1000 m^3, the highest Net Acidity detected at the Site was used to calculate the amount of neutralising material needed.
- Aglime rate was calculated as per below:

$$Liming\ rate\ \left(\frac{kg\ Lime}{m^3}\right) = \frac{A\ \left(\frac{molH^+}{tonne}\right) x\ B\ \left(\frac{tonnes}{m^3}\right) x\ \frac{100}{NV} x\ FOS}{C\ \left(\frac{molH^+}{kg}\right)}$$

Notes:

  - A = net acidity (includes retained acidity, but excludes any pre-existing neutralising capacity unless this measure has been corroborated by other data, for example slab incubation data)
  - B = bulk density
  - NV = Neutralisation value of the Aglime (min. 95)
  - FOS = factor of safety (min. 1.5)
  - C = Neutralising capacity of lime = 19.98mol/kg (assumes fine grained agricultural lime).

SMEC consider the calculated treatment liming rate would be 228kg lime /m^3 for neutralising the Unit 3 (estuarine soils) excavated based on the following calculation inputs:

- Maximum net acidity (excluding acid neutralising capacity) of 1702mH^+/t (equiv. 2.80 %S)
- Assumed soil bulk dry density 1.7t/m^3 (assumes clay)
- Use of fine-grained agricultural lime with a min. 95% neutralising capacity
- Factor of safety 1.5.

If anticipated disturbed volumes are likely to significantly increase beyond current estimates, then further testing of soils to refine lime rates could be carried out.

4.3.3 Verification Testing

To verify that appropriate quantities of lime have been used during treatment, the following will be carried out:

- A lime register will be maintained by the Contractor. The register will list the amount of lime delivered to the site (verified by delivery dockets), and where/when the lime has been used.
- Verification testing should be carried out by an experienced ASS consultant and comprise the following:
  - Collection of 1 sample per 250m^3 per stockpile/treatment batch, with a minimum of 2 samples if <250m^3
  - Each sample is to be made from a composite of six individual samples to obtain better representation covering a grid across the stockpile/batch at varying depths

  - Samples to be tested using the S_{CR} suite with full acid base accounting including retained acidity.
- Treatment batch sizes will be treated and verified according to the following:
  - The first batch of soil treated should be say no larger than 50m^3 to trial the treatment process and verification
  - Based on the anticipated soil volume, subsequent batches should be verified at volumes of say no larger than 250m^3.
- Soils will be deemed to have been adequately neutralised when:
  - $pH_{KCl} \geq 6.5$
  - The Verification Net Acidity is less than zero, calculated as per below:

Verification Net Acidity = Potential sulfidic acidity + Actual Acidity + Retained Acidity – (post treatment Acid Neutralising Capacity – initial Acid Neutralising Capacity)

- Verification results should be checked for compliance. If compliance is not achieved, then the material will require additional lime neutralisation along with verification testing
- Earthworks processes may require adjustment to suit the requirements of processing and treatment of ASS
- A validation report is to be prepared and provided confirming soils have been adequately neutralised in accordance with this plan and demonstrated through the validation sampling results.

4.4 Reuse of treated ASS

Treated and verified material can be used on site as fill, subject to the material being:

- Geotechnically suitable for the intended use
- Suitable from a contamination perspective (see note 1)
- Placed above the water table (typically greater than 1.5 mbgl)
- Placed greater than 50m away from any receiving drainage or surface water feature unless approved otherwise by a suitably qualified environmental consultant.

Note 1: Treated ASS to be reused onsite within proposed 'fill' areas may also be contaminated and requires further management measures and validation as outlined within the Remedial Action Plan (ref: 30013038-R02, dated 6 May 2022). Should the treated ASS be validated suitable for reuse from a contamination perspective, then material may be reused onsite within proposed 'fill' areas.

Any offsite disposal should be carried out in accordance with guidelines applicable at the time, such as the NSW EPA (2014) Waste Classification Guidelines: Part 1 Classifying Waste and NSW EPA (2014) Waste Classification Guidelines: Part 4 Acid Sulfate Soils.

A soil tracking system is to be established to manage the movement of neutralised ASS. It may be important in future to be able to have clear documentation about areas of the Site where neutralised ASS have been used and areas where they have not been used. This may be particularly important if at a later stage during development, some soils require excavation (e.g. footings, services etc) as this will affect classification for offsite disposal.

4.5 Water in excavations

If rainwater accumulates within the excavation prior to the completion of remedial works, this will be disposed offsite appropriately which may include:

- Disposal via a licensed liquid waste contractor to an appropriate facility
- Disposal to stormwater under relevant guidelines and approval from Council or relevant Authority with any supporting testing and monitoring requirements.

All waste tracking and disposal dockets will be kept for inclusion in the validation report.

Groundwater ingress into deep excavations (Excavations 1 and Excavation 2) will not be removed noting high permeability sandy soils. The exception is for Excavation 3 where a dewatering strategy will be implemented as outlined in Section 4.6.

4.6 Dewatering

4.6.1 Approvals and licencing

A dewatering strategy would be implemented as documented within the Groundwater Assessment and Management Report (*pending completion at time of this ASSMP*) to be prepared to address SEARs requirements.

Dewatering activities should be carried out in accordance with the planning approval conditions. Details of proposed dewatering activities should be documented within the CEMP.

Dewatering activities are unlikely to trigger a need for licence/permits considering the anticipated construction dewatering volumes. WaterNSW website states construction dewatering may trigger the need for a water access licence (WAL), unless an exemption applies. The WaterNSW factsheet *Water access licence exemption for aquifer interference activities taking 3ML or less of groundwater per year*, Factsheet 250920 (copy in Appendix E) further outlines when a small volume of groundwater may be taken through certain aquifer interference activities without the need for a water access licence.

4.6.2 Dewatering

This ASSMP considers dewatering activities would be required at Excavation 1 as discussed in Section 3.4.2 noting potential impacts to ASS of groundwater drawdown would be minimised, subject to dewatering strategy (pending completion at time of this ASSMP).

The dewatering should be carried out in general accordance with mitigation and control measures outlined in the National Acid Sulfate Soils Guidance (Shand, P *et al.* 2018) Guidance of the dewatering of acid sulfate soils in shallow groundwater environments (Shand P. et al 2018).

In consideration of the potential impacts of dewatering (refer to Section 3.4.2), the adopted control measures proposed during dewatering include:

- Temporary shoring/retention below the groundwater table using sheet piling to required depth (assessed by the dewatering strategy), restricting groundwater ingress flowrates into the excavation.
- Dewatering activities to occur using a submersible ‘pump and sump’ for required duration only (i.e. to facilitate excavation, installation/commissioning and backfilling) prior to allowing water levels to return to original levels within the deep excavation. This may be achievable for relatively ‘short term’ installation of underground storage tank (i.e. estimated between 2-5 days), and subject to scheduling of installation materials and labour. This would potentially reduce the overall volume of dewatering required, limiting groundwater drawdown and its effect on nearby ASS.
- Discharge water into specific holding tanks and test holding tanks water quality to inform offsite disposal contractor
- Observe pit or excavated area for signs of acidity daily and lime non-vertical cut faces at a rate of 5 kg/m² to limit acid build up and leaching.
- Complete dewatering record forms as required.

SMEC note that if retention systems such as sheet piles that limit impacts from drawdown are not used, then to address impacts of dewatering, a further assessment of the implications of dewatering on ASS would need to be carried out. Where the results of assessment indicate further control measures beyond those described in this ASSMP, then an addendum will be required specifying the additional control measures during deep dewatering.

4.7 Water monitoring

Excavations including dewatering in areas where ASS could occur require that a monitoring program be implemented. A standalone Groundwater Assessment and Management Report (*pending completion at time of this ASSMP*) is being

prepared to address SEARs requirements noting this would include further details on a construction water quality monitoring programme and will be followed.

SMEC recommend that a construction water quality monitoring programme be carried out to comply with the planning approval conditions and NSW Ports specific requirements (refer to Section 11 Water Quality and Stormwater of Port Kembla Development Code – June 2021). The construction water quality monitoring programme should be developed and documented within the CEMP (or sub plan) along with monitoring criteria and response actions.

The water quality monitoring requirements should be in accordance with the National Acid Sulfate Soils Guidance: Guidance of the dewatering of acid sulfate soils in shallow groundwater environments (Shand P. *et al* 2018), and include the following relevant to ASS at a minimum:

- Collection of baseline groundwater data - It is noted that previously baseline groundwater quality monitoring including field measurements and laboratory analysis has been carried out by SMEC on two events in March and October 2021 (refer to Section 2.5.4). Baseline parameters were general consistent with those recommended by the Guidelines.
- Water table monitoring – Water level monitoring should be carried out to confirm water table changes are minimal during dewatering of ASS. This may be carried out using a combination of available onsite groundwater monitoring wells during dewatering activities (refer to Figure 2, Appendix A).
- Groundwater field measurements - Frequent monitoring at short intervals during dewatering (e.g. daily) including pH, specific electrical conductivity, redox potential, alkalinity/acidity and olfactory (odour) observations of noxious gases. Continued measurements at longer intervals (e.g. weekly) is required until groundwater returns to original water level and no impacts observed. Comparison will be made to baseline groundwater data to assess potential for groundwater impacts.
- Sampling and testing- At least once during dewatering, groundwater sample collection and laboratory analysis including major cations (calcium, magnesium, potassium, sodium) and major anions (chloride, sulphate and fluoride), alkalinity, total acidity*, nitrogen (ammonia, nitrate, nitrite), total phosphorus*,soluble reactive phosphorus*, dissolved heavy metals (aluminium, arsenic, cadmium, cobalt*, chromium (total), copper, manganese, nickel, uranium*, zinc) and total unfiltered heavy metals* (aluminium, iron and manganese)*. Comparison will be made to baseline groundwater data to assess potential for groundwater impacts.

  *NB *Baseline parameters tested in October 2021 round*
- Assessment of monitoring trends – Carried out during and after dewatering operation for duration of monitoring including assessment of potential change from baseline conditions.
- Post works closure report – Monitoring results to be collated and reported within the monitoring closure report along with discussion of the environmental impacts observed.

Due to proximity of works to Port Kembla Outer Harbour, the CEMP should also include regular visual monitoring inspections of sensitive nearby water receptors (including adjacent harbour, stormwater drains and onsite/nearby stormwater pits) to enable early detection of possible impacts. These should be carried out at frequent intervals (e.g. daily) during excavations, stockpiling, lime neutralisation/treatment where ASS is disturbed.

The CEMP (or subplan) should include contingency response actions for addressing any visual signs of unusual discolouration, odour or significant change to baseline water quality within sensitive nearby water receptors as a result of excavation activities where ASS is disturbed. It should also address any additional construction water quality monitoring requirements required by a licence or approval which are not specified here.

4.8 Leachate and Water Liming

Ponded leachate from excavated ASS materials should not be appreciably acidic, since the management protocols have been formulated to prevent build-up of significant acidity. However, heavy or sustained rainfall during excavation, especially over weekends, may produce leachate from excavated stockpiles, which have pH less than the receiving water, since they have not had sufficient time to contact and react with the neutralising agent. In accordance with principles (Ahern et al, 1998), the following steps would be undertaken:

- Contain all potentially ‘polluted’ water within the site boundary by ensuring sufficient bunding or levees (using non-ASS soils or materials)

- Treat waters to acceptable levels prior to discharge to surrounding environments and in line with existing approvals and conditions. Treatment measures most commonly include liming with hydrated lime but may include other measures if suitable
- Monitor water quality at the discharge point (minimum, pH and EC) and record in field documentation.

Further details of the construction water quality monitoring programme would be developed and documented in the CEMP along with monitoring criteria and response actions.

5. Managing Compliance with ASSMP

5.1 Roles and Responsibilities

The Project team's organisational structure and roles and responsibilities are to be detailed in the Principal Contractor's CEMP. An overview of the key roles and responsibilities for the implementation of the ASSMP are summarised in Table 5-1. Specific responsibilities in relation to mitigation measures are also to be included.

Table 5-1 Roles and Responsibilities

Role	Key Responsibilities
Client / Principal Contractor* (Manildra Group Pty Ltd)	• Provide ASSMP and related information pertaining to ASS as required • Engage the Contractor to implement requirements • Responsible for overall implementation of the ASSMP • Provide induction, awareness, and training in accordance with this ASSMP • Monitoring of compliance with the ASSMP.
Contractor	• All civil earthworks (excavation, lime neutralisation disposal etc) • Liaise with the Consultant as required • Provide delegation and instruction to subcontractors (i.e. earthworks operators) as required to implement the ASSMP • Maintain site records and documentation (i.e. liming register, receipts).
Environmental Consultant	• Assist Contractor with initial briefing and toolbox talks (as required) to assist in compliance with the ASSMP • Estimate the liming rates required to neutralise all disturbed ASS materials • Verification soil sampling and testing • Provide guidance and comment on ASS management activities • Prepare final ASS validation report for Principal Contractor • Implement water monitoring in accordance with the construction water quality monitoring programme documented within the Groundwater Assessment and Management Report (*pending completion at the time of this ASSMP)*

** Assumes Manildra is the Principal Contractor*

The Contractor would also detail appropriate personnel for the following specific responsibilities relevant to ASS management for the Project and these responsibilities would be documented and communicated as part of site induction and training. These responsibilities include:

- Toolbox talks – ASS issues relevant to the stages project works
- Site Induction – Environmental Awareness (ASS)
- Ensure relevant personnel are aware of their responsibilities under the management plan
- Update of management plan as required
- Review and understanding of Management Plan/s
- Organise the appropriate storage of neutralising agent onsite
- Ensuring ASS management hierarchy principles are adopted
- Knowledge of ASS locations and extent(s)
- Administer the relevant controls and environmental management measures as per relevant sections of this management plan
- Liaise with Superintendent/Foremen to ensure all adequate environmental controls and management as per this management plan are in place and maintained

- Coordinate the testing of stockpiles and treated ASS in line with this management plan
- If treated ASS is reused on site, ensure it has passed verification testing and is in accordance with this management plan
- Record locations of ASS reuse for use within the Operational Management Plans
- Advise the Principal Contractor(s) if ASS incidents or unidentified ASS is encountered
- Organise the correct ordering, material quality and distribution of neutralising agent onsite
- Direct the mixing rates for neutralising agents and treatment of ASS throughout the project
- Ensure stockpiles and treatment areas for ASS are away from direct flows to waterways and drainage systems
- Ensure stockpile treatment pads are constructed in accordance with this management plan
- Ensure verification results for ASS are below the project set criteria
- Ensuring subcontractors comply with this management plan and procedures
- Assessment of physical controls in accordance with this management plan
- Water quality monitoring (surface and groundwater) in areas of ASS disturbance and reuse areas
- Dust suppression for ASS stockpiles
- Liaison with laboratory conducting verification testing during construction
- Documentation of all monitoring data and ASS verification records.

5.2 Training and Awareness

Training requirements would be defined in the Principal Contractor's CEMP. The Principal Contractor should appoint a representative to be responsible for managing ASS and be responsible for understanding the contents of this plan, the CEMP and implementing ASS management for the project.

Other project personnel, subcontractors and consultants would receive training in environmental obligations during the inductions and toolbox talks including ASS when there is potential for their work to intersect or be in areas with ASS. ASS management training would generally include:

- Unexpected discovery of ASS
- Location of known ASS within the alignment and the ASS treatment areas
- The requirements of the ASSMP.

Training records for Project personnel would be kept and maintained.

If required, a suitably qualified Environmental Consultant could be engaged to assist or train the Contractor in the identification of ASS.

5.3 Inspection, Surveillance and Monitoring

Daily visual inspections targeting the ASS management areas to identify actual or potential ASS concerns would be undertaken during construction by the Contractor. These inspections would form part of the Contractor's management and mitigation schedule in their CEMP of the ASSMP and be used to identify and rectify any ASS management issues.

ASS management issues identified through site inspections and monitoring of construction works would be managed in accordance with the Contractor's the CEMP.

Environmental inspections and monitoring events would be recorded and actioned to facilitate compliance with the ASSMP.

Discharge of water from treatment basins would be in accordance with the Contractor's CEMP. Prior to controlled discharge of water to the environment, sampling and testing would be undertaken by the Environmental Officer or

trained site delegates and laboratory confirmation would occur to ensure that the water quality criteria listed in CEMP are met. Reporting and documentation regarding water discharge would be in accordance with the CEMP.

5.4 Reporting Requirements

Project reporting would be undertaken in accordance with the Contractor's CEMP. The following reports would be prepared as part of the CEMP:

- A daily record would be maintained at all ASS sites and would include inspections, dates, times, sampling dates, locations and corrective actions if required.
- Dewatering records for all dewatering activities.
- An ASS validation report prepared by the Consultant to assess the effectiveness of the programs to treat and neutralise ASS in accordance with the ASSMP. The ASS validation report would include:
  - Details of treated ASS material Lime register (lime register to be provided by the Contractor)
  - Map showing stockpile location, volumes and existing controls (i.e. bunding and other erosion and sediment controls)
  - Results of verification sampling and testing
  - Summary of environmental inspections and monitoring
  - Incident reports and/or Corrective Action Request (if applicable)

Additional reporting required in relation to ASS management may be required in the event that unexpected finds of contamination or new ASS are encountered during works.

5.5 Non-Conformance

Any non-conformance with Environmental Procedures specified in the CEMP must be addressed in 48 hours and enacted as soon as practical. The personnel responsible for the non-conformance must be notified immediately for the purpose of issuing corrective action requests.

5.6 Corrective Action Requests and Instructions

Any non-conformance would be documented on an appropriate form stating the nature of the non-conformance and the mechanisms implemented to rectify the problem.

5.7 Review and Improvement of the ASSMP

During construction of the Project, it is anticipated that the management of ASS would be improved through a variety of mechanisms including:

- Reviewing past performance and identifying opportunities for improvement
- Monitoring current performance and evaluating against relevant project goals and objectives
- Identifying causes for non-conformances with goals and objectives
- Implementing actions to address deficiencies including corrective and preventative actions
- Ongoing monitoring to evaluate current effectiveness of changes.

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Appendix A. Figures



FIG NO. 1	**FIGURE TITLE** Site Locality Plan	**DATE** 05/05/2022	0 25 50 100 150 200 Metres 1:6,000	**PAGE SIZE** A3	**COORDINATE SYSTEM** GDA 1994 MGA Zone 56
PROJECT NO. 30013038	**PROJECT TITLE** Acid Sulfate Soils Management Plan - Manildra - Port Kembla Bulk Liquid Terminal	**CREATED BY** FA13847	**SOURCES** Roadnet MDS 2020, MetroMap Imagery © Aerometrex Pty Ltd		

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SMEC
Member of the Surbana Jurong Group

Location: V:\Projectz\30013038 - Ethanol Tank Farm, Port Kembla\Maps\ASSMP\30013038_ASSMP_F001_SiteLocality.mxd

Last updated by: FA13847 on 5/05/2022 at 15:32

LEGEND

- Site Boundary

Proposed Pipeline Centreline

- Aboveground pipeline centreline
- Underground pipeline centreline
- Design
- Proposed Underground Storage Tank

Proposed Site Features

- Drainage Swale
- Ethanol Tanks
- Service Road
- Bridge
- Office
- Car Parking
- Channel
- Gantry
- Landscape
- Tanks
- Station
- Wash Bund
- Fire Pump
- Feature
- Proposed Test Pit Locations

SMEC Test Locations - Main Terminal

- Boreholes (SMEC)
- Test pit - sample locations
- Test pit - stockpile observations only
- Groundwater Monitoring Well (SMEC)
- Existing Groundwater Monitoring Wells
- Historical Groundwater Monitoring Wells (not sampled)

SMEC Test Locations - Pipeline Route

- Borehole Locations
- Test Pit Location

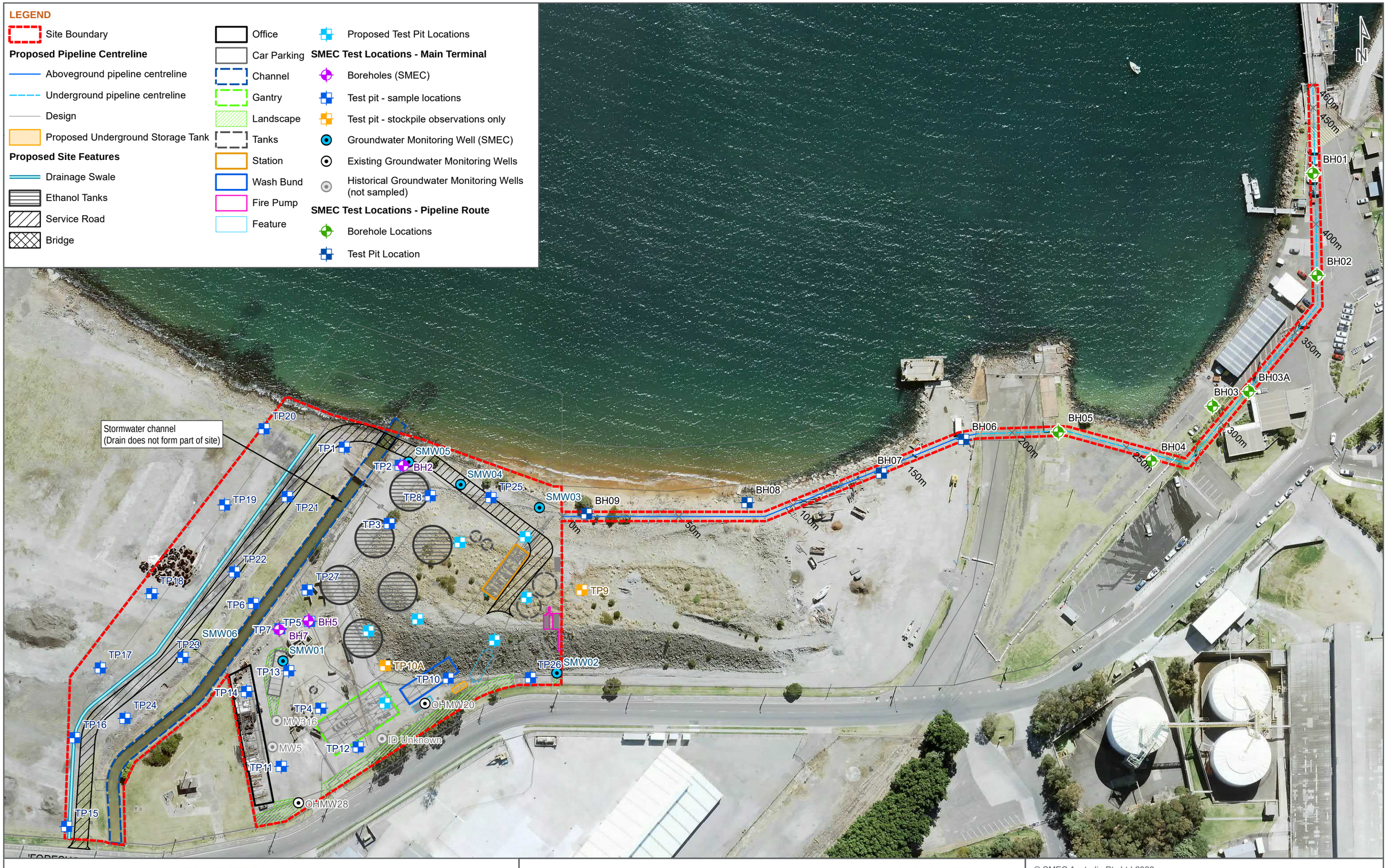


FIG NO. 2	**FIGURE TITLE** Site Layout and Test Location Plan Foreshore Road, Port Kembla	**DATE** 06/05/2022	0 25 50 1:1,500 Metres	**PAGE SIZE** A3	**COORDINATE SYSTEM** GDA 1994 MGA Zone 56
PROJECT NO. 30013038	**PROJECT TITLE** Acid Sulfate Soils Management Plan - Manildra - Port Kembla Bulk Liquid Terminal	**CREATED BY** FA13847	**SOURCES** Roadnet MDS 2020, Design supplied by client, MetroMap Imagery © Aerometrex Pty Ltd		

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Location: V:\Projectz\30013038 - Ethanol Tank Farm, Port Kembla\Maps\ASSMP\30013038_ASSMP_F002_SiteLayout.mxd

Last updated by: FA13847 on 6/05/2022 at 11:26

LEGEND

Site Location

Acid Sulfate Soil Probability

Disturbed Terrain

Beach

Note:
X1 denotes ground elevation between 1-2m AHD
X2 denotes ground elevation between 2-4m AHD
X4 denotes greater than 4m AHD

B

X2

X1

X2

X4

B

FIG NO. 3	**FIGURE TITLE** Acid Sulfate Soils Risk Map	**DATE** 05/05/2022	0 25 50 100 Metres 1:3,000	**PAGE SIZE** A3	**COORDINATE SYSTEM** GDA 1994 MGA Zone 56
PROJECT NO. 30013038	**PROJECT TITLE** Acid Sulfate Soils Management Plan - Manildra - Port Kembla Bulk Liquid Terminal	**CREATED BY** FA13847	**SOURCES** Roadnet MDS 2020, MetroMap Imagery © Aerometrex Pty Ltd		

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Location: V:\Projectz\30013038 - Ethanol Tank Farm, Port Kembla\Maps\ASSMP\30013038_ASSMP_F003_AcidSulfate.mxd

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LEGEND

Site Boundary

Proposed Site Features

- Ethanol Tanks
- Service Road
- Bridge
- Office
- Car Parking
- Channel
- Gantry
- Landscape
- Tanks
- Station
- Wash Bund
- Fire Pump
- Feature
- Design

SMEC Test Locations - Main Terminal

- Boreholes (SMEC)
- Test pit - sample locations
- Test pit - stockpile observations only
- Groundwater Monitoring Well (SMEC)
- Existing Groundwater Monitoring Locations
- Historical Groundwater Monitoring Wells (not sampled)

Note:
Brackets show existing ground elevation (m AHD)

Location ID	Analyte
Depth (m)	Concentration (%S w/w)
Concentration exceeds action criteria* (0.03% S - Coarse texture soils)	
Concentration exceeds action criteria* (0.1% S -Fine texture soils)	

BH5	Net Acidity excluding ANC (Sulfur Units)
4.2-4.65	0.024
7.2-7.65	0.055

BH7	Net Acidity excluding ANC (Sulfur Units)
3-3.45	0.012
4.5-4.95	0.021
6.0-6.45	0.020-0.034

TP13	Net Acidity excluding ANC (Sulfur Units)
2.0-2.2	2.803

TP10	Net Acidity excluding ANC (Sulfur Units)
1.9-2.1	2.02

Existing Bridges
Sandstone stockpile
Stormwater Channel
(Drain does not form part of the site)
Shed
Stormwater pit and strip drain
'FORESHORE ROAD'
ID Unknown
MW (damage)
MW316
MW5
TP1 (3.11 mAHD)
TP2 (2.88 mAHD)
BH2
TP8
TP3
TP9 (14.65 mAHD)
TP6 (1.33 mAHD)
BH5 (2.82m AHD)
TP7 (2.49 mAHD)
BH7
SMW06
TP10A
TP13 (2.59 mAHD)
TP14
TP10 (2.93m AHD)
SMW02
OHMW20 (2.89 mAHD)
TP4
TP12 (2.64 mAHD)
TP11
OHMW28 (2.41 mAHD)

FIG NO. 4	**FIGURE TITLE** Previous ASS Results Exceeding Criteria	**DATE** 06/05/2022	0 20 40 Metres 1:1,000	**PAGE SIZE** A3
PROJECT NO. 30013038	**PROJECT TITLE** Acid Sulfate Soils Management Plan - Manildra - Port Kembla Bulk Liquid Terminal	**CREATED BY** FA13847	**SOURCES** Roadnet MDS 2020, Design supplied by client, MetroMap Imagery © Aerometrex Pty Ltd	**COORDINATE SYSTEM** GDA 1994 MGA Zone 56

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LEGEND

- Site Location
- Design

Proposed Utilities

- Proposed Stormwater
- Proposed Drainage to Holding Tank
- Proposed Valve Controlled Drainage

Proposed Site Features

- Channel
- Retaining Wall Excavation
- Proposed Deep Excavation Sites

Outer Harbour

N

Retaining Wall
(Approx. 220m x 1.3m x 1-2m depth)

Stormwater Channel
(Drain does not form part of the site)

Excavation 1 -
Proposed stormwater treatment unit
(Approx. 3m x 3m X 4.5m deep)

Excavation 2 -
Proposed stormwater treatment unit
(Approx. 3m x 3m x 4.5m deep)

Sandstone Stockpile

Foreshore Road

Excavation 3 -
Proposed underground storage tank
(Approx. 10m x 5m x 4.5m deep)

FORESHORE ROAD

FIG NO. 5	**FIGURE TITLE** Proposed Deep Excavations	**DATE** 06/05/2022	0 5 10 20 30 40 50 Metres 1:1,000	**PAGE SIZE** A3	**COORDINATE SYSTEM** GDA 1994 MGA Zone 56
PROJECT NO. 30013038	**PROJECT TITLE** Acid Sulfate Soils Management Plan - Manildra - Port Kembla Bulk Liquid Terminal	**CREATED BY** FA13847	**SOURCES** Roadnet MDS 2020, Design supplied by client, MetroMap Imagery © Aerometrex Pty Ltd		

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Location: V:\Projectz\30013038 - Ethanol Tank Farm, Port Kembla\Maps\ASSMP\30013038_ASSMP_F005_RAP.mxd

Last updated by: FA13847 on 6/05/2022 at 11:43

Appendix B. Previous results

				Description	Field pH	Field pH after oxidation	Reaction description	Drop in pH by calculation	Chromium Suite																			Extraneous Material				By calc.
				Test Parameter	pHf	pHfox	Reaction description *(See legend)*	Difference (pHf - pHfox)	pH-KCL	Acid trail - Titratable Actual Acidity	sulfidic - TAA equiv. S% pyrite	Chromium Reducible Sulfur	Chromium Reducible Sulfur - acidity units	Sulfur - KCl Extractable	HCl Extractable Sulfur Correction Factor	HCl Extractable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - acidity units	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity (ANCbt)	Acid Neutralising Capacity acidity (a-ANCbt)	Acid Neutralising Capacity equivalent S% pyrite (s-ANCbt)	ANC Fineness Factor	CRS Suite - Net Acidity (Sulfur Units)	CRS Suite - Net Acidity (Acidity Units)	<2mm Fraction	>2mm Fraction	Analysed Material	Extraneous Material	Net Acidity excluding ANC (Sulfur Units)
				Units of measurement	pH Units	pH Units	-	pH Units	pH Units	moles H+/T	% pyrite S	% S	moles H+/T	% S	Factor	% S	% S	moles H+/T	% S	% CaCO3	moles H+/T	% S	Factor	% S	moles H+/T	g	g	%	%	% S
				Limit of reporting	0.1	0.1	-	0.1	0.1	2	0.003	0.005	3	0.02	1	0.02	0.02	10	0.02	0.01	2	0.02	-	0.02	10	0.005	0.005	-	-	0.02
				Sullivan et al 1998, Action criteria (Coarse texture soils)																											0.03
				Sullivan et al 1998, Action criteria (Fine texture soils)																											0.1
Sample Location ID	Sample Depth (m)	Sampling date	SOIL UNIT: Description	Laboratory Report																														
BH5	4.2-4.65	1/03/2021	SAND: medium to coarse grained, pale grey (ESTUARINE?)	778086	--	--	--	--	9.7	< 2	< 0.003	0.021	13	n/a	2	n/a	n/a	n/a	n/a	27	5500	8.8	1.5	< 0.02	< 10	46	< 0.005	100	< 0.1	0.024
BH5	7.2-7.65	1/03/2021	SAND: medium to coarse grained, pale grey. (ESTUARINE?)	778086	--	--	--	--	9.5	< 2	< 0.003	0.052	33	n/a	2	n/a	n/a	n/a	n/a	38	7600	12	1.5	< 0.02	< 10	17	< 0.005	100	< 0.1	0.055
BH7	3-3.45	2/03/2021	SAND: fine to coarse grained, pale grey. (ESTUARINE?)	778086	--	--	--	--	9.8	< 2	< 0.003	0.009	5.7	n/a	2	n/a	n/a	n/a	n/a	22	4400	7	1.5	< 0.02	< 10	52	< 0.005	100	< 0.1	0.012
BH7	4.5-4.95	2/03/2021	SAND: fine to coarse grained, pale grey. (ESTUARINE?)	778086	--	--	--	--	9.7	< 2	< 0.003	0.018	11	n/a	2	n/a	n/a	n/a	n/a	21	4200	6.7	1.5	< 0.02	< 10	85	0.19	100	0.2	0.021
BH7	6.0-6.45	2/03/2021	SAND: fine to coarse grained, pale grey. (ESTUARINE?)	778086	--	--	--	--	9.7	< 2	< 0.003	0.017	11	n/a	2	n/a	n/a	n/a	n/a	18	3600	5.8	1.5	< 0.02	< 10	83	< 0.005	100	< 0.1	0.020
QC4	(Duplicate of BH7/6.0-6.45)	2/03/2021	SAND: fine to coarse grained, pale grey. (ESTUARINE?)	778086	--	--	--	--	9.7	< 2	< 0.003	0.031	19	n/a	2	n/a	n/a	n/a	n/a	29	5700	9.2	1.5	< 0.02	< 10	47	< 0.005	100	< 0.1	0.034
TP1	2.0-2.2	17/02/2021	SAND: fine to coarse grained, pale orange, pale brown.	775286	9.3	7.5	1	1.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP1	2.8-3	17/02/2021	SAND: fine to coarse grained, pale orange, pale brown.	775286	9.3	7.5	1	1.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP2	2.0-2.3	15/02/2021	SAND: fine to coarse grained, pale brown, pale orange.	775286	9.0	9.3	4	-0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP2	3.0-3.2	15/02/2021	SAND: fine to coarse grained, pale brown, pale orange.	775286	9.1	9.4	4	-0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP3	3.0-3.2	15/02/2021	SAND: fine to coarse grained, pale brown, pale orange, with laminations of dark grey clay, trace sea shells. (AEOLIAN)	775286 / 777212	8.8	7.5	1	1.3	9.7	< 2	< 0.003	0.01	6	n/a	2	n/a	n/a	n/a	n/a	9.5	1900	3.1	1.5	< 0.02	< 10	39	< 0.005	100	< 0.1	0.013
TP3	3.5-3.7	15/02/2021	SAND: fine to coarse grained, pale brown, pale orange, with laminations of dark grey clay, trace sea shells	775286	7.9	8.4	4	-0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP4	1.3-1.5	15/02/2021	SAND: fine to coarse grained, pale brown. (AEOLIAN)	778145	--	--	--	--	9.3	< 2	< 0.003	< 0.005	< 3	N/A	2	n/a	n/a	n/a	n/a	1.5	300	0.47	1.5	< 0.02	< 10	76	4.8	94	6	<0.008
TP4	2.2-2.5	15/02/2021	SAND: fine to coarse grained, pale brown. (AEOLIAN)	778145	--	--	--	--	9.6	< 2	< 0.003	0.005	3.3	N/A	2	n/a	n/a	n/a	n/a	9.7	1900	3.1	1.5	< 0.02	< 10	88	14	86	14	0.008
TP5	1.6-1.9	15/02/2021	SAND: medium to coarse grained, pale brown.	775286	9.1	9.3	4	-0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP5	2.8-3.0 (*See note)	15/02/2021	SAND: medium to coarse grained, pale brown.	775286	8.4	7.6	4	0.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP6	0.5-0.6	17/02/2021	SAND: fine to coarse grained, pale grey, pale brown.	775286	8.9	8.7	4	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP6	1.3-1.5	17/02/2021	SAND: fine to coarse grained, pale grey, pale brown	775286	9.2	7.4	1	1.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP7	2.2-2.4	15/02/2021	SAND: fine to coarse grained, pale brown, with black carbonaceous lamination	775286	9.1	9.5	4	-0.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP7	2.8-3.0	15/02/2021	SAND: fine to coarse grained, pale brown, with black carbonaceous lamination. (ESTUARINE?)	775286 / 777212	9.1	7.4	1	1.7	9.7	< 2	< 0.003	0.011	6.7	n/a	2	n/a	n/a	n/a	n/a	21	4100	6.6	1.5	< 0.02	< 10	15	< 0.005	100	< 0.1	0.014
TP8	1.1-1.2	16/02/2021	SAND: fine to coarse grained, red, orange, brown.	775286	9.0	7.7	1	1.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP8	1.5-1.7	16/02/2021	SAND: fine to coarse grained, red, orange, brown. (AEOLIAN)	775286 / 778145	7.0	6.9	4	0.1	9.7	< 2	< 0.003	< 0.005	< 3	N/A	2	n/a	n/a	n/a	n/a	8.7	1700	2.8	1.5	< 0.02	< 10	81	2	98	2.5	<0.008
TP10	1.9-2.1 (*See note)	16/02/2021	CLAY trace silt: high plasticity, grey, with dark and pale grey laminations, trace fine to medium grained sand. (ESTUARINE?)	775286 / 777212	6.5	2.4	4	4.1	5.3	940	1.5	0.52	330	n/a	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	2	1300	53	< 0.005	100	< 0.1	2.02
TP10	2.3-2.5	16/02/2021	SAND: fine to coarse grained, orange, pale brown, trace sea shells.	775286	7.9	5.9	1	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP11	2.1-2.4 (*See note)	15/02/2021	SAND: fine to coarse grained, pale brown.	775286	9.0	7.3	1	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP11	2.8-3.0	15/02/2021	SAND: fine to coarse grained, pale brown.	775286	9.3	7.4	1	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Sample Location ID	Sample Depth (m)	Sampling date	SOIL UNIT: Description	Laboratory Report	Field pH	Field pH after oxidation	Reaction description	Drop in pH by calculation	Chromium Suite																Extraneous Material				By calc.
			Test Parameter		pHf	pHfox	Reaction description *(See legend)*	Difference (pHf - pHfox)	pH-KCL	Acid trail - Titratable Actual Acidity	sulfidic - TAA equiv. S% pyrite	Chromium Reducible Sulfur	Chromium Reducible Sulfur - acidity units	Sulfur - KCl Extractable	HCl Extractable Sulfur Correction Factor	HCl Extractable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - acidity units	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity (ANCbt)	Acid Neutralising Capacity acidity (a-ANCbt)	Acid Neutralising Capacity equivalent S% pyrite (s-ANCbt)	ANC Fineness Factor	CRS Suite - Net Acidity (Sulfur Units)	CRS Suite - Net Acidity (Acidity Units)	<2mm Fraction	>2mm Fraction	Analysed Material	Extraneous Material	Net Acidity excluding ANC (Sulfur Units)
			Units of measurement		pH Units	pH Units	-	pH Units	pH Units	moles H+/T	% pyrite S	% S	moles H+/T	% S	Factor	% S	% S	moles H+/T	% S	% CaCO3	moles H+/T	% S	Factor	% S	moles H+/T	g	g	%	%	% S
			Limit of reporting		0.1	0.1	-	0.1	0.1	2	0.003	0.005	3	0.02	1	0.02	0.02	10	0.02	0.01	2	0.02	-	0.02	10	0.005	0.005	-	-	0.02
			Sullivan et al 1998, Action criteria (Coarse texture soils)																										0.03
			Sullivan et al 1998, Action criteria (Fine texture soils)																										0.1
TP12	1.2-1.4	17/02/2021	SAND: fine to coarse grained, pale brown, red brown, trace sea shells.	775286	8.9	9.0	4	-0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP12	2.0-2.2	17/02/2021	SAND: fine to coarse grained, pale brown, red brown, trace sea shells.	775286	8.8	8.4	4	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP12	2.8-3.0	17/02/2021	SAND: fine to coarse grained, pale brown, red brown, trace sea shells.	775286	9.2	7.5	4	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP13	2.0-2.2	17/02/2021	Sandy CLAY: high plasticity, dark grey clay and sand, sand is fine to coarse grained, with hydrocarbon odour (ESTUARINE?)	778145	--	--	--	--	8	< 2	< 0.003	2.8	1700	N/A	2	n/a	n/a	n/a	n/a	9.8	2000	3.2	1.5	0.69	430	40	4.1	91	9.3	2.80
TP13	2.8-3.0	17/02/2021	SAND: fine to coarse grained, pale brown, pale grey.	775286	8.1	6.7	1	1.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP13	3.3-3.5	17/02/2021	SAND: fine to coarse grained, pale brown, pale grey.	775286	8.4	7.2	1	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP14	1.8-2.0	17/02/2021	SAND: fine to coarse grained, pale brown, pale orange.	775286	9.1	7.3	1	1.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP14	2.5-2.7	17/02/2021	SAND: fine to coarse grained, pale brown, pale orange.	775286	9.1	7.4	1	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				Minimum	6.5	2.4	1	-0.5	5.3	940	1.5	0.0	3.3	0.0	2.0	0.0	0.0	0.0	0.0	1.5	300	0.5	1.5	0.7	430	15.0	0.2	86	0.2	0.0
				Maximum	9.3	9.5	4.0	4.1	9.8	940	1.5	2.8	1700	0.0	2.0	0.0	0.0	0.0	0.0	38	7600	12.0	1.5	2.0	1300	88	14	100	14	2.8
				Total	25	25	25	25	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13

Colour legend

	Exceeds ASS action criteria (Coarse texture soils)
	Exceeds ASS action criteria (Fine texture soils)

Reaction description

Field Screen Rating	
1	No reaction to slight
2	Moderate reaction
3	Strong reaction with persistant
4	Extreme reaction

Table Notes:

Sullivan et al (1998) National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual, Table 5.4 Action criteria based on the texture and volume of material disturbed (assumes 1 to 1000 tonnes disturbed)

n/a Not applicable

- Not tested

* Asterix indicates samples for chromium reducible sulfur suite analysis were sub-sampled from the jar sample (refer to limitations in Section 7.5.1 of Report)

							Field parameters					Inorganics																	
							pH	Specific Conductivity (Ec @ 25°C)	Temperature	Dissolved Oxygen	Redox Potential	Ammonia as N	Ammonium as N	Nitrite as N	Nitrate as N	Reactive Phosphorus as P	Total Phosphorus as P	Total Hardness as CaCO3	Total Acidity as CaCO3	Total Dissolved Solids (Calc.)	Calcium	Magnesium	Sodium	Potassium	Chloride	Fluoride	Sulphate as SO4 - Turbidimetric	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Hydroxide Alkalinity as CaCO3	Total Alkalinity as CaCO3
Units of measurement								µS/cm	°C	%	mv	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Limit of reporting (ALS laboratory)							0.01	1	0.1	0.1	0.1	0.01	0.01	0.01	0.01	0.01	0.01	1	1	1	1	1	1	1	0.1	1	1	1	1	1
Limit of reporting (Eurofins laboratory)							--	--	--	--	--	0.01	0.01	0.02	0.02	0.01	0.01	5	10	10	0.5	0.5	0.5	0.5	1	0.5	5	20	10	20	20
Assessment criteria																															
Laboratory limits of reporting - adopted screening level for Total Recoverable Hydrocarbons																															
PFAS NEMP (2020) Ecological water quality guideline values (Table 5 Interim Marine - 95% Species Protection)																															
Friebel & Nadebaum 2011 Table A2 Groundwater HSLs for vapour intrusion (Commercial /industrial, 2-<4m Sand)																															
ANZG 2018 Default Guidelines Values for toxicants (Marine water – 95% species protection)												0.91																			
ANZG 2018 Default Guidelines Values for toxicants (Marine water – 80% species protection)												1.7																			
ANZECC & ARMCANZ (2000) Default trigger values for physical and chemical stressors for South-east Australia for slightly disturbed marine ecosystems, applying to estuaries							7.0-8.5			80-110																					
Water Sample ID	Sample Date	Lab Batch	Observations	Standing water level		Evidence of oily sheen or NAPL?																									
				Depth (m bgl)	Reduced Level (m AHD)																											
SMW01	10/03/2021	EW2101111	Slightly turbid brown, no odour	2.07	0.50	N	6.46	2,019	23.9	5.6	122.8	<0.01	--	1.03	1.3	<0.01	--	1120	--	1380	396	33	52	12	38	7.5	692	489	<1	<1	489
QA1 (Intra-laboratory duplicate of SMW01)	10/03/2021	EW2101111	--	--	--	--	--	--	--	--	--	<0.01	--	1.02	1.06	<0.01	--	1140	--	1370	401	34	53	12	38	7.3	701	505	<1	<1	505
QA1A (Inter-laboratory duplicate of SMW01)	10/03/2021	779367	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OHMW28	10/03/2021	EW2101111	Clear, no odour	1.77	0.64	N	6.48	2,880	23.6	3.7	-72.6	0.99	--	<0.01	0.12	<0.01	--	1460	--	1960	503	50	108	29	45	7.4	1460	398	<1	<1	398
OHMW20	10/03/2021	EW2101111	Clear, no odour	2.38	0.51	N	6.82	14,224	21.8	5.9	129.8	0.69	--	0.02	0.09	<0.01	--	1720	--	10100	227	279	2950	73	4770	3.2	1560	475	<1	<1	475
SMW01	21/10/2021	EW2104433	Clear, no odour	2.11	0.46	N	6.75	1,901	20.8	2.1	137	<0.01	<0.01	0.06	3.76	0.02	0.19	1070	44	1230	383	28	49	8	37	8.1	721	459	<1	<1	459
OHMW28	21/10/2021	EW2104433 / ES2140160	Clear- moderate rotten egg odour	1.86	0.55	N	6.61	2,960	20.6	3.0	-75.4	0.85	0.81	<0.01	0.03	<0.02	0.22	1600	57	1880	567	46	102	29	38	6.6	1570	402	<1	<1	402
QA1 (Intra-laboratory duplicate of OHMW28)	21/10/2021	EW2104433 / ES2140160	--	--	--	--	--	--	--	--	--	0.85	0.81	<0.01	0.03	<0.02	0.21	1620	57	1880	572	46	102	29	36	6.9	1550	395	<1	<1	395
QA1A (Intra-laboratory duplicate of OHMW28)	21/10/2021	834054	--	--	--	--	--	--	--	--	--	1.3	1.4	< 0.02	0.04	0.01	0.24	1600	28	2700	560	48	100	30	44	6.2	1700	380	< 10	< 20	380
OHMW20	21/10/2021	834054 / 838322	Slight yellowish colour, slight rotten egg odour	2.44	0.45	N	6.38	23,158	20.6	4.8	72.16	0.77	0.71	<0.01	0.05	<0.01	0.07	3040	53	14800	354	525	5000	95	7550	2.2	2080	428	<1	<1	428

Colour legend:

- Concentration exceeds HSLs Friebel & Nadebaum (2011) Human-health
- Concentration exceeds ANZG (2018) Aquatic ecosystems - 95% species protection
- Concentration exceeds ANZG (2018) Aquatic ecosystems - 80% species protection
- Concentration exceeds ANZECC / & ARMCANZ (2000) Physical and chemical stressors
- Concentration exceeds PFAS NEMP
- Laboratory limits of reporting exceed adopted criteria

Table Notes:

Friebel & Nadebaum (2011) Friebel & Nadebaum (2011) Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (technical paper No.10) Guidelines, CRC for Contamination Assessment and Remediation of the Environment (CRC CARE)

ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, August 2018), accessed 8 October 2018, URL: http://waterquality.gov.au/anz-guidelines

ANZECC & ARMCANZ (2000) ANZECC & ARMCANZ 2000, National Water Quality Management Strategy, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Protection of Aquatic Ecosystems

PFAS NEMP (2020) PFAS National Environmental Management Plan, Version 2.0 - January 2020, National Chemicals Working Group of the Heads of EPAs Australia and New Zealand

[A] No hardness corrections applied to default guideline values. Assumed 30mg/L CaCO3 applies.

[B] 99% protection of species adopted to account for potential bioaccumulative effects

[C] Low reliability values adopted

[D] Default guideline value assumes chromium (VI)

[E] Default guideline value assumes m-xylene

									BTEXN							TRH - 1999 fractions					TRH - 2013 fractions					
									Benzene	Toluene	Ethylbenzene	m+p-xylene	o-xylene	Xylenes (total)	Naphthalene	TRH C6 - C9	TRH C10 - C14	TRH C15 - C28	TRH C29 - C36	Sum of TPH C10-C36	TRH C6 - C10	TRH C6 - C10 less BTEX (F1)	TRH >C10 - C16	TRH >C10 - C16 less Naphthalene (F2)	TRH >C16 - C34	TRH >C34 - C40
Units of measurement									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Limit of reporting (ALS laboratory)									0.001	0.002	0.002	0.002	0.001	0.002	0.005	0.02	0.05	0.1	0.1	0.1	0.02	0.02	0.1	0.1	0.1	0.1
Limit of reporting (Eurofins laboratory)									0.001	0.001	0.001	0.002	0.001	0.003	0.01	0.02	0.05	0.1	0.1	0.1	0.02	0.02	0.05	0.05	0.1	0.1
Assessment criteria																										
Laboratory limits of reporting - adopted screening level for Total Recoverable Hydrocarbons															0.005	0.02	0.05	0.1	0.1	0.1	0.02	0.02	0.1	0.1	0.1	0.1
PFAS NEMP (2020) Ecological water quality guideline values (Table 5 Interim Marine - 95% Species Protection)																										
Friebel & Nadebaum 2011 Table A2 Groundwater HSLs for vapour intrusion (Commercial /industrial, 2-<4m Sand)									4.9	NL	NL			NL								6.2		NL		
ANZG 2018 Default Guidelines Values for toxicants (Marine water – 95% species protection)									0.7	0.18	0.08	0.075[E]			0.050[B]											
ANZG 2018 Default Guidelines Values for toxicants (Marine water – 80% species protection)									1.3	0.33	0.16	0.15[E]			0.120[B]											
ANZECC & ARMCANZ (2000) Default trigger values for physical and chemical stressors for South-east Australia for slightly disturbed marine ecosystems, applying to estuaries																										
Water Sample ID	Sample Date	Lab Batch	Observations	Standing water level		Evidence of oily sheen or NAPL?																				
				Depth (m bgl)	Reduced Level (m AHD)																					
SMW01	10/03/2021	EW2101111	Slightly turbid brown, no odour	2.07	0.50	N	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	0.02	<0.1	<0.1	<0.1	<0.1
QA1 (Intra-laboratory duplicate of SMW01)	10/03/2021	EW2101111	--	--	--	--	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
QA1A (Inter-laboratory duplicate of SMW01)	10/03/2021	779367	--	--	--	--	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.01	<0.02	0.16	<0.1	<0.1	0.16	<0.02	<0.02	0.14	0.14	<0.1	<0.1
OHMW28	10/03/2021	EW2101111	Clear, no odour	1.77	0.64	N	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
OHMW20	10/03/2021	EW2101111	Clear, no odour	2.38	0.51	N	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
SMW01	21/10/2021	EW2104433	Clear, no odour	2.11	0.46	N	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
OHMW28	21/10/2021	EW2104433 / ES2140160	Clear- moderate rotten egg odour	1.86	0.55	N	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
QA1 (Intra-laboratory duplicate of OHMW28)	21/10/2021	EW2104433 / ES2140160	--	--	--	--	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1
QA1A (Intra-laboratory duplicate of OHMW28)	21/10/2021	834054	--	--	--	--	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.003	< 0.01	< 0.02	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.05	< 0.05	< 0.05	< 0.1	<0.1
OHMW20	21/10/2021	834054 / 838322	Slight yellowish colour, slight rotten egg odour	2.44	0.45	N	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.02	<0.05	<0.1	<0.05	<0.05	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1

Colour legend:

- Concentration exceeds HSLs Friebel & Nadebaum (2011) Human-health
- Concentration exceeds ANZG (2018) Aquatic ecosystems - 95% species protection
- Concentration exceeds ANZG (2018) Aquatic ecosystems - 80% species protection
- Concentration exceeds ANZECC / & ARMCANZ (2000) Physical and chemical stressors
- Concentration exceeds PFAS NEMP
- Laboratory limits of reporting exceed adopted criteria

Table Notes:

Friebel & Nadebaum (2011) Friebel & Nadebaum (2011) Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (technical paper No.10) Guidelines, CRC for Contamination Assessment and Remediation of the Environment (CRC CARE)

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[A] No hardness corrections applied to default guideline values. Assumed 30mg/L CaCO3 applies.

[B] 99% protection of species adopted to account for potential bioaccumulative effects

[C] Low reliability values adopted

[D] Default guideline value assumes chromium (VI)

[E] Default guideline value assumes m-xylene

							Heavy Metals (Dissolved)											Heavy Metals (Total, unfiltered)			PAHs						Phenolic compounds		
							Aluminium	Arsenic	Cadmium	Chromium (total)	Cobalt (filtered)	Copper	Iron	Lead	Mercury	Nickel	Selenium	Uranium (filtered)	Zinc	Aluminium	Iron	Manganese	Anthracene	Benzo(a)pyrene	Fluoranthene	Naphthalene	Phenanthrene	Total PAH*	Pentachlorophenol	Phenol	Other Phenols
Units of measurement							mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Limit of reporting (ALS laboratory)							0.01	0.001	0.0001	0.001	0.001	0.001	0.05	0.001	0.0001	0.001	0.01	0.001	0.005	0.01	0.05	0.001	0.1	0.05	0.1	0.1	0.1	0.1	0.05	0.1	0.05 to 0.1
Limit of reporting (Eurofins laboratory)							0.05	0.001	0.0002	0.001	0.001	0.001	0.05	0.001	0.0001	0.001	0.001	0.005	0.005	0.05	0.05	0.005	0.01	0.01	0.01	0.01	0.01	0.01	--	--	--
Assessment criteria																															
Laboratory limits of reporting - adopted screening level for Total Recoverable Hydrocarbons																															
PFAS NEMP (2020) Ecological water quality guideline values (Table 5 Interim Marine - 95% Species Protection)																															
Friebel & Nadebaum 2011 Table A2 Groundwater HSLs for vapour intrusion (Commercial /industrial, 2-<4m Sand)																									NL						
ANZG 2018 Default Guidelines Values for toxicants (Marine water – 95% species protection)									0.0007[B]	0.0044[D]		0.0013		0.0044[C]	0.0001[B]	0.007[B]			0.015				0.01[B]	0.1[B]	1.0[B]	50[B]	0.6[B]		11	400	
ANZG 2018 Default Guidelines Values for toxicants (Marine water – 80% species protection)									0.036	0.085		0.008		0.012	0.0014	0.56			0.043				7.0	0.7	2.0	120	8.0		55		
ANZECC & ARMCANZ (2000) Default trigger values for physical and chemical stressors for South-east Australia for slightly disturbed marine ecosystems, applying to estuaries																															
Water Sample ID	Sample Date	Lab Batch	Observations	Standing water level		Evidence of oily sheen or NAPL?																									
				Depth (m bgl)	Reduced Level (m AHD)																											
SMW01	10/03/2021	EW2101111	Slightly turbid brown, no odour	2.07	0.50	N	0.03	0.044	0.0034	<0.001	--	0.019	0.57	0.016	<0.0001	0.127	0.05	--	0.494	--	--	--	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<LOR
QA1 (Intra-laboratory duplicate of SMW01)	10/03/2021	EW2101111	--	--	--	--	0.03	0.044	0.0033	<0.001	--	0.019	0.58	0.018	<0.0001	0.125	0.05	--	0.499	--	--	--	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<LOR
QA1A (Inter-laboratory duplicate of SMW01)	10/03/2021	779367	--	--	--	--	<0.05	0.026	0.0041	0.001	--	0.022	0.12	0.007	0.0002	0.110	0.057	--	0.500	--	--	--	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--	--	--
OHMW28	10/03/2021	EW2101111	Clear, no odour	1.77	0.64	N	<0.01	0.066	<0.0001	<0.001	--	0.004	15.4	<0.001	<0.0001	0.019	<0.01	--	<0.005	--	--	--	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<LOR
OHMW20	10/03/2021	EW2101111	Clear, no odour	2.38	0.51	N	<0.01	<0.001	0.0053	<0.001	--	<0.001	0.19	<0.001	<0.0001	0.010	<0.01	--	0.034	--	--	--	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<LOR
SMW01	21/10/2021	EW2104433	Clear, no odour	2.11	0.46	N	0.02	0.017	0.003	<0.001	0.008	0.036	0.18	0.014	<0.0001	0.094	0.06	0.008	0.849	0.66	2.38	0.072	<0.001	<0.001	<0.001	<0.004	<0.002	<0.001	<0.05	<0.1	<LOR
OHMW28	21/10/2021	EW2104433 / ES2140160	Clear- moderate rotten egg odour	1.86	0.55	N	<0.01	0.052	<0.0001	<0.001	0.006	<0.001	17.4	<0.001	<0.0001	0.027	<0.01	0.001	<0.005	0.07	20.2	1.15	<0.001	<0.001	<0.001	<0.004	<0.002	<0.001	<0.05	<0.1	<LOR
QA1 (Intra-laboratory duplicate of OHMW28)	21/10/2021	EW2104433 / ES2140160	--	--	--	--	<0.01	0.053	<0.0001	<0.001	0.006	<0.001	17.0	<0.001	<0.0001	0.027	<0.01	0.001	<0.005	0.08	23.5	1.26	<0.001	<0.001	<0.001	<0.004	<0.002	<0.001	<0.05	<0.1	<LOR
QA1A (Intra-laboratory duplicate of OHMW28)	21/10/2021	834054	--	--	--	--	< 0.05	< 0.001	< 0.0002	< 0.001	0.005	< 0.001	20.0	< 0.001	< 0.0001	< 0.001	< 0.001	<0.005	< 0.005	0.08	24	1.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--	--	--
OHMW20	21/10/2021	834054 / 838322	Slight yellowish colour, slight rotten egg odour	2.44	0.45	N	<0.01	<0.001	0.0007	<0.001	0.137	0.026	4.31	<0.001	<0.0001	0.013	<0.01	<0.001	<0.005	0.130	4.78	6.71	<0.001	<0.001	<0.001	<0.004	<0.002	<0.001	<0.05	<0.1	<LOR

Colour legend:

- Concentration exceeds HSLs Friebel & Nadebaum (2011) Human-health
- Concentration exceeds ANZG (2018) Aquatic ecosystems - 95% species protection
- Concentration exceeds ANZG (2018) Aquatic ecosystems - 80% species protection
- Concentration exceeds ANZECC / & ARMCANZ (2000) Physical and chemical stressors
- Concentration exceeds PFAS NEMP
- Laboratory limits of reporting exceed adopted criteria

Table Notes:

Friebel & Nadebaum (2011) Friebel & Nadebaum (2011) Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (technical paper No.10) Guidelines, CRC for Contamination Assessment and Remediation of the Environment (CRC CARE)

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[A] No hardness corrections applied to default guideline values. Assumed 30mg/L CaCO3 applies.

[B] 99% protection of species adopted to account for potential bioaccumulative effects

[C] Low reliability values adopted

[D] Default guideline value assumes chromium (VI)

[E] Default guideline value assumes m-xylene

							OCP										OPP				PCBs	Volatile Halogenated Compounds (aka Volatile Organic Compounds)				PFAS			
							Aldrin	Chlordane	DDT	Endosulfan	Endrin	Heptachlor	Lindane	Methoxychlor	Toxaphene	Total OCP	Chlorpyrifos	Fenitrothion	Temephos	Other OPP	Total PCBs	Total Fumigants	Halogenated Aliphatic Compounds	Halogenated Aromatic Compounds	Trihalomethanes	PFOS	Sum of PFHxS and PFOS	PFOA	Sum of PFAS (WA DER List)
Units of measurement							µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Limit of reporting (ALS laboratory)							0.01	0.01	0.01	0.01	0.01	0.005	--	0.01	--	0.005-0.1	0.02	2	0.02	0.2 to 10	0.1	5	5 to 50	5	5	0.01	0.01	0.01	0.01
Limit of reporting (Eurofins laboratory)							--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.01	0.01	0.05
Assessment criteria																													
Laboratory limits of reporting - adopted screening level for Total Recoverable Hydrocarbons																													
PFAS NEMP (2020) Ecological water quality guideline values (Table 5 Interim Marine - 95% Species Protection)																									0.13		220		
Friebel & Nadebaum 2011 Table A2 Groundwater HSLs for vapour intrusion (Commercial /industrial, 2-<4m Sand)																													
ANZG 2018 Default Guidelines Values for toxicants (Marine water – 95% species protection)							0.003[F]	0.001[F]	0.0004[F]	0.005[B]	0.004[B]	0.0004[F]	0.007[F]	0.004[F]	0.0006[F]		0.009	0.001[F]	0.05										
ANZG 2018 Default Guidelines Values for toxicants (Marine water – 80% species protection)										0.05	0.02						0.3		3.6										
ANZECC & ARMCANZ (2000) Default trigger values for physical and chemical stressors for South-east Australia for slightly disturbed marine ecosystems, applying to estuaries																													
Water Sample ID	Sample Date	Lab Batch	Observations	Standing water level		Evidence of oily sheen or NAPL?																							
				Depth (m bgl)	Reduced Level (m AHD)																									
SMW01	10/03/2021	EW2101111	Slightly turbid brown, no odour	2.07	0.50	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	--	<0.01	--	<LOR	<0.02	<2	<0.02	<LOR	<0.1	<5	<LOR	<5	<5	--	--	--	--
QA1 (Intra-laboratory duplicate of SMW01)	10/03/2021	EW2101111	--	--	--	--	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	--	<0.01	--	<LOR	<0.02	<2	<0.02	<LOR	<0.1	<5	<LOR	<5	<5	--	--	--	--
QA1A (Inter-laboratory duplicate of SMW01)	10/03/2021	779367	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OHMW28	10/03/2021	EW2101111	Clear, no odour	1.77	0.64	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	--	<0.01	--	<LOR	<0.02	<2	0.02	<LOR	<0.1	<5	<LOR	<5	<5	--	--	--	--
OHMW20	10/03/2021	EW2101111	Clear, no odour	2.38	0.51	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	--	<0.01	--	<LOR	<0.02	<2	0.02	<LOR	<0.1	<5	<LOR	<5	<5	--	--	--	--
SMW01	21/10/2021	EW2104433	Clear, no odour	2.11	0.46	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	--	<0.01	--	<LOR	<0.02	<2	<0.02	<LOR	<0.1	<5	<LOR	<5	<5	0.08	0.08	<0.01	0.08
OHMW28	21/10/2021	EW2104433 / ES2140160	Clear- moderate rotten egg odour	1.86	0.55	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	--	<0.01	--	<LOR	<0.02	<2	<0.02	<LOR	<0.1	<5	<LOR	<5	<5	<0.01	<0.01	<0.01	<0.01
QA1 (Intra-laboratory duplicate of OHMW28)	21/10/2021	EW2104433 / ES2140160	--	--	--	--	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	--	<0.01	--	<LOR	<0.02	<2	<0.02	<LOR	<0.1	<5	<LOR	<5	<5	<0.01	<0.01	<0.01	<0.01
QA1A (Intra-laboratory duplicate of OHMW28)	21/10/2021	834054	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.02	< 0.01	< 0.05
OHMW20	21/10/2021	834054 / 838322	Slight yellowish colour, slight rotten egg odour	2.44	0.45	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	--	<0.01	--	<LOR	<0.02	<2	<0.02	<LOR	<0.1	<5	<LOR	<5	<5	<0.01	<0.01	<0.01	<0.01

Colour legend:

- Concentration exceeds HSLs Friebel & Nadebaum (2011) Human-health
- Concentration exceeds ANZG (2018) Aquatic ecosystems - 95% species protection
- Concentration exceeds ANZG (2018) Aquatic ecosystems - 80% species protection
- Concentration exceeds ANZECC / & ARMCANZ (2000) Physical and chemical stressors
- Concentration exceeds PFAS NEMP
- Laboratory limits of reporting exceed adopted criteria

Table Notes:

Friebel & Nadebaum (2011) Friebel & Nadebaum (2011) Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (technical paper No.10) Guidelines, CRC for Contamination Assessment and Remediation of the Environment (CRC CARE)

ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, August 2018), accessed 8 October 2018, URL: http://waterquality.gov.au/anz-guidelines

ANZECC & ARMCANZ (2000) ANZECC & ARMCANZ 2000, National Water Quality Management Strategy, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Protection of Aquatic Ecosystems

PFAS NEMP (2020) PFAS National Environmental Management Plan, Version 2.0 - January 2020, National Chemicals Working Group of the Heads of EPAs Australia and New Zealand

[A] No hardness corrections applied to default guideline values. Assumed 30mg/L CaCO3 applies.

[B] 99% protection of species adopted to account for potential bioaccumulative effects

[C] Low reliability values adopted

[D] Default guideline value assumes chromium (VI)

[E] Default guideline value assumes m-xylene

Appendix C. Engineering logs

Member of the Surbana Jurong Group

local people
global experience

Explanatory Notes of Abbreviations and Terms

Used on Borehole and Excavation Logs

General

The “Geological and Engineering Log” presents data from drilling or excavation operations where material recovery is soil and or rock. Data presented is a combination of material recovered, regular sampling and in-situ testing. Excavations may present data obtained on the subsurface profile from observations of natural or man-made excavations. Logs may contain scaled graphical presentations, photography, or downhole imagery results. Logs may not contain all data types presented in these notes.

The “Non Core Drill Hole Engineering Log” presents data from drilling operations where a core barrel has not been used. The material is penetrated using methods other than those designed to recover core and is commonly soil or extremely to highly weathered. The “Cored Drill Hole Engineering Log” presents data from drilling operations where a core barrel has been used. The “Excavation - Geological Log” presents data obtained on the subsurface profile from observations of excavations, either natural or anthropogenic.

As far as is practicable, the data contained on the log sheet is factual. Some interpretation is inevitable with respect to the:

a. assessment of material boundaries in areas of partial sampling and recovery,

b. location of areas of core loss,

c. description and classification of material,

d. estimate of field strength, and

e. identification of drilling induced fractures.

Material description and classification is generally based on AS1726-2017 (as amended).

Drilling Method

Code	Description
ADT	Auger drilling with TC-bit
ADV	Auger drilling V-bit
AS	Auger screwing
AT	Air track
CA	Casing advancer
CC	Concrete core
CTR	Cable tool rig
DB	Wash bore drag bit
HA	Hand auger
HAND	Hand methods
HF	Hollow flight auger
HMLC	Diamond core 63.5 mm diameter
HQ / HRQ	Wire line core barrel 63.5 mm diameter
HQ3	Wire line core barrel 61.1 mm diameter
NDD	Non destructive drilling
NMLC	Diamond core 51.9 mm diameter
NQ	Wire line core barrel 47.6 mm diameter
NQ3	Wire line core barrel 45.1 mm diameter
PT	Continuous push tube
PQ	Wire line core barrel 85.0 mm diameter
RAB	Rotary air blast
RC	Reverse circulation
RD	Rotary blade or drag bit
RR	Rock roller
RT	Rotary tricone bit
SD	Sonic drilling
TBX	Tube-X
VC	Vibro-core drilling
WB	Wash bore drilling

Drilling Penetration

Ease of penetration in non-core drilling

Term	Description
VE	Very easy
E	Easy
F	Firm
H	Hard
VH	Very hard

Support and Casing

Code	Description	Code	Description
C	Casing	Hw	114.3 mm
M	Mud	Nw	88.9 mm
W	Water	PVC 150	150 mm

Core Run

Core lifts are identified by a line and depth with core loss per run as a percentage. Core loss is shown in the core run unless otherwise indicated.

Defect Spacing

The average distance between defects is measured parallel to the core axis in mm and may be expressed as a range or average.

Angle / Orientation

Angle from horizontal and orientation to magnetic north.

For inclined cored boreholes the Alpha and Beta angles are presented for orientated core. Alpha (α) is measured relative to the core axis, whilst Beta (β) is measured clockwise from the reference line looking down the core axis in the direction of drilling.

Excavation Method

Term	Definition
N	Natural exposure
X	Existing excavation
BB	Tractor mounted backhoe bucket
EX	Hydraulic excavator
EH	Hydraulic excavator with hammer
B	Bulldozer blade
R	Ripper

Water / Drilling Fluid

The drilling fluid used is identified and loss of return to the surface is estimated as a percentage, generally of each core lift.

Symbol	Description
	Water inflow
	Water outflow
	Water level: during drilling or immediately after completion of drilling
	Groundwater level with date observed prior to introduction of fluids or after standpipe construction
Not observed	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole / test pit.
Not encountered	The borehole / test pit was dry soon after excavation, however groundwater could be present in less permeable strata. Inflow may have been observed had the borehole / test pit been left open for a longer period.

Colour

The colour of a soil or rock is described in a moist/wet condition using simple terms, such as black, white, grey, red, brown, orange, yellow green or blue. These are modified as necessary by 'pale', 'dark' or 'mottled'. Borderline colours are described as a combination of these colours (e.g. orange-brown). Where a soil or rock consists of a primary colour with a secondary mottling it is described as (primary colour) mottled (first colour) and (secondary colour). Where colour is described outside of the material description it is for the interval.



Description of Soil

vi. Soil name (BLOCK LETTERS)

vii. Plasticity or particle size of soil

viii. Colour (i.e. dominant colour of material)

ix. Secondary soil components names & estimated proportions, including their plasticity / particle characteristics, colour

x. Minor soil components name, estimated proportions, including their plasticity / particle characteristics, colour

xi. Other minor soil components

xii. Moisture condition

xiii. Consistency / density

xiv. Structure of soil, geological origin

xv. Additional observations

Particle Size

Term		Grain Size
Clay		< 2 µm
Silt		2 – 75 µm
Sand	Fine	0.075 – 0.21 mm
	Medium	0.21 – 0.6 mm
	Coarse	0.6 – 2.36 mm
Gravel	Fine	2.36 – 6.7 mm
	Medium	6.7 – 19 mm
	Coarse	19 – 63 mm
Cobbles		63 – 200 mm
Boulders		> 200 mm

Fine Grained and Coarse Grained Soils

Term	Description
Fine Grained Soil (cohesive)	More than 35% of the material less than 63 mm is smaller than 0.075 mm (silts and clays)
Coarse Grained Soil	More than 65% of the material less than 63 mm is larger than 0.075 mm (sands, gravels and cobbles)

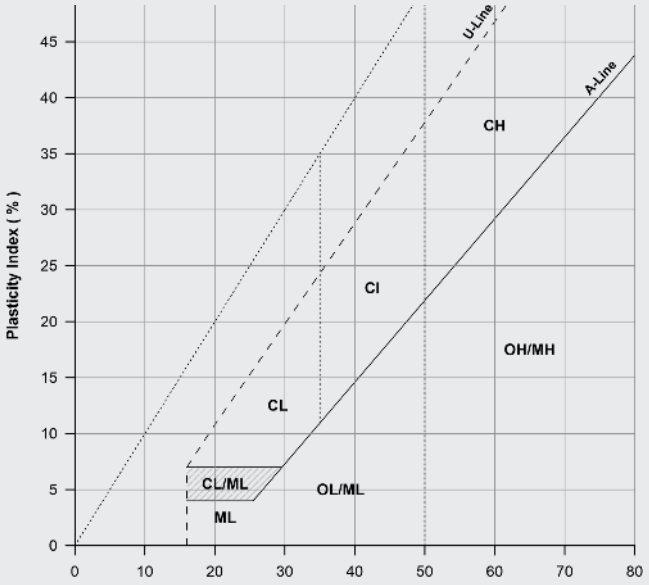
Descriptive Terms for Secondary and Minor Components

Designation of Components	In coarse grained soils				In fine grained soils	
	% Fines	Terminology	% Accessory coarse fraction	Terminology	% Sand / Gravel	Terminology
Minor	≤5	trace	≤ 15	trace	≤ 15	trace
	> 5, ≤ 12	with	> 15, ≤ 30	with	> 15, ≤ 30	with
Secondary	> 12	prefix	> 30	prefix	> 30	prefix

Plasticity – Fine Grained Soils

Liquid Limit (LL) %	Description
≤ 35	Low plasticity (L)
> 35 to ≤ 50	Medium plasticity (I)
> 50	High plasticity (H)

Plasticity Chart– Fine Grained Soils



Consistency Terms – Fine Grained Soils

Term	Undrained shear strength (kPa)	Indicative SPT (N) Blow Count	Field Guide to Consistency
Very Soft (VS)	< 12	0 – 2	Easily penetrated several centimetres by fist, exudes between fingers when squeezed in fist
Soft (S)	12 – 25	2 – 4	Easily penetrated several centimetres by thumb, easily moulded by light finger pressure
Firm (F)	25 – 50	4 – 8	Can be penetrated several centimetres by thumb with moderate effort, and moulded between the fingers by strong pressure
Stiff (St)	50 – 100	8 – 15	Readily indented by thumb but penetrated only with difficultly. Cannot be moulded by fingers
Very Stiff (VSt)	100 – 200	15 – 30	Readily indented by thumb nail, still very tough
Hard (H)	> 200	> 30	Indented with difficulty by thumb nail, brittle
Friable (Fr)	-		Can be easily crumbled or broken into small pieces

Density Terms – Coarse Grained Soils

Term	Density Index (%)	SPT (N) Blow Count
Very Loose (VL)	< 15	0 – 4
Loose (L)	15 – 35	4 – 10
Medium Dense (MD)	35 – 65	10 – 30
Dense (D)	65 – 85	30 – 50
Very Dense (VD)	> 85	> 50

Particle Characteristics – Coarse Grained Soils

Term	Description
Well graded	Having good representation of all particle sizes
Poorly graded	With one or more intermediate size poorly represented
Gap graded	With one or more intermediate sizes absent
Uniform	Essentially of one size

Angularity – Coarse Grained Soils

	Rounded
	Sub-rounded
	Angular
	Sub-angular

Origin of Soil

Fill	Formed by anthropogenic activity
Aeolian	Formed by wind
Alluvial	Formed by streams and rivers
Colluvial	Formed on slopes (talus)
Estuarine	Formed in marine environments
Lacustrine	Formed in lakes
Residual	Formed by weathering insitu

Soil Moisture

	Term	Code	Description
Coarse Grained	Dry	D	Looks and feels dry and free running
	Moist	M	Soil feels cool, darkened in colour, soils tend to stick together, soil grains do not run freely through fingers and no visible free water
	Wet	W	Soil feels cool, darkened in colour, soils tend to stick together, free water on remoulding
Fine Grained	Moist, Less than Plastic Limit	W < PL	Hard and friable or powdery, moisture content well below Plastic Limit
	Moist, Near Plastic Limit	W ≈ PL	Soil feels cool, darkened in colour, can be moulded, near Plastic Limit
	Moist, Wet of Plastic Limit	W > PL	Soil feels cool, dark, usually weakened, free water, moisture content well above Plastic Limit
	Wet, Near Liquid Limit	W ≈ LL	Soil exudes easily
	Wet, Wet of Liquid Limit	W > LL	Soil behaves as a liquid

Boundary Classifications

Soils possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.

Graphic Symbols

	Asphalt		MH
	CH		ML
	CI		OH
	CL		OL
	Concrete		PT
	Fill		SC
	GC		SM
	GM		SP
	GP		SW
	GW		Topsoil

Soil Classification

Soils are described in general accordance with AS1726-2017 as shown below.

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 63 mm and basing fractions on estimated mass)						GROUP SYMBOL	PRIMARY NAME
COARSE GRAINED SOILS More than 65% of the material is less than 63 mm and is larger than 0.075 mm	A particle size of 0.075 is about the smallest size distinguishable to the naked eye	**GRAVELS** More than half of coarse fraction is larger than 2.36 mm	**CLEAN GRAVELS** (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes, not enough fines to bind coarse grains, no dry strength; ≤ 5% fines		GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing, not enough fines to bind coarse grains, no dry strength; ≤ 5% fines		GP	GRAVEL
			GRAVELS w/ FINES (Appreciable amount of fines)	'Dirty' materials with excess of non-plastic fines, none to medium dry strength; ≥ 12% silty fines		GM	SILTY GRAVEL
				'Dirty' materials with excess of plastic fines, medium to high dry strength; ≥ 12% clayey fines		GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.36 mm	**CLEAN SANDS** (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes, not enough fines to bind coarse grains, no dry strength; ≤ 5% fines		SW	SAND
				Predominantly one size or a range of sizes with more intermediate sizes missing, not enough fines to bind coarse grains, no dry strength; ≤ 5% fines		SP	SAND
			SANDS w/ FINES (Appreciable amount of fines)	'Dirty' materials with excess of non-plastic fines, none to medium dry strength; ≥ 12% silty fines		SM	SILTY SAND
				'Dirty' materials with excess of plastic fines, medium to high dry strength; ≥ 12% clayey fines		SC	CLAYEY SAND
FINE GRAINED SOILS More than 35% of the material less than 63 mm is less than 0.075 mm		**IDENTIFICATION PROCEDURES ON FRACTIONS** < 0.075 mm					
		SILTS AND CLAYS Liquid Limit < 50%	**DRY STRENGTH**	**DILATANCY**	**TOUGHNESS**	**GROUP SYMBOL**	**PRIMARY NAME**
			None to low	Slow to rapid	Low	ML	SILT
			Medium to high	≥ 12% clayey fines	Medium	CL, CI*	CLAY
			Low to medium	Slow	Low	OL	ORGANIC SILT
		SILTS AND CLAYS Liquid Limit > 50%	Low to medium	None to slow	Low to medium	MH	SILT
			High to very high	None	High	CH	CLAY
			Medium to high	None to very slow	Low to medium	OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS: readily identified by colour, odour, spongy feel and frequently fibrous texture						PT	PEAT

* CL is low plasticity clay, CI is medium plasticity clay

Description of Rock

i. Rock name (BLOCK LETTERS)
ii. Grain size and mineralogy
iii. Colour (i.e. dominant colour of material)
iv. Fabric and texture
v. Features, inclusions, minor components, moisture content and durability
vi. Strength
vii. Weathering and/or alteration
viii. Rock mass properties – discontinuities and structure of rock
ix. Interpreted stratigraphic unit
x. Additional observations including geological structure

Simple rock names are used to provide a reasonable engineering description, rather than a precise geological classification. The rock name is chosen by considering the nature and shape of the grains or crystals, the texture and fabric of the rock material, the geological structure and setting, and information from the geological map of the area. Further guidance on the naming of rocks can be found in AS1726-2017, Tables 15, 16, 17 and 18. Typical rock types are described below, though subject to site specific variations.

Rock Type	Description	Example of Rock Name
Sedimentary	Formed by deposited beds of sediments, have grains that are cemented together and often rounded. Significant porosity	COMMON: Conglomerate, Breccia, Sandstone, Mudstone, Siltstone, Claystone ≥90% CARBONATE: Limestone, Dolomite, Calcirudite, Calcarenite, Calcisiltite, Calcilutite PYROCLASTIC: Agglomerate, Volcanic Breccia, Tuff
Igneous	Formed from molten rock and have a crystalline texture. Typically massive and low porosity. Rock types are from coarse to fine grained.	HIGH QUARTZ CONTENT: Granite, Microgranite, Rhyolite MODERATE QUARTZ CONTENT: Diorite, Microdiorite, Andesite LOW QUARTZ CONTENT: Gabbro, Dolerite, Basalt
Metamorphic	Formed when rocks are subject to heat and/or pressure and have typically have directional fabric. Typically have low porosity and crystalline structure. Rock types are from coarse to fine grained	FOLIATED: Gneiss, Schist, Phyllite, Slate NON-FOLIATED: Marble, Quartzite, Serpentinite, Hornfels
Duricrust	Formed as part of a weathering profile and show evidence of being cemented in situ. Cementation is typically irregular and exhibits replacement textures.	Ferricrete (Iron oxides and hydroxides) Silicrete (Silica) Calcrete (Calcium carbonate) Gypcrete (Gypsum)

Note: ( ) denotes dominant cementing mineralogy

Grain Size

Terms describing dominate grain size in sedimentary rocks.

Term	Grain size
Coarse	Mainly 0.6 mm to 2.0 mm
Medium	Mainly 0.2 mm to 0.6 mm
Fine	Mainly 0.06 mm (just visible) to 0.2 mm

Terms describing dominate grain size in igneous and metamorphic rocks

Term	Grain size
Coarse	Mainly greater than 2 mm
Medium	0.06 mm to 2 mm
Fine	Mainly less than 0.06 mm (just visible) to 0.2 mm

Texture and Fabric

Sedimentary rocks

Thickness	Bedding Term
< 6 mm	Thinly laminated
6 – 20 mm	Laminated
20 – 60 mm	Very thinly bedded
60 – 200 mm	Thinly bedded
0.2 – 0.6 m	Medium bedding
0.6 – 2 m	Thickly bedded
> 2 m	Very thickly bedded

Igneous rocks

Term	Definition
Amorphous	Indicates that the rock has no obvious crystalline structure
Crystalline	A regular molecular structure, showing crystal structure and symmetry.
Cryptocrystalline	The texture comprises crystals that are too small to recognise under an ordinary microscope. Indistinctly crystalline.
Porphyritic	Indicates the presence of phenocrysts (relatively large crystals in a fine grained ground mass) in igneous rocks.
Flow banded	Indicates visible flow lines in volcanic rocks and some intrusive rocks
Glassy	Entirely glass like. No crystalline units and without crystalline structure.
Vesicular	A texture of volcanic rocks that indicates the presence of vesicles (small gas bubbles). Where the vesicles are filled with a mineral substance they are termed Amygdales and the texture is Amygdaloidal.

Metamorphic

Term	Definition
Foliation	The parallel arrangement of minerals due to metamorphic process, which shall be defined by the terms in weak, moderate and strongly foliated.
Porphyroblastic	A texture indicating the presence of porphyroblasts (larger crystals formed by recrystallization during metamorphism, such as garnet or staurolite in a mica schist).
Cleavage	A type of foliation developed in fine grained metamorphic rocks such as slates.

Bedding and Fabric Development

Type	Definition
Massive	No obvious development of bedding – rock appears homogeneous
Poorly Developed	Bedding is barely obvious as faint mineralogical layering or grain size banding, but bedding planes are poorly defined.
Well Developed	Bedding is apparent in outcrops or drill core as distinct layers or lines marked by mineralogical or grain size layering.
Very Well Developed	Bedding is often marked by a distinct colour banding as well as by mineralogical or grain size layering.
Indistinct Fabric	There is little effect on strength properties
Distinct Fabric	The rock may break more easily parallel to the fabric

Rock Strength

Term (Code)	UCS (MPa)	$Is_{(50)}$ (MPa)	Field Guide to Strength
Very Low (VL)	0.6 - 2	> 0.03 to ≤ 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3 cm thick can be broken by finger pressure.
Low (L)	2 - 6	> 0.1 to ≤ 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blow of the pick point; has dull sound under hammer. A piece of core 150 mm long 50 mm in diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium (M)	6 - 20	> 0.3 to ≤ 1.0	Readily scored with a knife; a piece of core 150 mm long by 50 mm in diameter can be broken by hand with difficulty.
High (H)	20 - 60	> 1 to ≤ 3	A piece of core 150 mm long by 50 mm in diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High (VH)	60 - 200	> 3 to ≤ 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High (EH)	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Rock strength is assessed by laboratory Uniaxial Compressive Strength (UCS) testing and/or Point Load Strength Index (PLT) testing to obtain the $Is_{(50)}$ the strength table implies a 20 times correlation between $Is_{(50)}$ and UCS used for classification. Note however, multiplier may range from 4 (e.g. some carbonated and low strength rocks) to 40 (e.g. some igneous rocks and/or some high strength rocks). A site specific correlation based on testing, previous investigation or literature may be used where available. These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considered weaker due to the effect of rock defects.

Visual Log

A diagrammatic plot of defects showing type, spacing and orientation in relation to the core axis.

- Defects open in situ or clay sealed
- Defects closed in-situ
- Drill induced fractures or handling breaks
- Infilled seam

Rock Weathering and or Alteration Classification

Term (Code)		Definition	
Residual soil (RS)		Soil developed on extremely weathered rock. The rock mass structure and substance fabric are no longer evident but the soil has not been significantly transported.	
Extremely weathered (XW) Extremely altered (XA)		Rock is weathered to such an extent that it has 'soil' properties, i.e, it either disintegrates or can be remoulded in water, but the texture of original rock is still evident.	
Highly weathered (HW) Highly Altered (HA)	Distinctly weathered (DW)* Distinctly Altered (DA)	Whole rock material is discoloured usually by extent that iron staining or bleaching and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original rock substance is no longer recognisable	*Where is it not practical to distinguish between 'HW' and MW'. Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores
Moderately weathered (MW) Moderately Altered (MA)		Whole rock material is discoloured usually by staining that original colour of the fresh rock is no longer recognisable	
Slightly weathered (SW) Slightly altered (SA)		Rock is slightly discoloured but shows little or no change of strength from fresh rock	
Fresh rock (FR)		Rock shows no sign of decomposition or staining.	

Rock Core Recovery

TCR = Total Core Recovery (%)

$$\frac{\text{Length of Core Recovered}}{\text{Length of Core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$\frac{\text{Sum Length of Cylindrical Core Recovered}}{\text{Length of Core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$\frac{\text{Sum Length of Sound Core Pieces > 100mm in length}}{\text{Length of Core run}} \times 100$$

Types of Defects

Term		Code	Description
Parting		PT	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (i.e. cleavage). May be opened or closed.
Joint		JT	A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or sub-parallel to layering or to planar anisotropy in the rock material. May be open or closed.
Sheared Surface		SR	A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.
Sheared Zone		SZ	Zone of rock material with roughly parallel, near planar, curved, or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.
Crushed Zone [a]		CZ	A zone of broken and disturbed ground containing more than one identifiable Crushed Seam.
Fracture Zone [a]		FZ	A zone of broken ground with parallel to opposing boundaries dominated by abundant, extremely closely to closely spaced defects, which may be intact or open, and planar, curved, undulating, irregular, or stepped, resulting in a dissected rock mass of angular trapezoidal, triangular or rectangular fragments.
Seam (SE)	Sheared Seam	SS	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.
	Crushed Seam	CS	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.
	Infilled Seam	IS	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1 mm thick may be described as a veneer or coating on a joint surface.
	Extremely Weathered Seam	XS	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.
Fault [b]		FT	A fracture (defect) or fracture zone along which there has been an observable amount of displacement.
Vein [c]		VE	Any fracture that contains mineralized material. Veins can display either crack-normal extension or shear displacement coupled with crack-normal extension.
Vugh [a]		VG	An open void with secondary crystallisation which may be coated, partly or nearly completely filled.
Void [a]		VO	An open space created through natural or anthropogenic processes, including, but not limited to, caves, kettles, tunnels, mines, pipes, piping, landslides, faulting, shearing, dissolution, & erosion.
Mechanical Break		MB	A fracture or break induced or created by the sampling process (i.e. drilling (DB) handling (HB), drill lift (DL), excavation, or blasting).

All definitions as per AS1726-2017, except:

[a] SMEC Field Manual,
[b] British Standard BS 5930:2015, and
[c] Glossary of Geology (Fifth Edition - revised) (2011), American Geosciences Institute.

Defect Planarity

Code	Description
CR	Curved – A defect with a gradual change in orientation
IR	Irregular – A defect with many sharp changes in orientation
PL	Planar – Defect forms a continuous plane without variation in orientation
ST	Stepped – A defect with distinct sharp steps or step
UN	Undulose – A defect with undulations

Defect Roughness

Code	Description
RO	Rough – Many small surface irregularities generally related to the grain size of the parent rock
SM	Smooth – Few or no surface irregularities related to the grain size of the parent rock
PO	Polished – Planes have a distinct sheen or a smoothness
SL	Slickensided – Planes have a polished, grooved or striated surface consistent with differential movement of the parent rock along the plane
VR	Very rough – many large surface irregularities, amplitude generally more than 1mm

Type of Structures

Term	Code	Description
Bedding	BD	A layered arrangement of minerals parallel to the surface of deposition which has caused planar anisotropy in the rock substance.
Cleavage	CV	An alignment of fine grained minerals caused by deformation.
Schistosity	SH	A layered arrangement of minerals to each other
Foliation	FO	A planar alignment of minerals caused by deformation.
Void	VO	A completely empty space
Dyke	DK	Sheet-like bodies of igneous rock that cut across sedimentary bedding or foliations in rocks. They may be single or multiple in nature
Sill	SL	A sill is an intrusion of magma that spreads underground between the layers of another kind of rock
Contact	CX	A contact between intrusive and stratigraphic units.
Boundary	BN	A distinct boundary between two stratigraphic units
Vugh	VG	An open void with crystalisation

Note: Drill breaks (DB) and handling breaks (HB) are not included as natural discontinuity.

Discontinuity Spacing

Spacing (mm)	Description
> 6000	Extremely Widely Spaced
2000 - 6000	Very Widely Spaced
600 - 2000	Widely Spaced
200 - 600	Medium Spaced
60 - 200	Closely Spaced
20 - 60	Very Closely Spaced
< 20	Extremely Closely Spaced

Infill Material

Code	Name	Code	Name
Ap	Apatite	Ga	Galena
Ca	Calcite	Gp	Gypsum
Ch	Chlorite	Mn	Manganese
Cl	Clay	MnO	Manganese Oxide
Co	Coal	MS	Secondary mineral
Ep	Epidote	Py	Pyrite
Fe	Limonite/ Ironstone/ Goethite	Um	Unidentified mineral
FeO	Iron oxide	Qz	Quartz
Fs	Feldspar	X	Carbonaceous
		Ze	Zeolite

Discontinuity Observation

Term	Code	Description
Clean	CN	No visible coating or infill
Stain	SN	No visible coating or infill but surfaces are discoloured by mineral staining
Veneer < 1 mm	VN	A visible coating or soil or mineral substance but usually unable to be measured. If discontinuous over the plane, patchy veneer.
Coating > 1 mm to < 10 mm	CT	A visible coating or infilling of soil or mineral substance. Describe composition and thickness.
Filling (Filled) > 10 mm	FD	A visible filling of soil or mineral substance. Describe composition and thickness.

Discontinuity Orientation

Code	Description
VT	Vertical
HO	Horizontal
RL	Top right to bottom left
LR	Top left to bottom right

Samples and Field Tests

Code	Description
B	Bulk disturbed sample
BLK	Block sample
C	Core sample
CBR	CBR Mould Sample
CPT_u	Cone Penetration Test (with pore pressure)
DT	Dilatometer
DS	Small disturbed sample
ES	Soil sample for environmental testing
EW	Water sample for environmental testing
FP	Pressuremeter
G	Gas sample
H	Hydraulic fracturing
HP	Hand penetrometer test
I	Impression device
$Is_{(50)}$	Point Load Index
K	Permeability
LB	Large bulk disturbed sample
N	Standard penetration test result (N* denotes SPT sample recovery)
O	Core orientation
P	Piston sample
PID	Photoionisation detector reading in ppm
PP	Penetrometer
R	Hammer bouncing / refusal
SPT	Standard Penetration Test
U	Undisturbed push in sample
UCS	Uniaxial Compressive Strength
U50	Undisturbed tube sample (50 mm diameter)
U75	Undisturbed tube sample (75 mm diameter)
U100	Undisturbed tube sample (100 mm diameter)
VS	Vane shear test
● (A)	Axial Test
○ (D)	Diametral Test
□	Irregular Lump test

Laboratory Tests

Code	Description
ACM	Asbestos Containing Material
CD	Consolidated Drained
CU	Consolidated Undrained
LL	Liquid Limit
LS	Linear Shrinkage
MC	Moisture Content
MDD	Maximum Dry Density
OMC	Optimum Moisture Content
PBT	Plate Bearing Test
PI	Plasticity Index
PL	Plastic Limit
PSD	Particle Size Distribution
ρ_b	Bulk Density
ρ_p	Particle Density
ρ_d	Dry Density
UU	Undrained Unconsolidated

Backfill / Standpipe Detail

Symbol	Description	Symbol	Description
	Cement seal		Filter pack: sand filter
	Grout backfill GP -Cement BE - Bentonite Cement		Filter pack: gravel filter
	Un-slotted pipe		Bentonite seal
	Slotted pipe		Cutting – excavated material backfill
	Surface Completion: Monument Above Ground		Surface Completion: Gatic Ground Monument

Completion Details

Type	Description
Collapse	Exploratory hole collapsed before reaching planned depth
Equipment Failure	Boring or excavator equipment operational failure
Flooding	Flooding of excavation
Machine Limit	Limit of machine capability reached
Obstruction	Obstruction preventing further advancement
Operator Limit	Limit of operator limit/safety reached
Possible services	Indication of possible services below
Services present	Services encountered during exploratory hole
Squeezing	Hole squeezing boring equipment
Target Depth	Depth reached as planned
Target Depth (Instrumentation Installed)	Depth reached as planned instrumentation installed
Target Depth (Standpipe Installed)	Depth reached as planned open standpipe constructed
Material Refusal	Material preventing further advancement

Status

Code	Description
-2	Historic
-1	For information
0	Preliminary
1	Checked
2	Draft
3	Final

Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307823.6 m	Start Date	02/03/2021	Contractor	Numac	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183132.5 m	End Date	02/03/2021	Rig Type	Comacchio 205	Azimuth	
Site	Port Kembla	Elevation	2.88 m			Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Borehole Identifier: **BH2**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
ADT	Steel Casing - HW (114.3 mm) mm				02/03/21	0.0 / 2.9			0.10 / 2.78	GRAVEL: fine to medium grained, angular, pale grey, grey.											CEMENTED SLAG	BH2
										FILL Gravelly SILT with sand: non plastic, pale grey, pale orange, gravel is fine to coarse grained, angular, sand is fine to coarse grained, trace boulders, trace brick.											FILL	
						0.5 / 2.4			0.70 / 2.18	FILL Clayey SAND trace silt: fine to coarse grained, pale grey, orange, trace boulders.												
						1.0 / 1.9																
						1.5 / 1.4			1.50 / 1.38	SAND: fine to coarse grained, pale brown, pale orange.	M	L - MD									AEOLIAN	
						2.0 / 0.9		SP														
						2.5 / 0.4																
						3.0 / -0.1			3.00 / -0.12	SAND with gravel: fine to coarse grained, pale grey, with brown, orange, white, gravel is fine grained, sub-angular to sub-rounded, trace sea shells.											ESTUARINE?	
WB						3.5 / -0.6		SP			W	MD - D										
						4.0																

Observations and Comments

Blade TC bit refusal at 11.5m

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307823.6 m	Start Date	02/03/2021	Contractor	Numac
Client	Manildra Group Pty Ltd	North	6183132.5 m	End Date	02/03/2021	Rig Type	Comacchio 205
Site	Port Kembla	Elevation	2.88 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Borehole Identifier: **BH2**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
WB							4.0 -1.1				SAND with gravel: fine to coarse grained, pale grey, with brown, orange, white, gravel is fine grained, sub-angular to sub-rounded, trace sea shells. *(continued)*	W	MD - D									ESTUARINE?	
							4.5 -1.6																4.5
							5.0 -2.1																5.0
							5.5 -2.6																5.5
							6.0 -3.1		SP														6.0
							6.5 -3.6																6.5
							7.0 -4.1																7.0
							7.5 -4.6																7.5
							8.0																

Observations and Comments

Blade TC bit refusal at 11.5m

Notes

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307823.6 m	Start Date	02/03/2021	Contractor	Numac	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183132.5 m	End Date	02/03/2021	Rig Type	Comacchio 205	Azimuth	
Site	Port Kembla	Elevation	2.88 m			Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Borehole Identifier: **BH2**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock (0)	Defect Spacing (mm) (2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
WB						8.0 / -5.1		SP		SAND with gravel: fine to coarse grained, pale grey, with brown, orange, white, gravel is fine grained, sub-angular to sub-rounded, trace sea shells. *(continued)*	W	MD - D									ESTUARINE?	
						8.5 / -5.6																8.5
						9.0 / -6.1			9.00 -6.12	Clayey SAND: fine to coarse grained, pale green, pale grey, trace silt.	W PL										RESIDUAL SOIL	9.0
						9.5 / -6.6		SC														9.5
						10.0 / -7.1																10.0
						10.5 / -7.6			10.50 -7.62	Gravelly CLAY with sand: medium plasticity, pale green, mottled pale grey, brown, with white, sand is fine to coarse grained, gravel is fine grained, angular.		H									10.5
						11.0 / -8.1		CI														11.0
						11.5 / -8.6			11.25 -8.37 11.50	Hole Terminated at 11.50 m Refusal											EXTREMELY LOW TO VERY LOW STRENGTH WEATHERED ROCK AT TERMINATION DEPTH	11.5
						12.0																

Observations and Comments
Blade TC bit refusal at 11.5m

Notes
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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307782.7 m	Start Date	01/03/2021	Contractor	Numac
Client	Manildra Group Pty Ltd	North	6183065.9 m	End Date	01/03/2021	Rig Type	Comacchio 205
Site	Port Kembla	Elevation	2.77 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Borehole Identifier: **BH5**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
ADT	Steel Casing - HW (114.3 mm) mm				Not Observed	0.0 2.8			2.77	FILL Gravelly CLAY with sand: medium plasticity, dark grey, gravel is medium to coarse grained, angular, sand is medium to coarse grained, trace cobbles, trace silt.											FILL	BH5
									0.30												
						0.5 2.3			2.47	FILL Clayey GRAVEL with sand: medium to coarse grained, poorly graded, angular, dark grey, sand is medium to coarse grained.											0.5
						1.0 1.8															1.0
									1.40												
						1.5 1.3			1.37	SAND: medium to coarse grained, pale brown.	M	L - MD								AEOLIAN	1.5
WB				2.70m SPT 4, 3, 5 N=8		2.0 0.8		SP													2.0
									2.70												
				3.15m		2.5 0.3			0.07	SAND: medium to coarse grained, pale grey.										ESTUARINE? 2.70: SPT Recovery: 0.2 m	2.5
						3.0 -0.2		SP													3.0
						3.5 -0.7															3.5
						4.0															

Observations and Comments
Difficulty drilling from 11m

Notes
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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307782.7 m	Start Date	01/03/2021	Contractor	Numac
Client	Manildra Group Pty Ltd	North	6183065.9 m	End Date	01/03/2021	Rig Type	Comacchio 205
Site	Port Kembla	Elevation	2.77 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth
North
Survey

SMEC

Borehole Identifier: **BH5**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Testing: Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
WB							4.0 / -1.2				SAND: medium to coarse grained, pale grey. *(continued)*	M	L - MD									ESTUARINE?	
					4.20m SPT 12, 15, 17 N=32								D									4.20: SPT Recovery: 0.45 m	
				ES	4.65m		4.5 / -1.7																4.5
							5.0 / -2.2																5.0
					5.70m SPT 10, 14, 18 N=32		5.5 / -2.7															5.70: SPT Recovery: 0.45 m	5.5
	WB				6.15m	Not Observed	6.0 / -3.2		SP														6.0
							6.5 / -3.7																6.5
					7.20m SPT 5, 9, 10 N=19		7.0 / -4.2						MD									7.20: SPT Recovery: 0.45 m	7.0
				ES	7.65m		7.5 / -4.7																7.5
							8.0																

Observations and Comments

Difficulty drilling from 11m

Notes

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307782.7 m	Start Date	01/03/2021	Contractor	Numac
Client	Manildra Group Pty Ltd	North	6183065.9 m	End Date	01/03/2021	Rig Type	Comacchio 205
Site	Port Kembla	Elevation	2.77 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Borehole Identifier: **BH5**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
WB						Not Observed	8.0 / -5.2		SP		SAND: medium to coarse grained, pale grey. *(continued)*	M	MD									ESTUARINE?	
										8.30													
										-5.53	Clayey SAND trace gravel: fine to medium grained, grey, mottled pale green, brown, gravel is medium grained, angular, trace silt.											RESIDUAL SOIL	
					8.50m SPT 10, 11, 12 N=23		8.5 / -5.7															8.50: SPT Recovery: 0.45 m	8.5
					8.95m		9.0 / -6.2		SC														9.0
							9.5 / -6.7																9.5
					10.20m SPT 4, 6, 9 N=15		10.0 / -7.2			*10.20*												10.20: SPT Recovery: 0.45 m	10.0
										-7.43	CLAY with sand trace gravel: medium plasticity, grey, mottled pale green, brown, with white, sand is fine to coarse grained, gravel is fine grained, angular.	W≈PL	St										10.5
					10.65m 10.65m PP=350kPa		10.5 / -7.7		Cl														
					11.00m SPT 12, 22, 26 N=48		11.0 / -8.2			*11.00*												11.00: SPT Recovery: 0.45 m	11.0
										-8.23	Gravelly CLAY with sand: medium plasticity, grey, mottled pale green, brown, with white, gravel is fine to medium grained, angular, sand is fine to coarse grained.		H										
					11.45m				Cl														
NMLC		20 % Loss	R1 1.00m (40%) 32%				11.5 / -8.7			*11.50*													11.5
										-8.73	CORE LOSS 0.60m (11.50-12.10)												11.5
							12.0																

Observations and Comments
Difficulty drilling from 11m

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SMEC 2.10.7.2 LIB GLB Log - SMEC HYBRID BOREHOLE LANDSCAPE 30013038 GINT.GPJ <<DrawingFile>> 31/03/2021 17:22 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10

Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307782.7 m	Start Date	01/03/2021	Contractor	Numac
Client	Manildra Group Pty Ltd	North	6183065.9 m	End Date	01/03/2021	Rig Type	Comacchio 205
Site	Port Kembla	Elevation	2.77 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Borehole Identifier: **BH5**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
NMLC		20 % Loss	R1 1.00m (40%) 32%			Not Observed	12.0 -9.2			12.10 -9.33	CORE LOSS 0.60m (11.50-12.10) *(continued)*												
			12.50								DAPTO LATITE: fine to medium grained, pale green, speckled dark grey, orange, red.			XW HW	SS - VL VL - L					12.10-12.18: Weathered Zone, Cl Infilled, XW.		IGNEOUS - INTRUSIVE 12.23: Is(50) = 0 MPa 12.26: Is(50) = 0.02 MPa 12.39: Is(50 = 0.13 MPa 12.43: Is(50 = 0.09 MPa	
							12.5 -9.7			12.50 -9.73	Hole Terminated at 12.50 m Target depth												
							13.0 -10.2																
							13.5 -10.7																
							14.0 -11.2																
							14.5 -11.7																
							15.0 -12.2																
							15.5 -12.7																
							16.0																

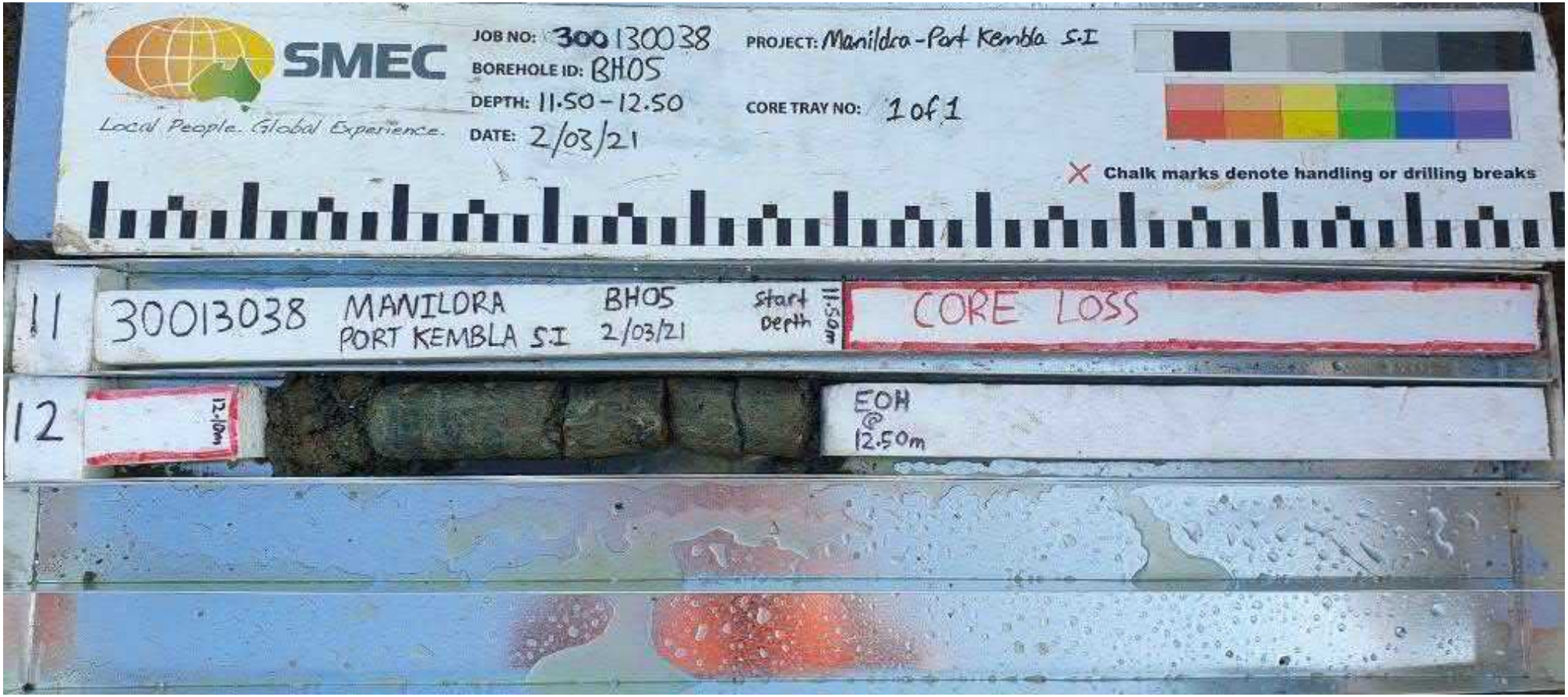
SMEC 2.10.7.2 LIB GLB Log _ SMEC HYBRID BOREHOLE LANDSCAPE 30013038 GINT.GPJ <<DrawingFile>> 31/03/2021 17:22 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10

Observations and Comments
Difficulty drilling from 11m

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Approved By	SRM	Date	31/03/2021
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SMEC 2.10.7.5 LIB_30013038.GLB GrfcTbl DG PHOTO CORE PHOTO 1 PER PAGE A4L 30013038 GINT.GPJ <<DrawingFile>> 08/03/2021 13:01 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10



PointID : BH5 Depth Range: 11.50 - 12.50 m - 89277e28-d396-448a-b109-e6f0bb1b6f9d

SMEC	TITLE: Manildra Group Pty Ltd Port Kembla Preliminary Geotechnical Investigation & Contamination Assessment Core Photo - BH5	DRAWN: TZ	DATE: 08/03/2021
		CHECKED:	DATE: 08/03/2021
		SCALE: Not To Scale	A4
		PROJECT No: 30013038	FIGURE No: 1/1

Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307770.1 m	Start Date	02/03/2021	Contractor	Numac
Client	Manildra Group Pty Ltd	North	6183062.2 m	End Date	02/03/2021	Rig Type	Comacchio 205
Site	Port Kembla	Elevation	2.49 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Borehole Identifier: **BH7**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral	Relative Strength Soil-Rock	Defect Spacing (mm)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
WB	Steel Casing - HW (114.3 mm) mm					02/03/21	0.0 / 2.5			2.49	FILL Bouldery SAND with gravel: fine to coarse grained, poorly graded, dark grey, boulders are up to 0.8m in diameter, gravel is fine to coarse grained, angular to sub-angular.						VL -0.1, L -0.3, M -1, H -3, VH -10, EH	0, 2, 20, 200, 2000					FILL	BH7
							0.5 / 2.0																	0.5
							1.0 / 1.5			1.20														1.0
										1.29	SAND: fine to coarse grained, pale brown, with black carbonaceous laminations.	M	L - MD										AEOLIAN	
							1.5 / 1.0		SP															1.5
							2.0 / 0.5																	2.0
							2.5 / 0.0			2.55		W												2.5
										-0.06	SAND: fine to coarse grained, pale grey.												ESTUARINE?	
					3.00m SPT 10, 13, 14 N=27		3.0 / -0.5						MD										3.00: SPT Recovery: 0.45 m	3.0
				ES					SP															
					3.45m		3.5 / -1.0																	3.5
							4.0																	

SMEC 2.10.7.2 LIB GLB Log _ SMEC HYBRID BOREHOLE LANDSCAPE 30013038 GINT.GPJ <<DrawingFile>> 31/03/2021 17:22 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307770.1 m	Start Date	02/03/2021	Contractor	Numac	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183062.2 m	End Date	02/03/2021	Rig Type	Comacchio 205	Azimuth	
Site	Port Kembla	Elevation	2.49 m			Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Borehole Identifier: **BH7**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Testing: Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency / Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
WB							4.0 / -1.5				SAND: fine to coarse grained, pale grey. *(continued)*		MD										ESTUARINE?	
					4.50m		4.5 / -2.0						D											4.5
				ES	SPT 12, 15, 17 N=32																		4.50: SPT Recovery: 0.45 m	
					4.95m		5.0 / -2.5																	5.0
					6.00m		5.5 / -3.0																	5.5
				ES	SPT 12, 15, 20 N=35		6.0 / -3.5		SP														6.00: SPT Recovery: 0.45 m	6.0
					6.45m		6.5 / -4.0																	6.5
							7.0 / -4.5																	7.0
							7.5 / -5.0																	7.5
							8.0																	

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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SMEC 2.10.7.2 LIB GLB Log _ SMEC HYBRID BOREHOLE LANDSCAPE 30013038 GINT.GPJ <<DrawingFile>> 31/03/2021 17:22 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10

Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307770.1 m	Start Date	02/03/2021	Contractor	Numac
Client	Manildra Group Pty Ltd	North	6183062.2 m	End Date	02/03/2021	Rig Type	Comacchio 205
Site	Port Kembla	Elevation	2.49 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Borehole Identifier: **BH7**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
							8.0 / -5.5		SP		SAND: fine to coarse grained, pale grey. *(continued)*		D									ESTUARINE?	
										8.50													
							8.5 / -6.0			-6.01	Sandy CLAY with gravel: medium plasticity, grey, mottled pale green, brown, with white, sand is fine to coarse grained, gravel is fine grained, angular.		VSt									RESIDUAL SOIL	8.5
					9.00m SPT 5, 8, 14 N=22		9.0 / -6.5															9.00: SPT Recovery: 0.45 m	9.0
					9.45m 9.45m PP=450kPa		9.5 / -7.0																9.5
WB							10.0 / -7.5		CI														10.0
							10.5 / -8.0																10.5
					11.20m SPT 4, 6, 27 N=33		11.0 / -8.5															11.20: SPT Recovery: 0.45 m	11.0
					11.65m		11.5 / -9.0		CI	*11.50* -9.01	Gravelly CLAY with sand: medium plasticity, grey, mottled pale green, brown, with white, gravel is fine to medium grained, angular, sand is fine to coarse grained.		H										11.5
NMLC		25 % Loss								*11.70* -9.21	CORE LOSS 0.37m (11.70-12.07)												
							12.0																

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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SMEC 2.10.7.2 LIB GLB Log - SMEC HYBRID BOREHOLE LANDSCAPE 30013038 GINT.GPJ <<DrawingFile>> 31/03/2021 17:22 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10

Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307770.1 m	Start Date	02/03/2021	Contractor	Numac
Client	Manildra Group Pty Ltd	North	6183062.2 m	End Date	02/03/2021	Rig Type	Comacchio 205
Site	Port Kembla	Elevation	2.49 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Borehole Identifier: **BH7**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral	Relative Strength Soil-Rock	Defect Spacing (mm)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
NMLC		25 % Loss	R1 0.80m (54%) 0%				12.0 / -9.5			12.07														
			12.50							-9.58	Gravelly CLAY with sand: medium plasticity, grey, mottled pale green, brown, with white, gravel is fine to medium grained, angular, sand is fine to coarse grained.		H								12.07-12.50: Weathered Zone, Cl Infilled		RESIDUAL SOIL	
		25 % Loss	R2 0.84m (40%) 0%				12.5 / -10.0		Cl	12.50														12.5
										-10.01	CORE LOSS 0.50m (12.50-13.00)													
							13.0 / -10.5			13.00														13.0
									Cl	13.08			H								13.00-13.08: Weathered Zone, XW.		EXTREMELY WEATHERED MATERIAL 13.00: Is(50) = 0.01 MPa	
										-10.59	Gravelly CLAY with sand: medium plasticity, grey, mottled pale green, brown, with white, gravel is fine to medium grained, angular, sand is fine to coarse grained.				DW	VL					13.15-13.17: Softened Zone, DW.			
			13.34							13.34	DAPTO LATITE: fine to medium grained, pale green with pink, speckled dark grey, orange, red, white.										13.24-13.29: Softened Zone, DW.		IGNEOUS - INTRUSIVE 13.19: Is(50) = 0.01 MPa	13.3
										-10.85	Hole Terminated at 13.34 m Termination due to cave-in													
							13.5 / -11.0																	13.5
							14.0 / -11.5																	14.0
							14.5 / -12.0																	14.5
							15.0 / -12.5																	15.0
							15.5 / -13.0																	15.5
							16.0																	

Observations and Comments

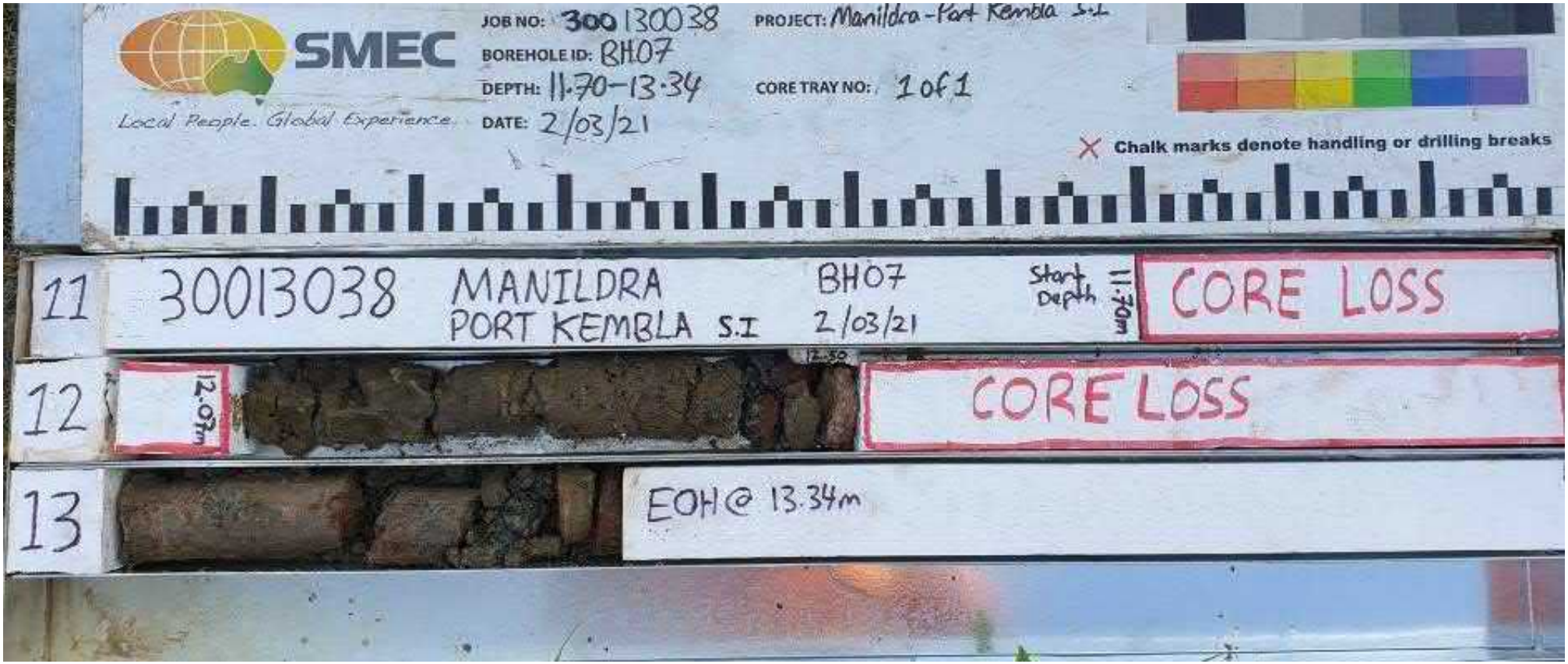
Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
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SMEC 2.10.7.2 LIB GLB Log - SMEC HYBRID B BOREHOLE LANDSCAPE 30013038 GINT.GPJ <<DrawingFile>> 31/03/2021 17:22 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10

SMEC 2.10.7.5 LIB_30013038.GLB GrfcTbl DG PHOTO CORE PHOTO 1 PER PAGE A4L 30013038 GINT.GPJ <<DrawingFile>> 08/03/2021 13:02 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10



PointID : BH7 Depth Range: 11.70 - 13.34 m - 84780416-7c43-46e2-952b-9213f560e361

SMEC	TITLE: Manildra Group Pty Ltd Port Kembla Preliminary Geotechnical Investigation & Contamination Assessment Core Photo - BH7	DRAWN: TZ	DATE: 08/03/2021
		CHECKED:	DATE: 08/03/2021
		SCALE: Not To Scale	A4
		PROJECT No: 30013038	FIGURE No: 1/1

Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307798.2 m	Start Date	17/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183140.5 m	End Date	17/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	3.11 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP01**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES		Not Observed	0.0 / 3.1			0.10 / 3.01	GRAVEL: fine to medium grained, poorly graded, angular, grey, pale grey.												CEMENTED SLAG
											FILL Gravelly SAND with cobbles: fine to coarse grained, dark grey, dark brown, gravel is fine to coarse grained, angular, iron slag, trace silt and iron material.												FILL
				ES			0.5 / 2.6																TP01
							1.0 / 2.1			1.00 / 2.11	FILL SAND with gravel trace cobbles: fine to coarse grained, brown, gravel is fine to coarse grained, angular, iron slag, trace iron material.												
							1.5 / 1.6			1.70 / 1.41	SAND: fine to coarse grained, pale orange, pale brown.	M	L - MD										AEOLIAN
				ES			2.0 / 1.1		SP														
							2.5 / 0.6			3.00													
				ES			3.0 / 0.1				Hole Terminated at 3.00 m Termination due to cave-in											3.0	3.0
							3.5 / -0.4																3.5
							4.0																

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Approved By	SRM	Date	31/03/2021
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SMEC 2.10.7.2 LIB GLB Log _ SMEC HYBRID BOREHOLE LANDSCAPE 30013038 GINT.GPJ <<DrawingFile>> 31/03/2021 17:32 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10

Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307822.2 m	Start Date	15/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183132.8 m	End Date	15/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.92 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP02**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES		Not Observed	0.0 / 2.9			0.10 / 2.82	GRAVEL: fine to medium grained, angular, pale grey, grey.											CEMENTED SLAG	TP02
				ES							FILL Gravelly SILT with sand: pale grey, pale orange, gravel is fine to coarse grained, angular, sand is fine to coarse grained, trace boulders, brick.											FILL	
							0.5 / 2.4			0.70 / 2.22	FILL Clayey SAND trace silt: fine to coarse grained, pale grey, orange, trace boulders.												0.5
				ES			1.0 / 1.9																1.0
							1.5 / 1.4			1.50 / 1.42	SAND: fine to coarse grained, pale brown, pale orange.	M	L - MD									AEOLIAN	1.5
				ES			2.0 / 0.9		SP														2.0
							2.5 / 0.4			2.95 / -0.03	SAND: fine to coarse grained, pale brown, pale orange.											ESTUARINE?	2.5
				ES			3.0 / -0.1		SP	3.40													3.0
											Hole Terminated at 3.40 m Target depth												3.4
							3.5 / -0.6																3.5
							4.0																

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Approved By	SRM	Date	31/03/2021
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SMEC 2.10.7.2 LIB GLB Log _ SMEC HYBRID BOREHOLE LANDSCAPE 30013038 GINT.GPJ <<DrawingFile>> 31/03/2021 17:32 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.7 2020-08-20 Prj: SMEC 2.10.8 2020-09-10

Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307817.4 m	Start Date	15/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183107.7 m	End Date	15/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	3.33 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP03**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES B			0.0 / 3.3			3.33 / 0.15	GRAVEL: medium to coarse grained, angular, pale grey, grey.											CEMENTED SLAG	TP03
										3.18	FILL Sandy CLAY with gravel: medium plasticity, dark grey, brown, sand is medium to coarse grained, gravel is fine to coarse grained, angular, with cobbles.											FILL	
				ES			0.5 / 2.8																0.5
							1.0 / 2.3																1.0
							1.5 / 1.8																1.5
				ES			2.0 / 1.3			2.00 / 1.33	SAND: fine to coarse grained, pale brown, pale orange, with laminations of dark grey clay, trace sea shells.	M	L - MD									AEOLIAN	2.0
						15/02/21	2.5 / 0.8		SP														2.5
				ES			3.0 / 0.3					W											3.0
										3.30 / 0.03	Sand: fine to coarse grained, pale brown, pale orange, with laminations of dark grey clay, trace sea shells.											ESTUARINE?	
				ES			3.5 / -0.2		SP														3.5
							4.0			3.70	Hole Terminated at 3.70 m Target depth												3.7

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307788.0 m	Start Date	15/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183028.5 m	End Date	15/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.44 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP04**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency / Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES	2, 16	15/02/21	0.0 / 2.4			2.44	FILL Clayey GRAVEL trace silt: medium to coarse grained, angular, pale grey, grey.											FILL 0.00: -0.2m Bonded Fibro - potential ACM fragment observed	TP04
										0.20													
				ES			0.5 / 1.9			2.24	FILL Gravelly CLAY with sand: medium plasticity, dark grey, brown, red, black, gravel is fine to coarse grained, angular, sand is medium to coarse grained, trace boulders and bricks.												
							1.0 / 1.4			1.20												0.60: -0.8m Bonded Fibro - potential ACM fragment observed	
				ES			1.5 / 0.9		SP	1.24	SAND: fine to coarse grained, pale brown.	M W	L - MD									AEOLIAN	
				ES			2.0 / 0.4																
							2.5 / -0.1			2.50	Hole Terminated at 2.50 m Termination due to cave-in												2.5
							3.0 / -0.6																
							3.5 / -1.1																
							4.0																

Observations and Comments
Hammer used to excavate top 0.2m (some ACM material observed at surface and in top 0.5m)

Penetrometer Notes
Type: DCP9
Blows per 100 mm

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307783.2 m	Start Date	15/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183065.7 m	End Date	15/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.82 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP05**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition / Consistency / Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES	2, 2, 3	Not Observed	0.0 / 2.8			2.82	FILL Gravelly CLAY with sand: medium plasticity, dark grey, gravel is medium to coarse grained, angular, sand is medium to coarse grained, trace cobbles, trace silt.											FILL	TP05
				B	7, 10					*0.30*													
							0.5 / 2.3			2.52	FILL Clayey GRAVEL with sand: medium to coarse grained, poorly graded, angular, dark grey, sand is medium to coarse grained.												
				ES			1.0 / 1.8			*1.40*													
									SP	1.42	SAND: medium to coarse grained, pale brown.	L - MD										AEOLIAN	
				ES			1.5 / 1.3																
							2.0 / 0.8																
							2.5 / 0.3			*2.60*													2.6
				ES			3.0 / -0.2				Hole Terminated at 2.60 m Termination due to cave-in												
							3.5 / -0.7																
							4.0																

Observations and Comments

Penetrometer Notes
Type: DCP9
Blows per 100 mm

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307759.1 m	Start Date	17/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183073.4 m	End Date	17/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	1.33 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth
North
Survey

SMEC

Pit Identifier: **TP06**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency / Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES	1, 2, 2, 1, 2, 2, 1, 2, 1, 1, 2, 1, 1, 4, 10, 12, 14	17/02/21	0.0 / 1.3			1.33	FILL SAND with gravel trace silt: fine to coarse grained, brown, dark grey, gravel is fine to coarse grained, angular, trace cobbles.											FILL	TP06
										0.50													
				ES			0.5 / 0.8		SP	0.83	SAND: fine to coarse grained, pale grey, pale brown.	M	L - MD									AEOLIAN	0.5
							1.0 / 0.3					W											1.0
										1.30			MD										
				ES	15, 17, 16, 18, 22, 20, 22, 23				SP	0.03	Sand: fine to coarse grained, pale grey, pale brown.											ESTUARINE?	
										1.50													
							1.5 / -0.2				Hole Terminated at 1.50 m Termination due to cave-in												1.5
							2.0 / -0.7																2.0
							2.5 / -1.2																2.5
							3.0 / -1.7																3.0
							3.5 / -2.2																3.5
							4.0																

Observations and Comments

Penetrometer Notes
Type: DCP9
Blows per 100 mm

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307770.4 m	Start Date	15/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183062.6 m	End Date	15/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.56 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP07**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES			0.0 / 2.6			2.56	FILL Bouldery SAND with gravel: fine to coarse grained, dark grey, boulders are up to 0.8m in diameter, gravel is fine to coarse grained, angular to sub-angular.											FILL 0.20: -0.5m Bonded Fibro - potential ACM fragment observed 0.70: -1.0m Bonded Fibro - potential ACM fragment observed	TP07
				ES			0.5 / 2.1																0.5
							1.0 / 1.6			1.20													1.0
									SP	1.36	SAND: fine to coarse grained, pale brown, with black carbonaceous lamination.	M	L - MD									AEOLIAN	
							1.5 / 1.1																1.5
							2.0 / 0.6					W											2.0
				ES			2.5 / 0.1			2.60													2.5
									SP	-0.04	Sand: fine to coarse grained, pale brown, with black carbonaceous lamination.											ESTUARINE?	
				ES			3.0 / -0.4			3.00	Hole Terminated at 3.00 m Target depth												3.0
							3.5 / -0.9																3.5
							4.0																

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307835.0 m	Start Date	16/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183119.6 m	End Date	16/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	3.79 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP08**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES B		Not Observed	0.0 / 3.8			3.79 / 0.15	GRAVEL: fine to coarse grained, angular, pale grey, grey.												CEMENTED SLAG
										3.64 / 0.45	FILL Silty GRAVEL with sand: fine to medium grained, poorly graded, angular, brown, red, gravel is iron slag, sand and is coarse grained, trace medium plasticity clay.												FILL
				ES			0.5 / 3.3			3.34 / 1.00	FILL SAND trace gravel with clay: fine to coarse grained, grey, dark grey, gravel is fine to medium grained, angular, trace silt.												TP08
				ES			1.0 / 2.8		SP	2.79	SAND: fine to coarse grained, red, orange, brown.	M	L - MD									AEOLIAN	
				ES			1.5 / 2.3			1.70	Hole Terminated at 1.70 m Termination due to cave-in												1.7
							2.0 / 1.8																
							2.5 / 1.3																
							3.0 / 0.8																
							3.5 / 0.3																
							4.0																

Observations and Comments
cave-in at 1.7m

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307900.2 m	Start Date	17/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183079.3 m	End Date	17/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	14.64 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP09**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition / Consistency / Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used					Not Observed	0.0 / 14.6			14.64	FILL BOULDERS with gravel trace cobbles: brown, boulders are up to 0.6m in diameter, extremely to highly weathered sandstone, onion ring weathering.											FILL	TP09
										0.40												
							0.5 / 14.1			14.24	FILL Clayey BOULDERS trace gravel: grey, trace sand, boulders are up to 0.6m in diameter, moderately weathered to slightly weathered sandstone.												
							1.0 / 13.6																
							1.5 / 13.1																
							2.0 / 12.6			2.40													2.4
							2.5 / 12.1				Hole Terminated at 2.40 m Target depth												
							3.0 / 11.6																
							3.5 / 11.1																
							4.0																

Observations and Comments
Sandstone stockpile testpit

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307842.8 m	Start Date	16/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183041.3 m	End Date	16/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.93 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth
North
Survey

SMEC

Pit Identifier: **TP10**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Testing: Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition / Consistency / Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES		16/02/21	0.0 / 2.9			2.93	GRAVEL: medium to coarse grained, angular, pale grey, grey.											CEMENTED SLAG
										0.20												
				ES						2.73	FILL Gravelly Silty SAND: coarse grained, dark grey, black, gravel is fine to coarse grained, angular, with iron slag and trace iron material.											FILL
										0.40												
							0.5 / 2.4			2.53	FILL Gravelly CLAY trace cobbles: high plasticity, dark brown, red brown, gravel is fine to coarse grained, angular with iron slag an trace iron material, trace coarse grained sand.											
				ES																		
							1.0 / 1.9															
							1.5 / 1.4															
										1.90												
				ES			2.0 / 0.9		CH	1.03	CLAY trace silt: high plasticity, grey, with dark and pale grey laminations, trace fine to medium grained sand.	W>PL										ESTUARINE?
										2.10												
									SP	0.83	SAND: fine to coarse grained, orange, pale brown, trace sea shells.	W										
				ES						2.50												
							2.5 / 0.4				Hole Terminated at 2.50 m Termination due to cave-in											
							3.0 / -0.1															
							3.5 / -0.6															
							4.0															

TP10 0.5 1.0 1.5 2.0 2.5 3.0 3.5

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307815.8 m	Start Date	16/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183046.7 m	End Date	16/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	4.33 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth
North
Survey

SMEC

Pit Identifier: **TP10A**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition / Consistency / Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used					Not Observed	0.0 / 4.3			4.33	FILL BOULDERS with cobbles with gravel: boulder grained, poorly graded, angular to sub-angular, grey, pale grey, brown, pale brown, boulders up to 0.6m, extremely to highly weathered sandstone, onion ring weathering.											FILL	TP10A
							0.5 / 3.8			0.50 3.83	FILL BOULDERS with cobbles trace gravel: grey, pale grey, brown, pale brown, boulders up to 0.6m in diameter, moderately weathered sandstone.												
							1.0 / 3.3																
							1.5 / 2.8																
							2.0 / 2.3			2.00	Hole Terminated at 2.00 m Target depth												2.0
							2.5 / 1.8																
							3.0 / 1.3																
							3.5 / 0.8																
							4.0																

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307771.0 m	Start Date	15/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183003.4 m	End Date	15/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.38 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP11**

Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency / Density	Sampling	Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow
0.0 / 2.4			2.38	GRAVEL: medium to coarse grained, angular, grey, pale grey.					
			0.20						
			2.18	FILL Gravelly CLAY with sand: medium plasticity, dark grey, gravel is medium to coarse grained, angular, sand is medium to coarse grained, trace glass.			ES	11, 24, 18	
0.5 / 1.9			0.60						
			1.78	FILL Clayey SAND trace gravel: medium to coarse grained, brown, pale brown, orange, gravel is medium to coarse grained, angular.			B ES	19, 11, 6	
1.0 / 1.4			1.10						
			1.28	FILL SAND with cobbles: medium to coarse grained, orange, red brown, cobbles are extremely weathered, very low strength sandstone.				11, 10, 16	
			1.30						
			1.08	SAND: fine to coarse grained, pale brown.	M	L - MD	ES	10, 8, 12	
1.5 / 0.9		SP						14, >>	
					W				15/02/21
2.0 / 0.4							ES		
2.5 / -0.1			2.40						
			-0.02	SAND: fine to coarse grained, pale brown.					
		SP					ES		
3.0 / -0.6			3.00	Hole Terminated at 3.00 m Target depth					
3.5 / -1.1									
4.0									

Inferred Rock Strength — Point Load Is(50): ● - Axial, ○ - Diametral; VL -0.1, L -0.3, M -1, H -3, VH -10, EH

Relative Strength Soil-Rock: 0

Defect Spacing (mm): 2, 20, 200, 2000

Visual

Fabric, Structure & Defect Description

Group Defects

Origin, Stratigraphic Unit & General Observations:
- CEMENTED SLAG
- FILL
- AEOLIAN
- ESTUARINE?

Installation: TP11

Observations and Comments

Penetrometer Notes
Type: DCP9
Blows per 100 mm

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307804.1 m	Start Date	17/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183011.6 m	End Date	17/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.64 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth
North
Survey

SMEC

Pit Identifier: **TP12**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES		17/02/21	0.0 / 2.6			0.10 / 2.54	GRAVEL: fine to coarse grained, poorly graded, angular, grey, pale grey.											CEMENTED SLAG	TP12
											FILL Gravelly Silty SAND: fine to coarse grained, dark brown, grey, gravel is fine to coarse grained, angular, iron slag.											FILL	
				ES			0.5 / 2.1																0.5
				ES						0.90 / 1.74	FILL GRAVEL with cobbles trace sand: coarse grained, poorly graded, angular, dark grey, iron slag, sand is coarse grained, trace iron material.												
							1.0 / 1.6			1.20 / 1.44	SAND: fine to coarse grained, pale brown, red brown, trace sea shells.	M	L - MD									AEOLIAN	1.0
				ES					SP														
				ES			1.5 / 1.1																1.5
				ES																			
							2.0 / 0.6																2.0
										2.60 / 0.04	Sand: fine to coarse grained, pale brown, red brown, trace sea shells.	W										ESTUARINE?	
							2.5 / 0.1		SP	2.90													2.9
											Hole Terminated at 2.90 m Termination due to cave-in												
							3.0 / -0.4																3.0
							3.5 / -0.9																3.5
							4.0																

Observations and Comments
hole abandoned at 2.9m due to cave-in

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307774.2 m	Start Date	17/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183044.4 m	End Date	17/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.59 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC

Pit Identifier: **TP13**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		17/02/21	0.0 / 2.6			2.59 / 0.20	GRAVEL: fine to medium grained, angular, pale grey, grey.											CEMENTED SLAG	TP13
			ES			0.5 / 2.1			2.39 / 0.50	FILL Gravelly CLAY trace cobbles: medium plasticity, dark grey, dark brown, gravel is fine to coarse grained, angular, iron slag.											FILL	0.5
			ES			1.0 / 1.6			2.09	FILL Sandy GRAVEL with clay: fine to coarse grained, poorly graded, brown, gravel is iron slag, sand is medium to coarse grained, trace brick.												1.0
						1.5 / 1.1																1.5
			ES			2.0 / 0.6			2.00													2.0
			ES					CH	0.59 / 2.20	Sandy CLAY: high plasticity, dark grey/pale grey mottled clay and sand, sand is fine to coarse grained.	M	F									ESTUARINE? 2.10: Strong hydrocarbon odour and possible black oil staining noted in sandy clay	
								SP	0.39	SAND: fine to coarse grained, pale brown, pale grey.		L - MD									AEOLIAN	
						2.5 / 0.1			2.60		W											2.5
			ES						-0.01	Sand: fine to coarse grained, pale brown, pale grey.											ESTUARINE?	
						3.0 / -0.4		SP														3.0
			ES						3.50													
						3.5 / -0.9				Hole Terminated at 3.50 m Target depth												3.5
						4.0																

Observations and Comments
hydrocarbon contaminated soil encountered at 2 -2.2m

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Preliminary Geotechnical Investigation	East	307756.1 m	Start Date	17/02/2021	Contractor	Ledacon
Client	Manildra Group Pty Ltd	North	6183035.6 m	End Date	17/02/2021	Equipment Type	Hitachi 13t
Site	Port Kembla	Elevation	2.40 m			Mounting	Track
Job Number	30013038	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth
North
Survey

SMEC

Pit Identifier: **TP14**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Colour	Weathering & Alteration	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		17/02/21	0.0 / 2.4			2.40	GRAVEL: fine to medium grained, poorly graded, angular, pale grey, grey.											CEMENTED SLAG	TP14
									0.20												FILL	
			ES			0.5 / 1.9			2.20	FILL Gravelly CLAY trace sand: high plasticity, brown, dark grey, gravel is fine to coarse grained, angular, iron slag, sand is medium to coarse grained, trace boulders and brick.											0.5
						1.0 / 1.4			*1.20*													1.0
			ES					CH	1.20	Sandy CLAY: high plasticity, dark grey/pale grey mottled with some decomposed organic material.	W>PL	F									ESTUARINE?	
									1.40												1.30: Strong hydrocarbon odour and possible black oil staining noted in sandy clay	
						1.5 / 0.9			1.00	SAND: fine to coarse grained, pale brown, pale orange.	M	L - MD									AEOLIAN	1.5
			ES					SP			W											
						2.0 / 0.4			*2.40*													2.0
			ES			2.5 / -0.1		SP	0.00	Sand: fine to coarse grained, pale brown, pale orange.											ESTUARINE?	2.5
									2.70													
										Hole Terminated at 2.70 m Target depth												2.7
						3.0 / -0.6																3.0
						3.5 / -1.1																3.5
						4.0																

Observations and Comments
hydrocarbon contaminated soil observed at 1.2-1.4m

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Detailed Site Investigation	East	307678.8 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6182977.6 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.073 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP15**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Testing: Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral	Relative Strength Soil-Rock	Defect Spacing (mm)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		Not Observed	0.0 / 3.1			3.07	FILL Gravelly SAND: fine to coarse grained, dark grey, with foreign materials (glass fragment, brick, plastic).						VL -0.1, L -0.3, M -1, H -3, VH -10, EH	0, 2, 20, 200, 2000				FILL	
									0.20													
			ES			0.5 / 2.6			2.87	FILL Clayey SILT: pale grey mottled pale yellow.											FILL (UNIT 1D)	
										0.60 m: becoming Clayey SAND, fine to medium grained, brown											0.65: copper pipe diameter 20mm noted	
									0.90												FILL	
			ES			1.0 / 2.1			2.17	FILL SAND: medium grained, pale yellow orange, with coarse grained gravel and cobbles, trace boulders, trace foreign materials (concrete, reo wire).											1.20-1.40: a large fragment of reinforced concrete pipe (diameter ~1.2m) was observed	
									1.40												AEOLIAN	
			ES			1.5 / 1.6		SP	1.67	SAND: medium grained, pale yellow.	M	L										
						2.0 / 1.1															2.20: observed collapsing sands	
						2.5 / 0.6			2.50	Hole Terminated at 2.50 m											2.50: collapsing sands	
						3.0 / 0.1																
						3.5 / -0.4																
						4.0																

Observations and Comments
no odour throughout

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Detailed Site Investigation	East	307682.3 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183015.7 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	4.043 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP16**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling (Testing)	Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition / Consistency / Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength (Point Load Is(50) ● Axial ○ Diametral)	Relative Strength Soil-Rock	Defect Spacing (mm)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		Not Observed	0.0 / 4.0			4.04	FILL Gravelly SAND: dark grey, trace coarse grained angular to sub-angular gravel.											FILL	
									0.30												0.30: distinct odour (sweet phenolic hydrocarbon)	
			ES			0.5 / 3.5			3.74	FILL Clayey GRAVEL: dark grey to black, gravel consisting of mainly coalwash, trace silt.											
									0.50												FILL (UNIT 1D)	0.5
									3.54	FILL Clayey SILT: pale brown with mottled yellow, trace plastic, metal rod.											0.50: strong odour (sweet phenolic hydrocarbon)	
			ES			1.0 / 3.0																1.0
						1.5 / 2.5			1.60													1.5
									2.44	FILL Clayey SILT: dark brown with mottled yellow, trace sub-rounded gravel.												
			ES			2.0 / 2.0															1.80: strong odour (sweet phenolic hydrocarbon)	2.0
						2.5 / 1.5			2.70	2.60 m: increase in moisture, presence of slag and gravel												2.5
										Hole Terminated at 2.70 m Termination due to slow progress on dense material												
						3.0 / 1.0																3.0
						3.5 / 0.5																3.5
						4.0																

Observations and Comments
odour is sweet phenolic odour

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Detailed Site Investigation	East	307693.2 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183045.7 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	4.033 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP17**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		Not Observed	0.0 / 4.0			4.03	SLAG: pale grey, trace bricks.											CEMENTED SLAG 0.00-0.20: moderately cemented (dense to very dense cemented slag)	
									0.20												FILL (UNIT 1D)	
			ES			0.5 / 3.5			3.83	FILL Clayey SILT: dark brown with mottled yellow, trace brck and angular to sub-angular gravel. 0.60 m: wood bark											0.50-0.90: slight sweet phenolic hydrocarbon odour observed	0.5
			ES			1.0 / 3.0				0.90 m: trace plastic												1.0
			ES			1.5 / 2.5			*1.70*												FILL	1.5
			ES			2.0 / 2.0			2.33	FILL Silty CLAY: high plasticity, pale brown, with sub-rounded cobbles.												2.0
			ES			2.5 / 1.5			*2.50*												2.50: strong Sweet phenolic hydrocarbon odour	2.5
									1.53	FILL Sandy CLAY: dark grey brown, with black staining from organic matter.												
			ES			3.0 / 1.0			*2.90*												AEOLIAN	3.0
									1.13	SAND: medium grained, yellow brown.	M	L										
									3.10	Hole Terminated at 3.10 m												
						3.5 / 0.5																3.5
						4.0																

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Detailed Site Investigation	East	307715.4 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183077.5 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.863 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP18**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Testing: Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		Not Observed	0.0 *3.9*			3.86	FILL GRAVEL: angular to sub-angular, pale grey to black, gravel consisting of mainly slag.											FILL	
									0.20													
			ES			0.5 *3.4*			3.66	FILL Sandy GRAVEL: well rounded and angular to sub-angular, red, gravel mainly appears to be slag nudules. 0.30 m: trace wires											0.5
						1.0 *2.9*																1.0
			ES			1.5 *2.4*																1.5
						2.0 *1.9*																2.0
						2.5 *1.4*																2.5
						3.0 *0.9*			*3.00*												ESTUARINE?	3.0
									0.86	SAND: medium grained, pale yellow.	M	L										
									3.20													
										Hole Terminated at 3.20 m Termination due to unstable pit wall collapsing												
						3.5 *0.4*																3.5
						4.0																

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Detailed Site Investigation	East	307746.7 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183115.7 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.590 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP19**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling (Testing)	Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength (Point Load Is(50) ● Axial ○ Diametral)	Relative Strength Soil-Rock	Defect Spacing (mm)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		Not Observed	0.0 / 3.6			3.59	FILL Sandy GRAVEL: angular to sub-angular, dark brown to dark grey, gravel consisting of mainly coalwash.						VL 0.1 L 0.3 M 1 H 3 VH 10 EH	0 2 20 200 2000				FILL 0.00-1.70: coalwash	
			ES			0.5 / 3.1																	0.5
						1.0 / 2.6																	1.0
						1.5 / 2.1				SAND layer at 1.50m to 1.70m, medium grained, pale yellow to orange													1.5
									1.70														
			ES						1.89	FILL Clayey GRAVEL: angular to sub-angular and rounded, dark brown to red, trace sand throughout.													
						2.0 / 1.6																	2.0
						2.5 / 1.1																	2.5
									2.80														
			ES			3.0 / 0.6			0.79	SAND: medium grained, pale yellow.	M	MD										AEOLIAN	3.0
									3.20														
										Hole Terminated at 3.20 m													
						3.5 / 0.1																	3.5
						4.0																	

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Detailed Site Investigation	East	307763.7 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183148.4 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.489 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP20**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Testing: Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES		Not Observed	0.0 / 3.5			3.44	FILL Sandy GRAVEL: fine to coarse grained, dark grey to black, gravel consisting of mainly coalwash.											FILL 0.00-0.05: coalwash	
										0.20 / 3.29	FILL SAND: fine to coarse grained, pale brown. FILL Gravelly CLAY: medium to high plasticity, orange brown mottled.												
				ES			0.5 / 3.0			0.60 / 2.89	FILL SAND: medium grained, pale yellow with dark grey laminations.											0.60-1.00: reworked estuarine	0.5
				ES			1.0 / 2.5			1.00 / 2.49	SAND: medium grained, orange.	M	L									AEOLIAN	1.0
				ES			1.5 / 2.0				1.80 m: becoming pale yellow												1.5
							2.0 / 1.5			2.20	Hole Terminated at 2.20 m												2.0
							2.5 / 1.0																2.5
							3.0 / 0.5																3.0
							3.5 / 0.0																3.5
							4.0																

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
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Geological & Engineering Log

Project	Detailed Site Investigation	East	307773.5 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183119.3 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.268 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP21**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling (Testing)	Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength (Point Load Is(50) ● Axial ○ Diametral)	Relative Strength Soil-Rock	Defect Spacing (mm)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES			0.0 / 3.3			3.27	Clayey GRAVEL: angular to sub-rounded, pale grey, with sand throughout.												CEMENTED SLAG 0.00-0.30: weakly to moderately cemented slag	
										0.30														
				ES			0.5 / 2.8			2.97	FILL Clayey GRAVEL: angular to sub-angular, pale grey to black, with cobbles, gravel consisting of mainly coalwash.												FILL 0.30-1.60: coalwash	0.5
							1.0 / 2.3																	1.0
				ES			1.5 / 1.8			*1.60*													1.60-2.70: reworked estuarine soil	1.5
										1.67	FILL SAND: coarse grained, with coarse grained sub-angular to sub-rounded gravel, trace fabric.													
							2.0 / 1.3																	2.0
							2.5 / 0.8			*2.70*														2.5
										0.57	SAND: yellow, trace sub-angular to angular gravel.	M	L										AEOLIAN	
							3.0 / 0.3			*3.00*	Hole Terminated at 3.00 m												3.00: water ingress	3.0
							3.5 / -0.2																	3.5
							4.0																	

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
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Geological & Engineering Log

Project	Detailed Site Investigation	East	307750.9 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183086.9 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.525 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP22**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Testing: Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		Not Observed	0.0 / 3.5			3.53	FILL Sandy CLAY: brown, trace rootlets.											FILL	
									0.50													
						0.5 / 3.0			3.03	FILL Clayey GRAVEL: angular to sub-angular, dark grey to black, with cobbles >60mm, gravel consisting of mainly coalwash.											0.50-1.80: coalwash	0.5
			ES			1.0 / 2.5																1.0
						1.5 / 2.0			*1.80*													1.5
									1.73	SAND: coarse grained, reddish yellow.	M	L									AEOLIAN	
			ES			2.0 / 1.5			*2.30*													2.0
										Hole Terminated at 2.30 m												
						2.5 / 1.0																2.5
						3.0 / 0.5																3.0
						3.5 / 0.0																3.5
						4.0																

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
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Geological & Engineering Log

Project	Detailed Site Investigation	East	307728.8 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183050.2 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.422 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP23**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES			0.0 / 3.4			3.42	FILL Clayey GRAVEL: sub-angular to sub-rounded, dark grey to black, low plasticity clay, with cobbles, gravel consisting of mainly coalwash.											FILL 0.00-2.10: coal wash	
							0.5 / 2.9																
				ES			1.0 / 2.4																
							1.5 / 1.9																
				ES			2.0 / 1.4			2.10													
										1.32	FILL Clayey SAND: pale brown, low plasticity clay, with bricks, ceramics, sub-angular gravel and sub-rounded cobbles.												
				ES			2.5 / 0.9				2.60 m: concrete foundation pillar, bricks, ceramics												
										3.00													
							3.0 / 0.4				Hole Terminated at 3.00 m Termination due to unstable edges											3.00: water ingress	
							3.5 / -0.1																
							4.0																

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
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Geological & Engineering Log

Project	Detailed Site Investigation	East	307703.9 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183024.1 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.396 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP24**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Testing: Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) *Elevation*	Graphic Log	Soil Code	*Depth* RL	Soil / Rock Material Description	Moisture Condition Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES		Not Observed	0.0 *3.4*			3.40	FILL Clayey GRAVEL: sub-angular, red, well rounded nodules, gravel mainly appears well-rounded slag nodules.										FILL	
						0.5 *2.9*															0.5
										0.80 m: wire rope (~15mm diameter)											
						1.0 *2.4*															1.0
			ES																		
						1.5 *1.9*															1.5
						2.0 *1.4*															2.0
			ES						*2.40*												
						2.5 *0.9*			*2.50*	FILL Clayey SAND: pale brown to yellow, trace timber, sub-rounded cobble.											2.5
										Hole Terminated at 2.50 m Termination due to unstable pit											
						3.0 *0.4*															3.0
						3.5 *-0.1*															3.5
						4.0															

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
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Geological & Engineering Log

Project	Detailed Site Investigation	East	307861.1 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183118.8 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.291 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP25**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling	Testing: Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Testing: Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength: Point Load Is(50) ● Axial ○ Diametral (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	Relative Strength Soil-Rock	Defect Spacing (mm) (0, 2, 20, 200, 2000)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES			0.0 3.3			3.29	CEMENTED SLAG: recovered as gravelly sand, pale grey.											CEMENTED SLAG	
										0.30													
				ES			0.5 2.8			2.99 0.50	FILL Clayey SAND: dark brown, with angular gravel, trace rootlets.											FILL	0.5
										2.79	FILL SAND: coarse grained, yellow with grey laminate throughout, trace rootlets.												
							1.0 2.3																1.0
							1.5 1.8																1.5
							2.0 1.3																2.0
				ES						2.40													
							2.5 0.8			0.89	SAND: pale brown to yellow, sub-angular to angular cobbles and rocks.	M	L									AEOLIAN	2.5
										2.80													
				ES						0.49	SAND: orange to yellow.											ESTUARINE?	
							3.0 0.3																3.0
							3.5 -0.2															3.50: water ingress	3.5
				ES						3.80													
							4.0				Hole Terminated at 3.80 m Termination due to unstable pit												

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
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Geological & Engineering Log

Project	Detailed Site Investigation	East	307878.1 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183041.6 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	2.915 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP26**

Method	Casing Support	Water (Gain/Loss)	Run (TCR) RQD	Sampling (Testing)	Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition / Consistency / Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength (Point Load Is(50) ● Axial ○ Diametral)	Relative Strength Soil-Rock	Defect Spacing (mm)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used			ES		Not Observed	0.0 / 2.9			2.92	CEMENTED SLAG: recovered as gravelly sand, pale grey.											CEMENTED SLAG	
										0.20													
										2.72	FILL Sandy CLAY: low plasticity, dark brown, trace rootlets.											FILL	
				ES			0.5 / 2.4																0.5
							1.0 / 1.9			1.00													1.0
										1.92	FILL Clayey SAND: pale brown to orange, with angular to sub-rounded gravel, lenses of coal wash throughout.												
				ES			1.5 / 1.4																1.5
							2.0 / 0.9			2.40													2.0
											Hole Terminated at 2.40 m												
							2.5 / 0.4																2.5
							3.0 / -0.1																3.0
							3.5 / -0.6																3.5
							4.0																

Observations and Comments

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Detailed Site Investigation	East	307782.3 m	Start Date	12/10/2021	Contractor	Ledacon Pty Ltd	Inclination	90°
Client	Manildra Group Pty Ltd	North	6183079.2 m	End Date	12/10/2021	Equipment	13 Tonne Excavator	Azimuth	
Site	Port Kembla	Elevation	3.045 m	Dimensions	3.00 m x 0.60 m	Mounting	Track	North	
Job Number	30013038	Datum	MGA94 Zone 56/AHD					Survey	

SMEC

Pit Identifier: **TP27**

Method	Casing Support Water (Gain/Loss)	Run (TCR) RQD	Sampling (Testing)	Strength SPT, DCP, Is(50) (MPa), PP (UCS kPa), SV (kPa)	Permeability, Level & Inflow	Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Inferred Rock Strength (Point Load Is(50) ● Axial ○ Diametral)	Relative Strength Soil-Rock	Defect Spacing (mm)	Visual	Fabric, Structure & Defect Description	Group Defects	Origin, Stratigraphic Unit & General Observations	Installation
EX	No casing used		ES			0.0 / 3.0			3.05 / 0.20	FILL Silty CLAY: dark brown, with rootlets.												FILL	
									2.85	FILL Sandy CLAY: brown, with cobbles and boulders (200-600mm), trace foreign materials (metal rope, timber, rubber) and fibre cement fragments (suspected ACM).												0.20-1.00: ACM fibre cement fragment observed in good condition, approx. three fragments of length 60-80mm	
			ES			0.5 / 2.5																	0.5
			ES			1.0 / 2.0																	1.0
			ES			1.5 / 1.5				1.50 m: increase in boulders, metal rope found												1.30: ACM fibre cement fragment observed in good condition, single, length 40mm	1.5
									1.80														
			ES			2.0 / 1.0			1.25	SAND: pale brown to orange and yellow.	M	L										AEOLIAN	2.0
									2.50														
			ES			2.5 / 0.5			0.55	Clayey SAND: black.	W											ESTUARINE?	2.5
									2.80													2.70: water ingress	
									2.90	Clayey SAND: pale brown to pale yellow.													
						3.0 / 0.0			0.15	SAND: yellow.													3.0
									3.40														
						3.5 / -0.5				Hole Terminated at 3.40 m													3.5
						4.0																	

Observations and Comments
more evidence of boulders deeper in the pit

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	308214.660 m	Start Date	29/03/2022	Contractor	Epoca	Inclination	90°
Client	Manildra Group	North	6183259.600 m	End Date	29/03/2022	Rig Type	Geoprobe 7822DT	Azimuth	
Site	Port Kembla	Elevation	4.140 m			Mounting	Track	North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **BH01**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) *Elevation*	Graphic Log	Soil Code	Depth *RL*	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
										0.0 *4.1*			*4.14*	ASPHALT: dark grey, black.						ASPHALT	
													0.10 *4.04*	FILL Gravelly SAND: medium grained, angular to sub-angular, dark brown.						FILL (ROADBASE)	
					ES		0.20m PID= 5.1ppm			0.2 *3.9*											0.2
										0.4 *3.7*				0.50: orange film (plastic)							0.4
										0.6 *3.5*											0.6
													0.70 *3.44*	FILL Clayey SAND: medium grained, pale brown, grey, trace gravel.						FILL	
					ES		0.80m PID= 4.3ppm			0.8 *3.3*											0.8
									Not Observed	1.0 *3.1*											1.0
										1.2 *2.9*											1.2
					ES		1.40m PID= 3.9ppm			1.4 *2.7*				1.40: sand is getting coarser (orange)							1.4
										1.6 *2.5*											1.6
										1.8 *2.3*											1.8
													1.95	Hole Terminated at 1.95 m Refusal on suspected boulder							
										2.0											

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	308216.380 m	Start Date	04/05/2022	Contractor	Epoca	Inclination	90°
Client	Manildra Group	North	6183215.660 m	End Date	04/05/2022	Rig Type	Geoprobe 7822DT	Azimuth	
Site	Port Kembla	Elevation	4.260 m			Mounting	Track	North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

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Borehole Identifier: **BH02**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
										0.0 4.3			4.26	ASPHALT: black, cemented.						ASPHALT	
					ES		0.10m PID= 8.9ppm						0.10 4.16	FILL Silty SAND: fine to medium grained, dark grey, with angular to sub-angular gravel, moist.						FILL	
										0.2 4.1			0.30 3.96	FILL Gravelly SAND: fine to medium grained, brown, sub-angular gravel, with clay.							
					ES		0.40m PID= 12.6ppm			0.4 3.9											
										0.6 3.7				0.70-0.80: less gravelly							
										0.8 3.5			0.80 3.46	FILL Gravelly Silty SAND: fine grained, pale brown, medium grained gravel.							
					ES		0.90m PID= 11.2ppm			1.0 3.3			1.20								
										1.2 3.1				Hole Terminated at 1.20 m Refusal on suspected boulder							
										1.4 2.9											
										1.6 2.7											
										1.8 2.5											
										2.0											

Not Observed

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	308171.590 m	Start Date	04/05/2022	Contractor	Epoca	Inclination	90°
Client	Manildra Group	North	6183159.600 m	End Date	04/05/2022	Rig Type	Geoprobe 7822DT	Azimuth	
Site	Port Kembla	Elevation	3.750 m			Mounting	Track	North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

SMEC
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Borehole Identifier: **BH03**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
										0.0 3.8			3.75	FILL Silty CLAY: medium plasticity, dark brown, with gravel, trace rootlets, moist, soft.						FILL (TOPSOIL)	
					ES		0.10m PID= 9.1ppm			0.2 3.6				0.30: timber (possibly sleeper)							0.2
										0.4 3.4											0.4
										0.6 3.2			0.60 3.15	FILL GRAVEL: fine to medium grained, dark grey-black, with mulch, moist.						FILL (COALWASH)	0.6
					ES		0.60m PID= 6.3ppm														
					ES		0.70m PID= 9.4ppm			0.8 3.0				0.70-0.80: thin layer of clayey sand							0.8
									Not Observed	1.0 2.8											1.0
										1.2 2.6			1.20 2.55	FILL Sandy CLAY: medium plasticity, brownish orange, moist, sand is coarse grained, with angular to sub-angular gravel.						FILL	1.2
					ES		1.40m PID= 12.9ppm			1.4 2.4											1.4
										1.6 2.2											1.6
										1.8 2.0											1.8
										2.0				Hole Terminated at 2.00 m Target depth							

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East		Start Date	04/05/2022	Contractor	Epoca	Inclination	90°
Client	Manildra Group	North		End Date	04/05/2022	Rig Type	Geoprobe 7822DT	Azimuth	
Site	Port Kembla	Elevation				Mounting	Track	North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	NOT SURVEYED

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Borehole Identifier: **BH03A**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) *Elevation*	Graphic Log	Soil Code	Depth *RL*	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
					ES		0.10m PID= 5.2ppm		Not Observed	0.0			0.06	ASPHALT: dark grey, cemented.						ASPHALT	
														FILL Sandy CLAY: low plasticity, dark brown-brown, with angular to sub-angular gravel, moist.						FILL	
										0.2			0.40								0.2
					ES		0.40m PID= 8.2ppm			0.4				Hole Terminated at 0.40 m Refusal on suspected concrete slab							0.4
										0.6											0.6
										0.8											0.8
										1.0											1.0
										1.2											1.2
										1.4											1.4
										1.6											1.6
										1.8											1.8
										2.0											

Observations and Comments
Moved hole to alternate location BH03

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	308145.200 m	Start Date	04/05/2022	Contractor	Epoca	Inclination	90°
Client	Manildra Group	North	6183136.000 m	End Date	04/05/2022	Rig Type	Geoprobe 7822DT	Azimuth	
Site	Port Kembla	Elevation	3.740 m			Mounting	Track	North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **BH04**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) *Elevation*	Graphic Log	Soil Code	Depth *RL*	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
										0.0 *3.7*			0.05 *3.69*	FILL SLAG: dark grey, loosely cemented.						FILL (CEMENTED SLAG)	
					ES		0.10m PID= 4ppm			0.2 *3.5*				FILL Clayey SAND: dark grey, with angular to sub-angular gravel, with coalwash throughout, moist.						FILL	0.2
													0.30 *3.44*	FILL GRAVEL: fine to medium grained, black, with angular to sub-angular gravel, trace sand, moist.						FILL (COALWASH)	
										0.4 *3.3*											0.4
					ES		0.50m PID= 8.6ppm		Not Observed	0.6 *3.1*											0.6
													0.70 *3.04*	FILL Silty SAND: fine to medium grained, black, with coalwash, with angular to sub-angular gravel, moist.						FILL	
										0.8 *2.9*											0.8
										1.0 *2.7*			1.10								1.0
														Hole Terminated at 1.10 m Refusal on suspected boulder							
										1.2 *2.5*											1.2
										1.4 *2.3*											1.4
										1.6 *2.1*											1.6
										1.8 *1.9*											1.8
										2.0											

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	308105.270 m	Start Date	04/05/2022	Contractor	Epoca	Inclination	90°
Client	Manildra Group	North	6183148.440 m	End Date	04/05/2022	Rig Type	Geoprobe 7822DT	Azimuth	
Site	Port Kembla	Elevation	3.360 m			Mounting	Track	North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **BH05**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
					ES		0.00m PID= 7.2ppm			0.0 3.4			3.36	FILL Silty CLAY: dark brown, with sand, trace rootlets and sandstone gravel.						FILL (TOPSOIL)	
										0.2 3.2											0.2
					ES		0.40m PID= 9.3ppm			0.4 3.0			0.40 2.96	FILL Clayey SAND: brown, with sandstone gravel (rounded to sub-rounded).						FILL	0.4
										0.6 2.8											0.6
										0.8 2.6											0.8
										1.0 2.4				1.00: boulders encountered							1.0
										1.2 2.2											1.2
					ES		1.40m PID= 8.4ppm			1.4 2.0											1.4
										1.6 1.8											1.6
					ES		1.80m PID= 11.3ppm			1.8 1.6			1.90								1.8
										2.0				Hole Terminated at 1.90 m Refusal on suspected boulder							

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	308064.610 m	Start Date	04/04/2022	Contractor	Ledacon
Client	Manildra Group	North	6183145.310 m	End Date	04/04/2022	Rig Type	6.5T 300mm Bucket
Site	Port Kembla	Elevation	3.420 m			Mounting	
Job No	30013174	Datum	MGA94 Zone 56/AHD				

Inclination	90°
Azimuth	
North	
Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **BH06**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) *Elevation*	Graphic Log	Soil Code	Depth *RL*	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
										0.0 *3.4*			*3.42*	0.00: shell fragments and dried grass on surface FILL Sandy CLAY: dark brown, with angular to sub-angular gravel.						FILL	
					ES		0.10m PID= 1.7ppm			0.2 *3.2*											0.2
					ES		0.40m PID= 1.9ppm			0.4 *3.0*			0.50								0.4
													2.92	FILL Clayey SAND: coarse grained, reddish brown, with minor coalwash.							
					ES		0.70m PID= 1.1ppm			0.6 *2.8*				0.70: yellow hollow pipe encountered							0.6
										0.8 *2.6*			0.80								0.8
													2.62	FILL Clayey SAND: medium grained, pale grey-brown.							
					ES		0.90m PID= 2.9ppm		Not Observed				0.90							FILL (COALWASH)	
													2.52	FILL GRAVEL: fine to medium grained, black, shiny, trace green gravel.							
										1.0 *2.4*				1.00: metal cable (appox 30mm in diameter)							1.0
					ES		1.10m PID= 2.3ppm							1.10: boulder encountered (500mm)							
										1.2 *2.2*											1.2
										1.4 *2.0*				1.40: metal railway plate							1.4
										1.6 *1.8*											1.6
					ES		1.70m PID= 3.6ppm														
										1.8 *1.6*			1.80	Hole Terminated at 1.80 m Refusal on boulders							1.8
										2.0											

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	308029.280 m	Start Date	04/04/2022	Contractor	Ledacon	Inclination	90°
Client	Manildra Group	North	6183130.770 m	End Date	04/04/2022	Rig Type	6.5T 300mm Bucket	Azimuth	
Site	Port Kembla	Elevation	2.850 m			Mounting		North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **BH07**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) *Elevation*	Graphic Log	Soil Code	Depth *RL*	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
										0.0 *2.9*			2.85	FILL Silty SAND: medium grained, dark brown-brown, rootlets.						FILL (TOPSOIL)	
					ES		0.10m PID= 1.6ppm						0.20								
					ES		0.20m PID= 2.8ppm			0.2 *2.7*			*2.65*	FILL Sandy CLAY: low plasticity, dark brown, black, moist, soft.						FILL	0.2
													0.40								
										0.4 *2.5*			*2.45*	FILL Clayey SAND: medium grained, brown, angular to sub-angular gravel.							0.4
										0.6 *2.3*				0.60: cobbles encountered, shell fragments							0.6
										0.8 *2.1*											0.8
					ES		0.90m PID= 2.9ppm		Not Observed				1.00								
										1.0 *1.9*				Hole Terminated at 1.00 m Target depth							1.0
										1.2 *1.7*											1.2
										1.4 *1.5*											1.4
										1.6 *1.3*											1.6
										1.8 *1.1*											1.8
										2.0											

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	307971.640 m	Start Date	04/04/2022	Contractor	Ledacon	Inclination	90°
Client	Manildra Group	North	6183118.080 m	End Date	04/04/2022	Rig Type	6.5T 300mm Bucket	Azimuth	
Site	Port Kembla	Elevation	2.760 m			Mounting		North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **BH08**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) *Elevation*	Graphic Log	Soil Code	Depth *RL*	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
					ES		0.00m PID= 4.3ppm		Not Observed	0.0 *2.8*			2.76	FILL Sandy CLAY: low plasticity, dark brown, moist, with angular to sub-angular gravel, cobbles (100mm).						FILL 0.00: ACM fragments observed on surface	
										0.2 *2.6*										0.20-0.40: ACM fragments in northern wall of pit	0.2
					ES		0.30m PID= 4.8ppm													0.35: ACM in pit	
					ES		0.40m PID= 2.7ppm			0.4 *2.4*										0.40: ACM in pit, glass fragments	0.4
																				0.50: nylon rope	
										0.6 *2.2*											0.6
										0.8 *2.0*			0.95								0.8
										1.0 *1.8*				Hole Terminated at 0.95 m Refusal on boulders							1.0
										1.2 *1.6*											1.2
										1.4 *1.4*											1.4
										1.6 *1.2*											1.6
										1.8 *1.0*											1.8
										2.0											

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project Pipeline Route TSI
Client Manildra Group
Site Port Kembla
Job No 30013174

East
North
Elevation
Datum MGA94 Zone 56/AHD

Start Date 04/04/2022
End Date 04/04/2022

Contractor Ledacon
Rig Type 6.5T 300mm Bucket
Mounting

Inclination 90°
Azimuth
North
Survey NOT SURVEYED

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **BH09**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
										0.0				FILL Silty SAND: medium to coarse grained, brown, with rootlets.						FILL (TOPSOIL)	
					ES		0.10m PID= 0.9ppm						0.20								
					ES		0.20m PID= 2.1ppm			0.2				FILL Silty Clayey SAND: black, with boulders (500mm).						FILL	0.2
										0.4				0.40: with angular to sub-angular gravel							0.4
										0.6											0.6
										0.8				0.80: more boulders and cobbles							0.8
					ES		0.90m PID= 1.9ppm		Not Observed	1.0			1.00	Hole Terminated at 1.00 m Target depth							1.0
										1.2											1.2
										1.4											1.4
										1.6											1.6
										1.8											1.8
										2.0											

Observations and Comments

Notes
Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI
Client	Manildra Group
Site	Port Kembla
Job No	30013174

East	307771.690 m	Start Date	03/03/2021
North	6183048.650 m	End Date	03/03/2021
Elevation	2.570 m		
Datum	MGA94 Zone 56/AHD		

Contractor	Numac
Rig Type	Comacchio 205
Mounting	Track

Inclination	90°
Azimuth	
North	
Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **SMW01**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
										0.0 2.6			2.57	FILL GRAVEL: fine to medium grained, angular, pale grey, grey.						FILL (CEMENTED SLAG)	WELL01
													0.20 2.37	FILL Gravelly CLAY trace cobbles: medium plasticity, dark grey, dark brown, gravel is fine to coarse grained, angular, iron slag.						FILL	
ADT	Steel Casing - HW (114.3 mm)												0.50 2.07	FILL Sandy GRAVEL with clay: fine to coarse grained, poorly graded, brown, gravel is iron slag, sand is medium to coarse grained.							1.0
										1.0 1.6											1.5
										2.0 0.6		SC	2.00 0.57	Clayey SAND clay: fine to coarse grained, dark grey, black, material smelling of hydrocarbons.	M	L - MD				ESTUARINE?	2.0
WB									03/03/21				2.50 0.07	SAND: fine to coarse grained, pale grey, grey, slight hydrocarbon odour.	W						
										3.0 -0.4		SP									3.0
										4.0 -1.4											4.0
													4.50	Hole Terminated at 4.50 m Target depth							4.5
										5.0											

Observations and Comments

Possible hydrocarbon contaminants encountered at 2-2.5m.
Protecive steel monument cemented in place, 0.73m stick up above surface level.

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	307889.380 m	Start Date	04/06/2022	Contractor	Epoca
Client	Manildra Group	North	6183043.420 m	End Date	04/06/2022	Rig Type	Geoprobe 7822DT
Site	Port Kembla	Elevation	2.890 m			Mounting	
Job No	30013174	Datum	MGA94 Zone 56/AHD				

Inclination	90°
Azimuth	
North	
Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **SMW02**

Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
0.0 2.9			0.10 2.79	FILL SLAG: grey, fine to coarse grained, angular sand matrix.	W<PL	VL				FILL (CEMENTED SLAG)	SMW02
				FILL CLAY: high plasticity, brown to black, trace fine to coarse grained sand, angular to sub-rounded gravel.		VS				FILL	0.7
1.0 1.9				1.10: increasing brown		L					1.0
2.0 0.9											2.0
3.0 -0.1			2.90 -0.01	FILL Clayey Silty SAND: fine to medium grained, sub-rounded, black, low plasticity clay.							3.0
			4.00								4.0
4.0 -1.1				Hole Terminated at 4.00 m Target Depth (standpipe installed)							4.0
5.0											

Testing: PP (kPa), VS (kPa), Peak / Remoulded — SPT, PID (ppm), DCP

Method | Casing | Support | Water (Gain/Loss) | Run (TCR) | Sampling | Water Level & Inflow

Observations and Comments

PVC pipe stick up 0.74m

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	307881.900 m	Start Date	20/04/2022	Contractor	Numac Drilling	Inclination	90°
Client	Manildra Group	North	6183114.520 m	End Date	20/04/2022	Rig Type	Sonic	Azimuth	
Site	Port Kembla	Elevation	3.090 m			Mounting	Track	North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

SMEC
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Borehole Identifier: **SMW03**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow	Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
SD	Casing								20/04/22	0.0 3.1			3.09	FILL Gravelly CLAY: low to medium plasticity, pale brown, fine to coarse grained, angular gravel, with fine to coarse grained sand, with cobbles (60-80mm) comprising sandstone.	M	F				FILL	
													0.80 2.29	FILL Sandy CLAY: low to medium plasticity, brown mottled orange, fine to coarse grained sand, with fine to medium grained gravel.							
										1.0 2.1										1.50: Driller noted some resistance	
										2.0 1.1				2.00-2.30: SAND, medium grained, pale brown observed							
													2.30 0.79	FILL Gravelly SILT: low plasticity, dark grey, fine to coarse grained gravel, with cobbles and boulders comprising latite (dark grey-black with shiny inclusions).		St					
										3.0 0.1				3.00-3.30: Boulder encountered/penetrated						3.00-3.30: Driller cored through boulder	
													3.30 -0.21	SAND: medium grained, yellow-red.		L				ESTUARINE	
										4.0 -0.9		SP		4.00-4.50: becoming pale yellow							
													4.50	Hole Terminated at 4.50 m Target Depth (standpipe installed)							
										5.0											

Installation: SMW03 — 0.3, 1.0, 1.5, 2.0, 3.0, 4.0, 4.5

Observations and Comments

Standpipe Surface Completion: Monument; Hole Flushed, PVC pipe stick up 0.69m; No Water Sample collected
Development Method: Bailer; Well Development - Purged 40L, brown, torbid water; Well Volume ~13L

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	307848.120 m	Start Date	20/04/2022	Contractor	Numac Drilling
Client	Manildra Group	North	6183124.300 m	End Date	20/04/2022	Rig Type	Sonic
Site	Port Kembla	Elevation	2.960 m			Mounting	Track
Job No	30013174	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **SMW04**

Depth (m) / Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
0.0 / 3.0			2.96	FILL Gravelly SAND: fine to coarse grained, brown, fine to coarse grained gravel.	M	MD				FILL	
1.0 / 2.0			1.00 / 1.96	FILL Sandy CLAY: low to medium plasticity, brown, medium to coarse grained sand, with fine to medium grained gravel.		F				1.00: Driller noted increased resistance (possible boulders)	
2.0 / 1.0				2.30-2.50: Boulder encountered, Latite, dark grey, angular borken edges							
			2.70 / 0.26	SAND: medium grained, yellow-red.		L				ESTUARINE	
3.0 / 0.0		SP		3.50-4.50: becoming pale yellow							
4.0 / -1.0			4.50	Hole Terminated at 4.50 m Target Depth (standpipe installed)							
5.0											

Method: SD; Casing: Casing
Water Level & Inflow: 20/04/22
Testing: SPT; PP (kPa) VS (kPa) Peak / Remoulded PID (ppm); DCP
Support; Water (Gain/Loss); Run (TCR); Sampling

Installation: SMW04; 0.3; 1.0; 1.5; 2.0; 3.0; 4.0; 4.5

Observations and Comments

PVC Pipe Stick Up: 0.65m; Hole Flushed; No Water Sample collected
Development Method: Bailer; Well Volume ~13.4L
Well Development - Purged 40L, brown, torbid water 0-20L; pale brown, slightly cloudy 20-40L (improved clarity)

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	307825.760 m	Start Date	20/04/2022	Contractor	Numac Drilling
Client	Manildra Group	North	6183134.070 m	End Date	20/04/2022	Rig Type	Sonic
Site	Port Kembla	Elevation	2.860 m			Mounting	Track
Job No	30013174	Datum	MGA94 Zone 56/AHD				

Inclination 90°
Azimuth North
Survey

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **SMW05**

Method	Casing	Support	Water (Gain/Loss)	Run (TCR)	Sampling	Testing: SPT	Testing: PP (kPa) VS (kPa) Peak / Remoulded PID (ppm)	Testing: DCP	Water Level & Inflow
SD	Casing								20/04/22

Depth (m) Elevation	Graphic Log	Soil Code	Depth RL	Soil / Rock Material Description	Moisture Condition	Consistency Density	Alteration	Weathering	Rock Strength	Origin, Stratigraphic Unit & General Observations	Installation
0.0 2.9			0.10 2.76	FILL SILT with gravel: with fine to coarse grained gravel, trace coarse grained, sub-angular to angular gravel.	D	L				FILL	
				FILL CEMENTED SLAG.		VD				FILL (CEMENTED SLAG) 0.10-0.40: heavily pulverised cemented material	
			0.40 2.46	FILL Gravelly CLAY: black, pale grey, fine to coarse, sub-angular to sub-rounded gravel, with sand, trace rootlets.	M	F				FILL	
1.0 1.9			1.70 1.16	FILL Clayey GRAVEL: fine to coarse grained, sub-angular, black, yellow brown, with sand.	D						
2.0 0.9			2.30 0.56	FILL Gravelly SAND: fine to coarse grained, brown, red brown, fine grained, sub-angular to sub-rounded gravel, trace pebbles, trace clay.	M	L					
3.0 -0.1			3.00 -0.14	LATITE BOULDERS / COBBLES.	W	VD				PULVERISED MATERIAL AROUND FRAGMENTS	
		SP	3.20 -0.34	SAND: fine grained, red, yellow, pale brown.	M	L				ESTUARINE (QUARTZ BASED)	
		SP	3.70 -0.84	SAND: fine grained, yellow, pale brown to pale grey.	W						
4.0 -1.1			4.50	Hole Terminated at 4.50 m Target Depth (standpipe installed)							
5.0											

Installation: SMW05 — 0.3, 1.0, 1.5, 2.0, 3.0, 4.0, 4.5

Observations and Comments

PVC Pipe Stick Up: 0.72m; Hole Flushed; No Water Sample collected
Development Method: Bailer; Well Volume 13.4L

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Geological & Engineering Log

Project	Pipeline Route TSI	East	307734.250 m	Start Date	04/06/2022	Contractor	Epoca	Inclination	90°
Client	Manildra Group	North	6183055.700 m	End Date	04/06/2022	Rig Type	Geoprobe 7822DT	Azimuth	
Site	Port Kembla	Elevation	3.410 m			Mounting		North	
Job No	30013174	Datum	MGA94 Zone 56/AHD					Survey	

SMEC
Member of the Surbana Jurong Group

Borehole Identifier: **SMW06**

Depth (m) / Elevation	Graphic Log	Soil Code	Depth / RL	Soil / Rock Material Description	Moisture Condition
0.0 / 3.4				FILL Silty SAND: grey, abundant grass.	M
			3.31	FILL Clayey SAND: fine to coarse grained, sub-rounded to sub-angular, grey, trace gravel.	
			0.30 / 3.11	FILL Silty Gravelly SAND: fine to coarse grained, sub-rounded to sub-angular, black, coalwash.	
			0.50 / 2.91	FILL Sandy Gravelly CLAY: red brown, fine to coarse grained, sub-angular to rounded sand, rounded coarse furnace slag gravel.	W<PL
1.0 / 2.4				FILL Silty SAND: grey.	M
2.0 / 1.4			2.00 / 1.41	SAND: fine to coarse grained, angular to rounded, yellow, quartz/lithic.	W
3.0 / 0.4		SP			
4.0 / -0.6			4.50	Hole Terminated at 4.50 m Target Depth (standpipe installed)	
5.0					

Origin, Stratigraphic Unit & General Observations: FILL (TOPSOIL) 0.00: 0.76m standpipe stick up; FILL; AEOLIAN

Installation: SMW06

Observations and Comments

PVC pipe stick up 0.76m

Notes

Classifications compliant with AS1726-2017: Geotechnical Site Investigations unless otherwise noted.
Defect Log Abridged. Additional detail in digital dataset. Lugeon: BS5930:1999
For Inclined Holes: Angles reported in defects are apparent dip from core horizontal unless as α or β.
Refer to explanatory notes for SMEC logs for details of abbreviations or basis of description.

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Approved By	AW	Date	27/04/2022
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SMEC 2.10.13 UB.GLB Log_SMEC HYBRID LOG LANDSCAPE_SOIL SMEC ENV WOL 30013174.GPJ <<DrawingFile>> 27/04/2022 16:32 10.02.00.04 Datgel Tools | Lib: SMEC 2.10.9 2021-08-30 Prj: SMEC 2.10.8 2020-09-10

Appendix D. Proposed design drawings

MANILDRA GROUP
100% AUSTRALIAN OWNED

BULK LIQUIDS FACILITY
PORT KEMBLA, NSW

CIVIL WORKS DRAWINGS

CIVIL	
DRG. No.	**DRAWING TITLE**
20399-C01	GENERAL CONSTRUCTION NOTES, DRAINAGE & EARTHWORKS
20399-C02	SITE GRADING & DRAINAGE PLAN SHEET 1 OF 2
20399-C03	SITE GRADING & DRAINAGE PLAN SHEET 2 OF 2
20399-C04	STORMWATER PIT SCHEDULE & CONSTRUCTION DETAILS
20399-C05	PIT CONSTRUCTION DETAILS
20399-C06	DISCHARGE OUTLET CONSTRUCTION DETAILS
20399-C07	BULK EARTHWORKS PLAN
20399-C08	CONCEPTUAL EROSION & SEDIMENT CONTROL PLAN
20399-C09	EROSION & SEDIMENT PLAN CONSTRUCTION DETAILS
20399-C10	CONCRETE PAVEMENT LEGEND & CONSTRUCTION NOTES
20399-C11	SITE PAVEMENT PLAN SHEET 1 OF 2
20399-C12	SITE PAVEMENT PLAN SHEET 2 OF 2
20399-C13	SITE PAVEMENT DETAILS SHEET 1 OF 2
20399-C14	SITE PAVEMENT DETAILS SHEET 2 OF 2
20399-C15	SITE RETAINING WALL LONG SECTIONS
20399-C16	SECURITY FENCING DETAILS
20399-C17	PROPOSED DRIVEWAY CROSSOVER PLAN
20399-C20	RETAINING WALL DETAILS SHEET 1
20399-C21	RETAINING WALL DETAILS SHEET 2



LOCALITY PLAN
NOT TO SCALE

TENDER ONLY
NOT FOR CONSTRUCTION

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	23.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE: CIVIL WORKS
DRAWING SCHEDULE

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
23.11.2021	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C00	A

GENERAL NOTES:

1. ALL DIMENSIONS AND CO-ORDINATES ARE TO BE VERIFIED ON SITE BEFORE WORK COMMENCES.
2. FIGURED DIMENSIONS ARE TO TAKE PRECEDENCE OVER SCALE READINGS.
3. DURING CONSTRUCTION, BARRIERS, LIGHTS & SIGNS SHALL BE MAINTAINED TO ENSURE SAFE PASSAGE OF TRAFFIC AND PEDESTRIANS IN ACCORDANCE WITH THE REQUIREMENTS OF THE LOCAL AUTHORITY.
4. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AUSTRALIAN STANDARDS BY-LAWS AND ORDINANCES OF THE RELEVANT LOCAL AUTHORITY, AND WORKPLACE HEALTH AND SAFETY REQUIREMENTS.
5. THE CONTRACTOR SHALL MAKE GOOD, AT HIS COST, ANY DAMAGE TO ANY SERVICE IF SUCH DAMAGE OCCURS AS A RESULT OF HIS OPERATIONS.
6. ALL DISTURBED VERGE AREAS MUST BE REINSTATED WITH TURF.
7. ALTER ANY SERVICES WHEN THE RELEVANT AUTHORITY OR ASSESSMENT MANAGER DETERMINES THAT THE WORK ASSOCIATED WITH THIS DEVELOPMENT HAVE IMPACTED EXISTING SERVICES.
8. THE SURVEY INFORMATION SHOWN MAY NOT ADEQUATELY REFLECT CURRENT SITE CONDITIONS. THE CONTRACTOR SHALL ASSESS SITE CONDITIONS PRIOR TO COMMENCING CONSTRUCTION. ANY DISCREPANCIES IN THE SURVEY INFORMATION SHALL BE REPORTED TO THE SUPERINTENDENT. REFER TO SURVEY FOR DETAILS.
5. EXISTING SERVICES SHOWN HAVE NOT BEEN CONFIRMED ON SITE. THE CONTRACTOR SHALL DETERMINE THE LOCATION AND DEPTH OF SERVICES WITHIN OR ADJACENT TO THE WORKS BY CONTACTING THE RELEVANT SERVICE AUTHORITY AND APPROVED UNDERGROUND SERVICES LOCATOR A MINIMUM OF 14 DAYS PRIOR TO COMMENCEMENT OF WORKS. ADVISE THE SUPERINTENDENT OF ANY DISCREPANCIES AND CLASHES BEFORE PROCEEDING. THE CONTRACTOR SHALL BE REQUIRED TO COORDINATE AND PROGRAM WORKS TO RESOLVE ANY CLASHES WITH RELEVANT SERVICE AUTHORITIES PRIOR TO COMMENCEMENT OF ANY WORKS. RESOLUTION OF CLASHES SHALL BE APPROVED BY THE RELEVANT SERVICE AUTHORITIES.
6. ALL NEW WORK SHALL BE JOINED NEATLY TO EXISTING. PROPOSED LEVELS FOR CONNECTING TO EXISTING WORKS MAY BE VARIED WHERE NECESSARY ON SITE BY THE SUPERINTENDENT TO ACHIEVE A SATISFACTORY SMOOTH FINISH.
7. THE CONTRACTOR IS RESPONSIBLE FOR THE REMOVAL AND DISPOSAL OF ALL RUBBISH AND SPOIL FROM THE SITE.

STORMWATER DRAINAGE NOTES:

1. ALL DIMENSIONS ARE TO BE CHECKED ON-SITE BEFORE WORK COMMENCES
2. FIGURED DIMENSIONS ARE TO TAKE PRECEDENCE OVER SCALE READINGS.
3. DURING CONSTRUCTION, BARRIERS, LIGHTS & SIGNS SHALL BE MAINTAINED TO ENSURE SAFE PASSAGE OF TRAFFIC AND PEDESTRIANS IN ACCORDANCE WITH THE REQUIREMENTS OF THE LOCAL AUTHORITY.
4. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH S.A.A CODES & BY-LAWS AND ORDINANCES OF THE RELEVANT LOCAL AUTHORITY, AND WORKPLACE HEALTH AND SAFETY REQUIREMENTS.
5. CONTRACTOR TO VERIFY ALL INVERT LEVELS, SURFACE LEVELS, COVER OVER DRAINAGE LINES, AND MINIMUM FALLS ARE CORRECT & OBTAINABLE PRIOR TO COMMENCEMENT OF WORKS.
6. PIPES Ø375 AND LARGER TO BE REINFORCED CONCRETE OR FRC CLASS `2' APPROVED SPIGOT AND SOCKET WITH RUBBER RING JOINTS U.N.O.
7. PIPES UP TO Ø300 SHALL BE SEWER GRADE PVC-U MINIMUM CLASS SN6 WITH SOLVENT WELDED JOINTS..
8. PIPES SHALL BE LAID AS PER TYPICAL PIPE TRENCH DETAIL AND IN ACCORDANCE WITH AS1289 5.2.1.
9. FOR TRENCHES NOT UNDER PAVEMENTS WHERE EXCAVATED MATERIAL MAY BE USED FOR BACKFILL, THE MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE UNDISTURBED MATERIAL EITHER SIDE OF THE TRENCH.
10. WHERE TRENCHES ARE IN ROCK, THE PIPE SHALL BE BEDDED ON A MINIMUM OF 50mm CONCRETE BED (OR 75mm BED OF 12mm BLUE METAL) UNDER THE BARREL OF THE PIPE.
11. ENLARGERS, CONNECTORS AND JUNCTIONS TO BE PRECAST OR PROPRIETARY FITTINGS WHERE PIPES ARE LESS THAN Ø300.
12. CARE IS TO BE TAKEN WITH LEVELS OF STORMWATER LINES. GRADES SHOWN ARE NOT TO BE REDUCED WITHOUT APPROVAL.
13. GRATES AND COVERS SHALL CONFORM TO AS 3996.
14. ALL FINISHED SURFACE LEVELS SHOWN ON GULLY GRATES AND MANHOLES ARE LOCATED ON THE CAST IRON COVER UNLESS OTHERWISE SHOWN.
15. ON COMPLETION OF PIPE INSTALLATION ALL DISTURBED AREAS MUST BE REINSTATED TO "AS FOUND" CONDITION.
16. THE CONTRACTOR SHALL MAKE GOOD, AT HIS COST, ANY DAMAGE TO ANY SERVICE IF SUCH DAMAGE OCCURS AS A RESULT OF HIS OPERATIONS.
17. CONSTRUCT STORMWATER LINES, PITS AND MANHOLES IN ACCORDANCE WITH RELEVANT LOCAL AUTHORITY STANDARD DRAWINGS & SPECIFICATIONS IF NOT OTHERWISE DETAILED ON THE DRAWINGS.
18. ALL PITS/MANHOLES DEEPER THAN 1000mm TO BE FIXED WITH GALV. STEEL PROPRIETARY STEP IRONS.
19. ALL UNDERGROUND SERVICES ARE TO BE PROVEN ONSITE AND THE CONTRACTOR TO LIAISE WITH RELEVANT AUTHORITIES REGARDING ANY IMPACTS PRIOR TO COMMENCEMENT OF ANY CONSTRUCTION WORKS..

EARTHWORKS NOTES:

SUBGRADE PREPARATION :

1. AREAS UPON WHICH FILL IS TO BE PLACED SHALL BE CLEARED, GRUBBED AND STRIPPED. THE TOTAL AREA ON WHICH FILL IS TO BE PLACED SHALL BE FREE OF SOFT AREAS, WITH THE TOP 150mm OF THE NATURAL SUBGRADE MATERIAL COMPACTED TO 95% STANDARD MAXIMUM DRY DENSITY (MDD-S) COMPACTED AT OPTIMUM MOISTURE CONTENT (OMC) ± 3% PRIOR TO FILLING. THE AREA SHALL BE PROOF ROLLED IN THE PRESENCE OF THE SUPERINTENDENT TO DETERMINE POORLY COMPACTED, SOFT OR UNSTABLE AREAS WITH UP TO 4 PASSES OF EITHER:
   - MINIMUM 8 TONNE (STATIC WEIGHT) VIBRATING STEEL SMOOTH DRUM ROLLER,
   - OPERATING UNDER FULL AMPLITUDE VIBRATION, ROLLING AT APPROXIMATELY 2KM/HR
     OR
   - MINIMUM 20 TONNE (STATIC WEIGHT) RUBBER TYRED, ROLLER, WITH PRESSURE 900kPa MINIMUM, ROLLING AT 3-4KM/HR.
2. WHERE DIRECTED BY THE SUPERINTENDENT, SOFT, WET OR UNSTABLE AREAS SHALL BE EXCAVATED AND THE UNSUITABLE MATERIAL REUSED ON SITE EITHER BY DRYING OUT OR FOR MIXING WITH IMPORTED MATERIAL TO ENABLE COMPACTION AS FILLING.
3. THE BOTTOM OF SUCH EXCAVATION SHALL BE COMPACTED WITH APPROVED EQUIPMENT TO 95% MDD-S, COMPACTED AT OMC ± 3% PRIOR TO BACKFILLING WITH APPROVED FILL MATERIAL.
4. ON NO ACCOUNT SHALL ANY FILL BE PLACED BEFORE APPROVAL OF THIS AREA IS GIVEN BY THE SUPERINTENDENT.
5. QUANTITIES OF UNSUITABLE MATERIAL NOT OTHERWISE APPARENT BY SITE INSPECTION AT TIME OF TENDER SHALL BE INSPECTED AND AGREED WITH THE SUPERINTENDENT WHEN ENCOUNTERED AT PROOF ROLLING.
6. WHERE SIGNIFICANT GROUND WATER IS ENCOUNTERED AFTER REMOVAL OF EXISTING FILL A GRANULAR BRIDGING LAYER SHALL BE PROVIDED PRIOR TO PLACING OF GENERAL FILL. THE BRIDGING LAYER SHALL BE 75mm MAX SIZE 'BALLAST' ROCK WITH A GEOSYNTHETIC SEPARATION LAYER BETWEEN ANY BRIDGING LAYER AND THE OVERLYING FILL. REFER ENGINEER FOR SPECIFIC DETAILS.

FILL MATERIAL:

1. THE CONTRACTOR SHALL ALLOW TO IMPORT ALL FILL MATERIAL TO THE SITE IN EXCESS OF ON SITE CUT TO FILL. WITH HIS TENDER THE CONTRACTOR SHALL PROVIDE DETAILS OF ALL IMPORTED MATERIAL PROPOSED TO BE USED AS FILL INCLUDING, BUT NOT LIMITED TO, THE SOURCES OF FILL, PLASTIC INDEX, LINEAR SHRINKAGE, PARTICLE GRADINGS, CALIFORNIA BEARING RATIO (CBR). ANY MATERIAL TEST INFORMATION PROVIDED MUST BE CARRIED OUT BY A NATA REGISTERED LABORATORY. DURING TENDER NEGOTIATIONS MORE EXTENSIVE TESTING MAY BE REQUESTED TO CONFIRM THE QUALITY OF PROPOSED FILL FROM SPECIFIC SITES NOMINATED AS ORIGINS OF FILL AS WELL AS SITE INSPECTIONS.
2. QUALITY CONTROL TESTING OF IMPORTED FILL SHALL BE UNDERTAKEN BY A NATA APPROVED LABORATORY AS PART OF LEVEL '1' SUPERVISION TO ENABLE CERTIFICATION THAT ALL FILL MATERIALS MEETS THE MINIMUM STANDARDS ACCEPTED BY THE PRINCIPAL. THIS WILL INCLUDE PLASTIC INDEX, LINEAR SHRINKAGE, PARTICLE GRADINGS, CBR AS CONSIDERED NECESSARY.
3. GENERAL FILL QUALITY: WELL GRADED GRANULAR MATERIAL HAVING PROPERTIES AS FOLLOWS:

- MAXIMUM PARTICLE SIZE: 75mm
- PLASTICITY INDEX: <15%
- LIQUID LIMIT: <35%
- CBR >15

FILL CONSTRUCTION:

1. ALL FILL MATERIAL SHALL BE PLACED, SPREAD AND COMPACTED IN UNIFORM LAYERS NOT EXCEEDING 150mm COMPACTED THICKNESS. DURING PLACEMENT OF FILL, THE MOISTURE CONTENT SHALL BE CONTROLLED WITHIN -3% AND +1% OF OMC. EACH LAYER AS IT IS PLACED SHALL BE COMPACTED TO 98% MDD-S BEFORE THE FOLLOWING LAYER IS PLACED. FILL MATERIAL WHICH BECOMES EXCESSIVELY WET AFTER PLACEMENT SHALL BE DRIED OUT AND RE-COMPACTED TO 98% MDD-S, OR SHALL BE REPLACED WITH APPROVED MATERIAL AGAIN COMPACTED TO 98% MDD-S, AT THE CONTRACTOR'S EXPENSE.
2. DENSITY TESTS SHALL BE CARRIED OUT BY A NATA APPROVED LABORATORY. REWORK AND RETEST AREAS WHICH DO NOT ACHIEVE DENSITY UNTIL THAT DENSITY IS ACHIEVED AT THE CONTRACTOR'S EXPENSE.
3. TESTS SHALL BE CARRIED OUT AT NOT LESS THAN ONE TEST PER 500m^3 OR ONE TEST PER LAYER PER 2500m^2 WHICHEVER REQUIRES THE MORE TESTS; DISTRIBUTE THE TESTS EVENLY THROUGHOUT THE FILL.
4. A COPY OF ALL TESTS RESULTS SHALL BE FAXED DIRECTLY TO THE SUPERINTENDENT BY THE LABORATORY IMMEDIATELY WHEN THE TEST RESULTS ARE AVAILABLE AND THEN TO THE CONTRACTOR. A REPORT OF ALL COMPACTION TESTING WILL BE REQUIRED WITH THE FILL CERTIFICATION DETAILING EXACT LOCATIONS AND LEVEL OF TESTS UNDERTAKEN AND ALL REMEDIAL WORK UNDERTAKEN AND RETESTED.
5. SUPERVISION OF FILLING OPERATIONS BY A NATA APPROVED LABORATORY WILL BE REQUIRED TO ENABLE CERTIFICATION THAT ALL FILL HAS BEEN PLACED AND COMPACTED IN ACCORDANCE WITH THIS SPECIFICATION TO LEVEL '1' IN ACCORDANCE WITH AS3798.

GRADING TO FORMATION LEVEL:

1. ON COMPLETION OF EXCAVATION OR FILLING AS SPECIFIED, THE FORMATION SHALL BE GRADED TO CONFORM ACCURATELY TO THE LINES, GRADES AND CROSS-SECTION SHOWN ON THE DRAWINGS CONFORMING TO A LEVEL TOLERANCE OF ± 20mm GENERALLY. PROVIDE EVEN GRADES GENERALLY BETWEEN SPOT LEVELS.

ENVIRONMENTAL PROTECTION:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING, ERECTING AND MAINTAINING EROSION AND SEDIMENT CONTROL DEVICES ON THE SITE AND ENTRY TO THE SITE TO COMPLY WITH ALL STATUTORY AND LOCAL GOVERNMENT REQUIREMENTS.
2. THIS MAY INVOLVE THE CONSTRUCTION OF SEDIMENT FENCES TO THE PERIMETER OF THE SITE TO PREVENT CONTAMINATED STORMWATER ENTERING WATERWAYS AND ALSO APPROPRIATE MEASURES TO PREVENT TRACKING OF MATERIALS ONTO PUBLIC ROADS. IN ADDITION THE CONTRACTOR SHALL TAKE ALL REASONABLE PRECAUTIONS TO ELIMINATE DUST NUISANCE FROM THE SITE.

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	19.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE: GENERAL CONSTRUCTION NOTES, DRAINAGE & EARTHWORKS

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
19.11.2021	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C01	A

CONTINUATION ON C02

TRUE NORTH
PLANT NORTH
36.6°

REFER TO RETAINING WALL SET FOR DETAILS

1:3 GRASSED BATTERS

DIVERSION SWALE 400 BASE, 300 DEPTH MIN. 1:2.5 BATTERS @ 1:200 MIN. REFER TYPICAL SECTION FOR DETAILS

IL:3.98

SERVICE ROAD

EXISTING CANAL

FORESHORE ROAD

Ø225 PVC-U

Ø300 PVC-U

2xØ225 PVC-U

Ø160 HDPE

15 RCP CLASS 2

REFER TO DRW C14 FOR CROSSOVER DETAILS

IL:4.35

1x150mm LAYER OF d50 =100mm ROCK (1800W x 1500L) OVER NON-WOVEN BIDIM A24 GEOTEXTILE.

2x300 RCP

IL:3.35

EXTRACT FOR CLARITY

100mm GRAVEL TYPICAL OVER BIDIM A24 GEOTEXTILE

300 MIN

1 : 2.5

VARIES

400 MIN

DIVERSION SWALE TYPICAL DETAIL

N.T.S

PKHD	AHD
0.000	0.872
3.000	3.872

FOR SURVEY DATA REFER TO DETAIL SURVEY DRAWING No 64146-2 PREPARED BY MASTER SURVEYING DATED 25.06.2021

LEGEND:

	PROPERTY BOUNDARY
	PROPOSED RETAINING WALL REFER MANUFACTURER DRAWINGS FOR DETAILS
	EXISTING CONTOUR LEVEL (0.25m INTERVAL)
	PROPOSED CONTOUR LEVEL (0.10m INTERVAL)
	PROPOSED STORMWATER
RW	PROPOSED RAINWATER
	PROPOSED DRAINAGE TO HOLDING TANK
× 9.99	PROPOSED SPOT HEIGHT (mPKHD)
✳ 9.99	EXISTING SPOT HEIGHT (mPKHD)
× 2.00 (TOC)	EXISTING SPOT HEIGHT ON CANAL WALL (mPKHD)
× 2.00 (TOR)	PROPOSED SPOT HEIGHT ON RETAINING WALL (mPKHD)
FFL 9.99	FINISHED FLOOR LEVEL (mPKHD)
GPT	GROSS POLLUTANT TRAP HUMES HUMEGARD HG15
MH	STORMWATER MANHOLE
GP	STORMWATER GULLY PIT
TD	TRENCH DRAIN
GP1	STORMWATER/ETHANOL SPILLS GULLY PIT
VP	COLLECTION PIT FITTED WITH A VALVE
HT	HOLDING TANK
P	2x AIR PUMPS.REFER MECHANICAL DRAWINGS FOR DETAILS
PS	MAIN COLLECTION CHAMBER
DP	PROPOSED DOWNPIPE
RWT	5kL RAINWATER TANK INCLUDING IRRIGATION SYSTEM

TENDER ONLY
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REFER DRAWINGS C08 &C09 FOR EROSION & SEDIMENT CONTROL MEASURES DURING CONSTRUCTION

5 0 5 10 15 20 25m
Metres

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	19.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP PORT KEMBLA BULK LIQUIDS FACILITY FORESHORE ROAD PORT KEMBLA, NSW

DRAWING TITLE: SITE GRADING & DRAINAGE PLAN. SHEET 1 OF 2

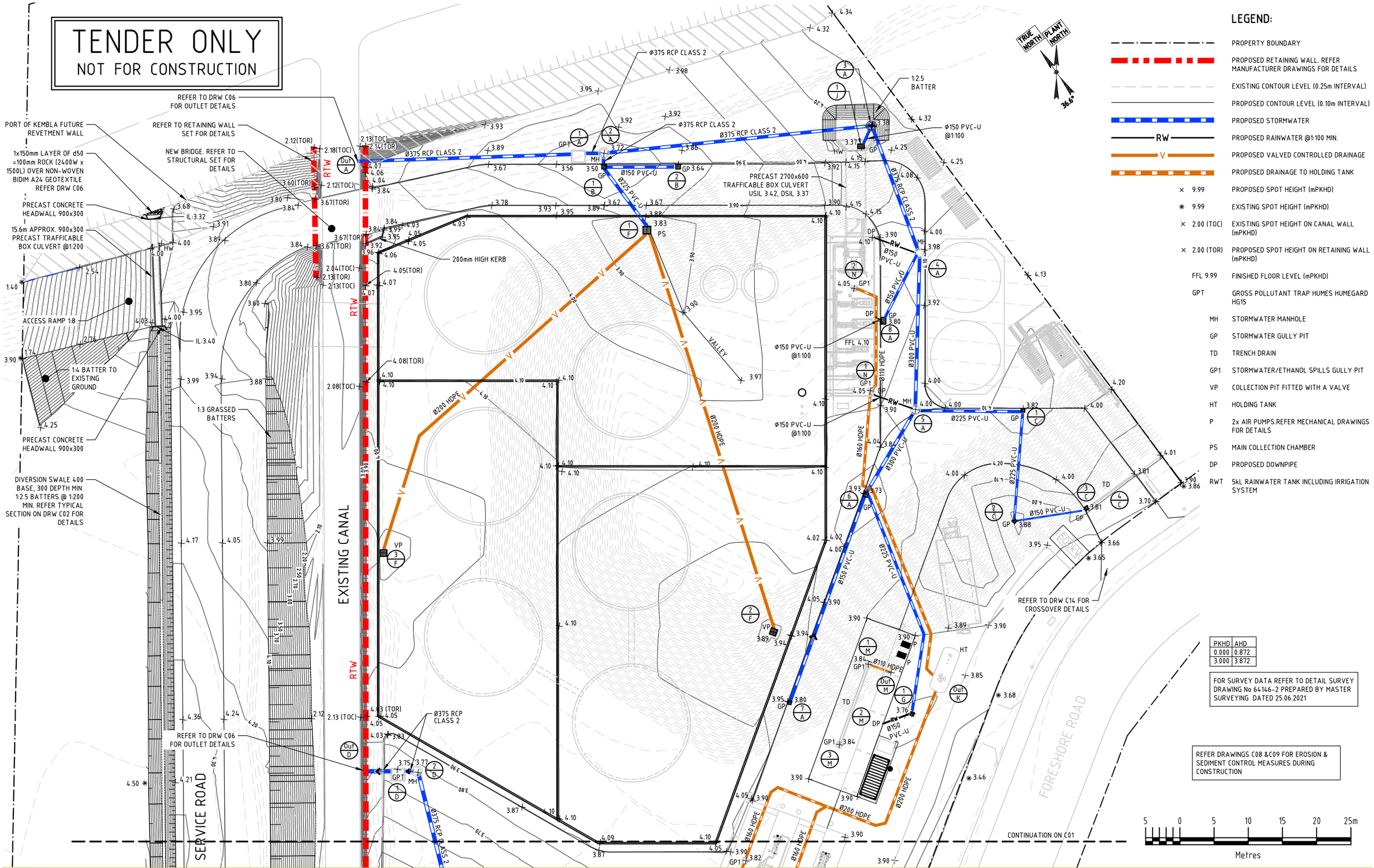
STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
02.09.2021	1:500	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C02	A

TENDER ONLY
NOT FOR CONSTRUCTION



LEGEND:

		PROPERTY BOUNDARY
		PROPOSED RETAINING WALL. REFER MANUFACTURER DRAWINGS FOR DETAILS
		EXISTING CONTOUR LEVEL (0.25m INTERVAL)
		PROPOSED CONTOUR LEVEL (0.10m INTERVAL)
		PROPOSED STORMWATER
RW		PROPOSED RAINWATER @1:100 MIN.
V		PROPOSED VALVED CONTROLLED DRAINAGE
		PROPOSED DRAINAGE TO HOLDING TANK
×	9.99	PROPOSED SPOT HEIGHT (mPKHD)
✳	9.99	EXISTING SPOT HEIGHT (mPKHD)
×	2.00 (TOC)	EXISTING SPOT HEIGHT ON CANAL WALL (mPKHD)
×	2.00 (TOR)	PROPOSED SPOT HEIGHT ON RETAINING WALL (mPKHD)
FFL	9.99	FINISHED FLOOR LEVEL (mPKHD)
GPT		GROSS POLLUTANT TRAP HUMES HUMEGARD HG15
MH		STORMWATER MANHOLE
GP		STORMWATER GULLY PIT
TD		TRENCH DRAIN
GP1		STORMWATER/ETHANOL SPILLS GULLY PIT
VP		COLLECTION PIT FITTED WITH A VALVE
HT		HOLDING TANK
P		2x AIR PUMPS.REFER MECHANICAL DRAWINGS FOR DETAILS
PS		MAIN COLLECTION CHAMBER
DP		PROPOSED DOWNPIPE
RWT		5kL RAINWATER TANK INCLUDING IRRIGATION SYSTEM

PKHD	AHD
0.000	0.872
3.000	3.872

FOR SURVEY DATA REFER TO DETAIL SURVEY DRAWING No 64146-2 PREPARED BY MASTER SURVEYING DATED 25.06.2021

REFER DRAWINGS C08 &C09 FOR EROSION & SEDIMENT CONTROL MEASURES DURING CONSTRUCTION

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	19.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP
100% AUSTRALIAN OWNED

PROJECT DETAILS:
MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE:
SITE GRADING & DRAINAGE PLAN. SHEET 2 OF 2

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
02.09.2021	1:500	A3

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DRAWING NO	REV
20399-C03	A

STORMWATER PIT/MANHOLE SCHEDULE					
STRUCTURE No	STRUCTURE DESCRIPTION	GRATE/LID TYPE	SL	IL US	IL DS
OUT/A ×	OUTLET THROUGH RETAINING WALL	N/A	-	2.14	2.12 ×
1/A	HUMES HUMEGARD HG15	CLASS 'B' LIDS BY HUMES	3.50	2.46	2.46
2/A	1050mm DIAM. PRECAST CONCRETE MANHOLE	600 DIAM. CLASS 'B' GALV. OR C.I. LID & FRAME	3.72	FROM 3/A 2.50 FROM 1/B 2.66	2.48
3/A	1050mm DIAM. PRECAST CONCRETE MANHOLE	600 DIAM. CLASS 'B' GALV. OR C.I. LID & FRAME	3.38	FROM 1/J & 4/A 2.79	2.77
4/A	1200mm DIAM. PRECAST CONCRETE MANHOLE	600 DIAM. CLASS 'D' GALV. OR C.I. LID & FRAME	3.98	2.96	2.94
5/A	1050mm DIAM. PRECAST CONCRETE MANHOLE	600 DIAM. CLASS 'D' GALV. OR C.I. LID & FRAME	4.00	FROM 6/A 3.15 FROM 1/B 3.15	3.13
6/A	600 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	600 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.73	3.04	3.02
7/A	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.80	-	3.36
8/A	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.80	-	3.07
1/B	600 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	600 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.50	FROM 2/B 2.70 FROM 1/F 2.70	2.68
2/B	600 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	600 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.64	-	2.81
1/C	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.82	3.32	3.30
2/C	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.88	3.42	3.40
3/C	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.81	3.56	3.52
4/C	8.5m OF ATCO SK2-00 POWER DRAIN SLOPED CHANNEL	CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.81 TO 3.81	3.61	3.56
OUT/D ×	OUTLET THROUGH RETAINING WALL	N/A	-	2.23	2.13 ×
1/D	HUMES HUMEGARD HG15	CLASS 'D' LIDS BY HUMES	3.75	2.26	2.26
2/D	1050mm DIAM. PRECAST CONCRETE MANHOLE	600 DIAM. CLASS 'D' GALV. OR C.I. LID & FRAME	3.77	2.29	2.27
3/D	900 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	900 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.38	FROM 1/E: 2.45 FROM 4/D: 2.45	2.43
4/D	900x600 CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	900x600 CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.36	2.64	2.62
5/D	600 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	600 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.30	2.91	2.89
6/D	600 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	600 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.70	-	3.15
1/E	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.38	-	2.55
1/F ××× ××××	1200mm SQ. CAST IN-SITU GULLY PIT FITTED WITH A ISOLATION VALVE	1200 SQ. CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.83	FROM 3/F: 2.78 FROM 2/F: 2.78	2.76
2/F ××	900 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE FITTED WITH AN ISOLATION VALVE	900 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.89	-	3.29
3/F ××	900 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE FITTED WITH AN ISOLATION VALVE	900 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.87	-	3.27
1/G	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'B' GALV. OR C.I. GRATE & FRAME	3.76	-	3.21
OUT/H	300 DIAM. PRECAST CONCRETE TWIN-CELL PIPE HEADWALL	N/A	3.39	2.55	2.54 ×
1/H	900x600 CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	900x600 CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.60	2.64	2.62
2/H	900x600 CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	900x600 CLASS 'B' GALV. OR C.I. GRATE & FRAME	3.31	-	2.69
1/J	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'B' GALV. OR C.I. GRATE & FRAME	3.37	-	2.82

STORMWATER PIT/MANHOLE SCHEDULE					
STRUCTURE No	STRUCTURE DESCRIPTION	GRATE/LID TYPE	SL	IL US	IL DS
OUT/K	30kL DOUBLE WALLED FRP TANK ENVIROTANK MODEL DWT H30	LIDS BY ENVIROTANK	VARIES	FROM 1/K:2.74 FROM 1/N: 2.50	REFER TO P&IDS
1/K	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE (WATER SEALED)	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.82	3.17	3.15
2/K	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE (WATER SEALED)	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.82	-	3.32
3/K	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE (WATER SEALED)	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.38	3.24	3.22
4/K	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE (WATER SEALED)	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.82	-	3.39
OUT/M	ABOVE GROUND PUMP CONNECTION. REFER P&IDS FOR DETAILS	N/A	4.10	4.10	REFER TO P&IDS
1/M	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE (WATER SEALED)	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.84	3.58	3.58
2/M	300Wx300Hx12m LONG CAST IN-SITU TRENCH DRAIN WITH 200mm THICK WALLS & BASE	CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.84 TO 3.84	3.64	3.58
3/M	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	3.84	-	3.64
1/N	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE (WATER SEALED)	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	4.05	3.27	3.05
2/N	450 SQ CAST IN-SITU GULLY PIT WITH 200mm THICK WALLS & BASE (WATER SEALED)	450 SQ CLASS 'D' GALV. OR C.I. GRATE & FRAME	4.05	-	3.45

× EXISTING LEVELS TO BE CONFIRMED ONSITE PRIOR TO START OF CONSTRUCTION WORKS.
×× PIT TO BE FITTED WITH A 200mm WIDE x 200mm HIGH PENSTOCK VALVE MODEL ZWA INSTALLED STRICTLY AS PER MANUFACTURER RECOMMENDATIONS
××× PIT TO BE FITTED WITH A 225mm WIDE x 225mm HIGH PENSTOCK VALVE MODEL ZWA INSTALLED STRICTLY AS PER MANUFACTURER RECOMMENDATIONS
×××× REFER TO MECHANICAL SET FOR ETHANOL SPILL LINE PUMP SYSTEM TO BE INSTALLED IN THIS PIT

PIPE TRENCHING NOTES:

1. EMBEDMENT ZONE MATERIAL: 5mm OR 10mm SCREENINGS, OR ALTERNATIVELY WASHED SCREENED BEDDING SAND TO GRADING SPECIFIED BELOW TO BED ZONE.

SIEVE SIZE (mm)	PASSING (% BY MASS)
19.0	100
2.36	40-100
0.425	15-70
0.075	3-30

2. BACKFILL TO CONSIST OF APPROVED SUBGRADE REPLACEMENT MATERIAL WITH A MINIMUM CALIFORNIA BEARING RATIO OF 15, PLACED IN 150mm LAYERS AND COMPACTED UNTIL THE DRY DENSITY IS NOT LESS THAN 98% STANDARD MAXIMUM DRY DENSITY.
3. COMPACTED BACKFILL SHALL BE GRANULAR FILL COMPRISING CRUSHED ROCK (75mm MAXIMUM SIZE, NON PLASTIC OPEN GRADED MATERIAL) OR CRUSHER RUN RECYCLED CONCRETE. WHERE APPROVED UNDER SPECIAL CIRCUMSTANCES, STABILISED SAND (1 PART CEMENT TO 12 PARTS SAND BY VOLUME) OR CONTROLLED LOW STRENGTH MATERIAL OR LEAN MIX CONCRETE OR CLASS 3 MATERIAL MAY BE BE PERMITTED.
4. COMPACTED BACKFILL UNDER FOOTPATHS AND BIKEWAYS: EXCAVATED MATERIALS MAY BE USED PROVIDED ADEQUATE COMPACTION CAN BE OBTAINED. ALTERNATIVELY USE GRANULAR FILL OR SAND.
5. WHERE APPROVED, SELECTED MATERIAL FROM EXCAVATIONS SHALL BE PLACED IN 150mm LAYERS & COMPACTED TO A MINIMUM CONSOLIDATION OF 98% STANDARD COMPACTION.
6. INCREASE EXCAVATION LOCALLY AT SPIGOT AND SOCKET JOINTS (RIGID PIPES) TO ENSURE MINIMUM BOTTOM COVER AS SHOWN.

PIPE TRENCH DETAIL (TYPICAL)
NTS

PIPE TRENCH TABLE			
PIPEØ	A	B	C
≥75 ≤150	100	100	75
>150 <300	150	150	100
≥300 ≤450	300	150	100
>450 ≤900	300	150	100
>900 ≤1500	300	200	100
>1500 ≤4000	0.25 x OD	300	150

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	02.09.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

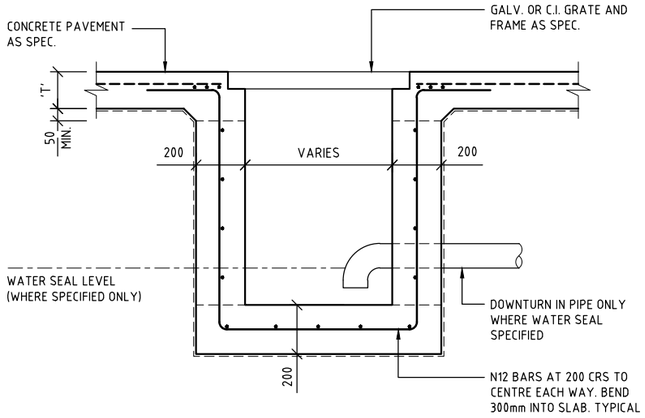
DRAWING TITLE: STORMWATER PIT SCHEDULE & CONSTRUCTION DETAILS

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
02.09.2021	NTS	A3

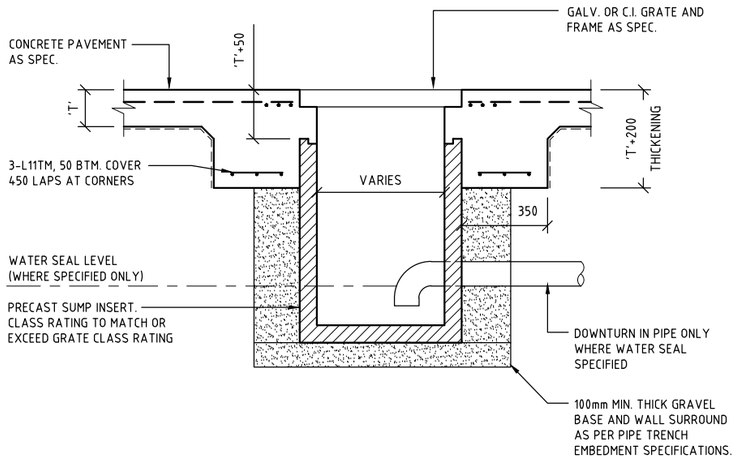
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DRAWING NO	REV
20399-C04	A



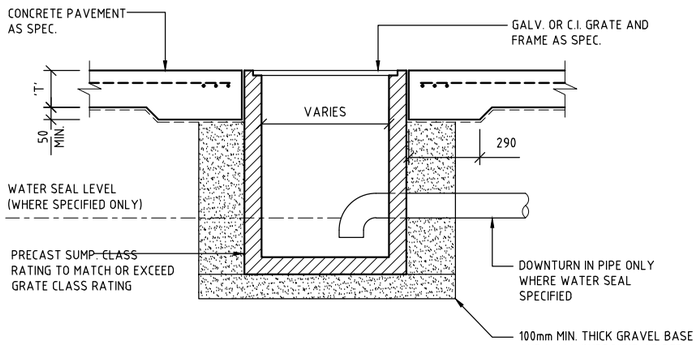
TYPICAL CAST IN-SITU PIT DETAIL

SCALE 1 : 25
(REFER TO PIT SCHEDULE FOR GULLY PIT SIZES)



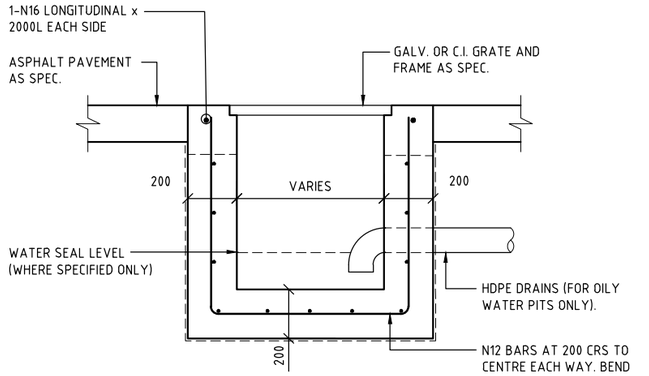
ALTERNATIVE PRECAST PIT DETAIL CLASS 'C' & CLASS 'D' GRATES

SCALE 1 : 25
(REFER TO PIT SCHEDULE FOR GULLY PIT SIZES)



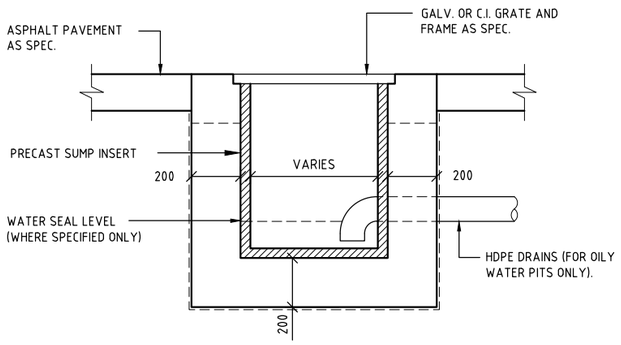
ALTERNATIVE PRECAST PIT DETAIL CLASS 'B' GRATE

SCALE 1 : 25
(REFER TO PIT SCHEDULE FOR GULLY PIT SIZES)



TYPICAL CAST IN-SITU PIT DETAIL

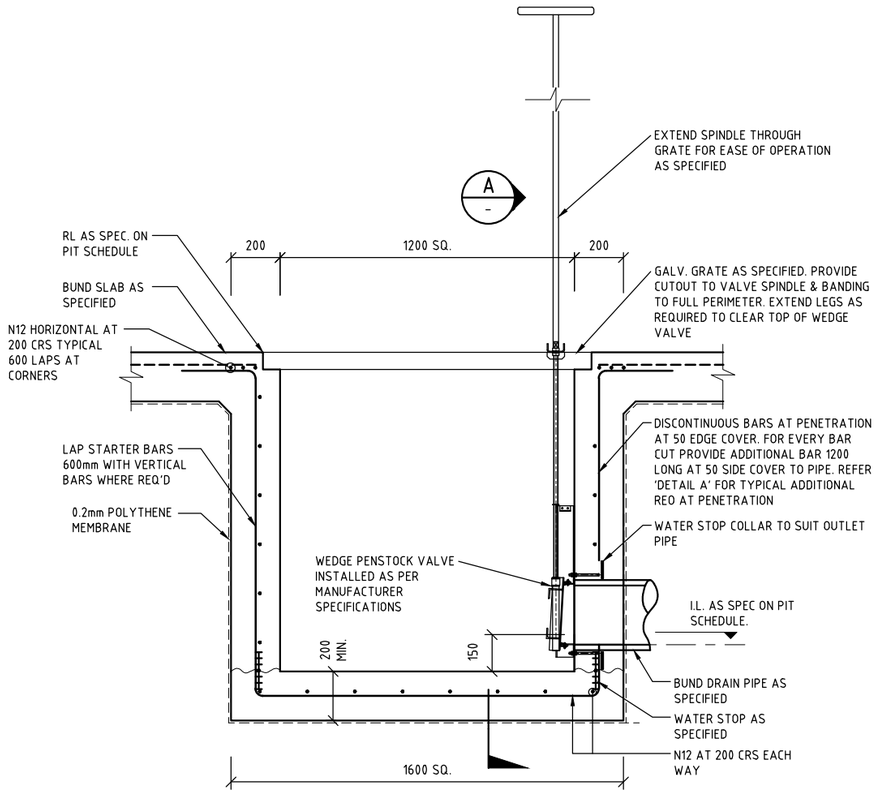
SCALE 1 : 25
(REFER TO PIT SCHEDULE FOR GULLY PIT SIZES)



ALTERNATIVE PRECAST PIT DETAIL

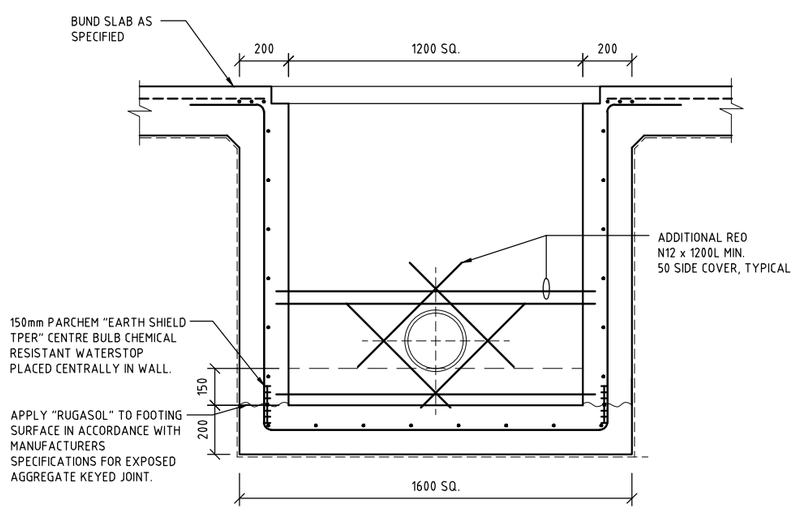
SCALE 1 : 25
(REFER TO PIT SCHEDULE FOR GULLY PIT SIZES)

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TYPICAL CAST IN-SITU GULLY PIT WITH PENSTOCK VALVE DETAIL

SCALE 1 : 25
(REFER TO PIT SCHEDULE FOR GULLY PIT SIZES)



A - TYPICAL REINFORCEMENT DETAIL
1 : 25

250 0 500 1000 1250mm
Millimetres

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	19.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

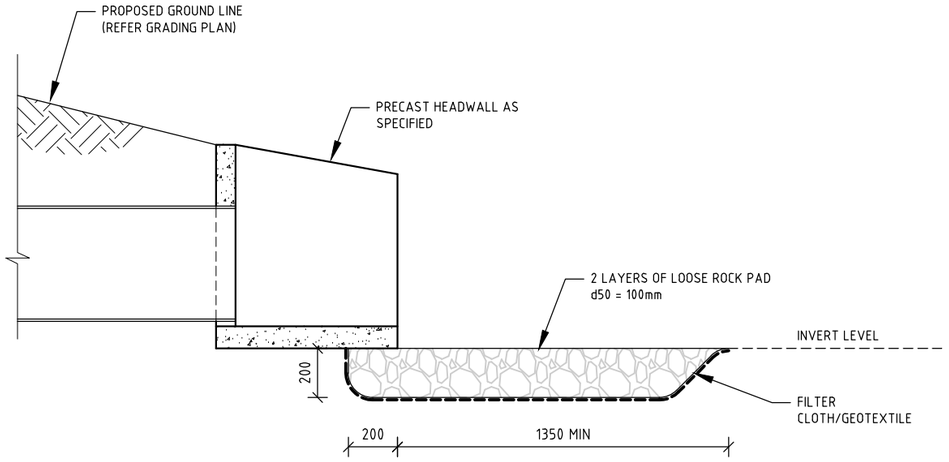
DRAWING TITLE: PIT CONSTRUCTION DETAILS

STATUS: TENDER

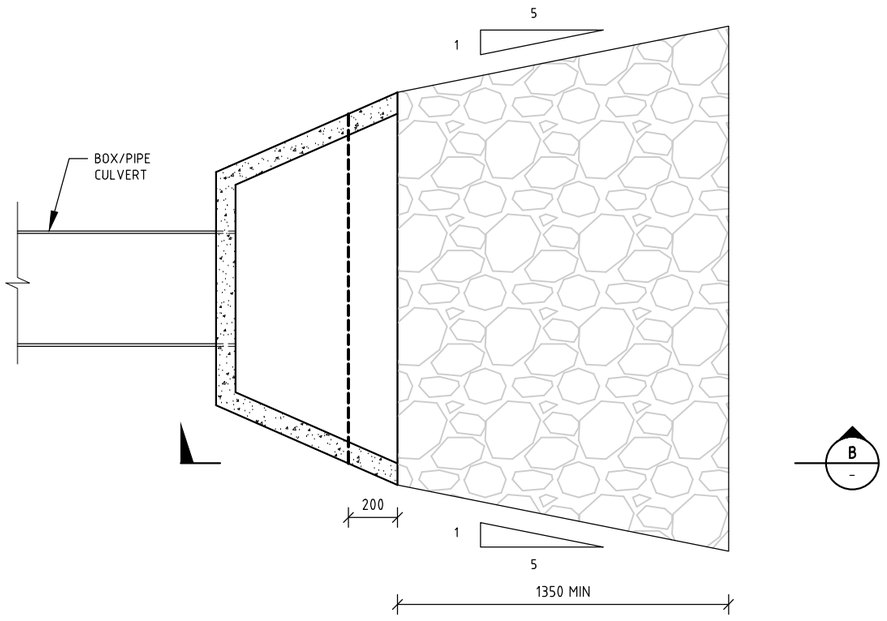
DATE CREATED	ORIGINAL SCALE	SHEET
02.09.2021	1:25	A3

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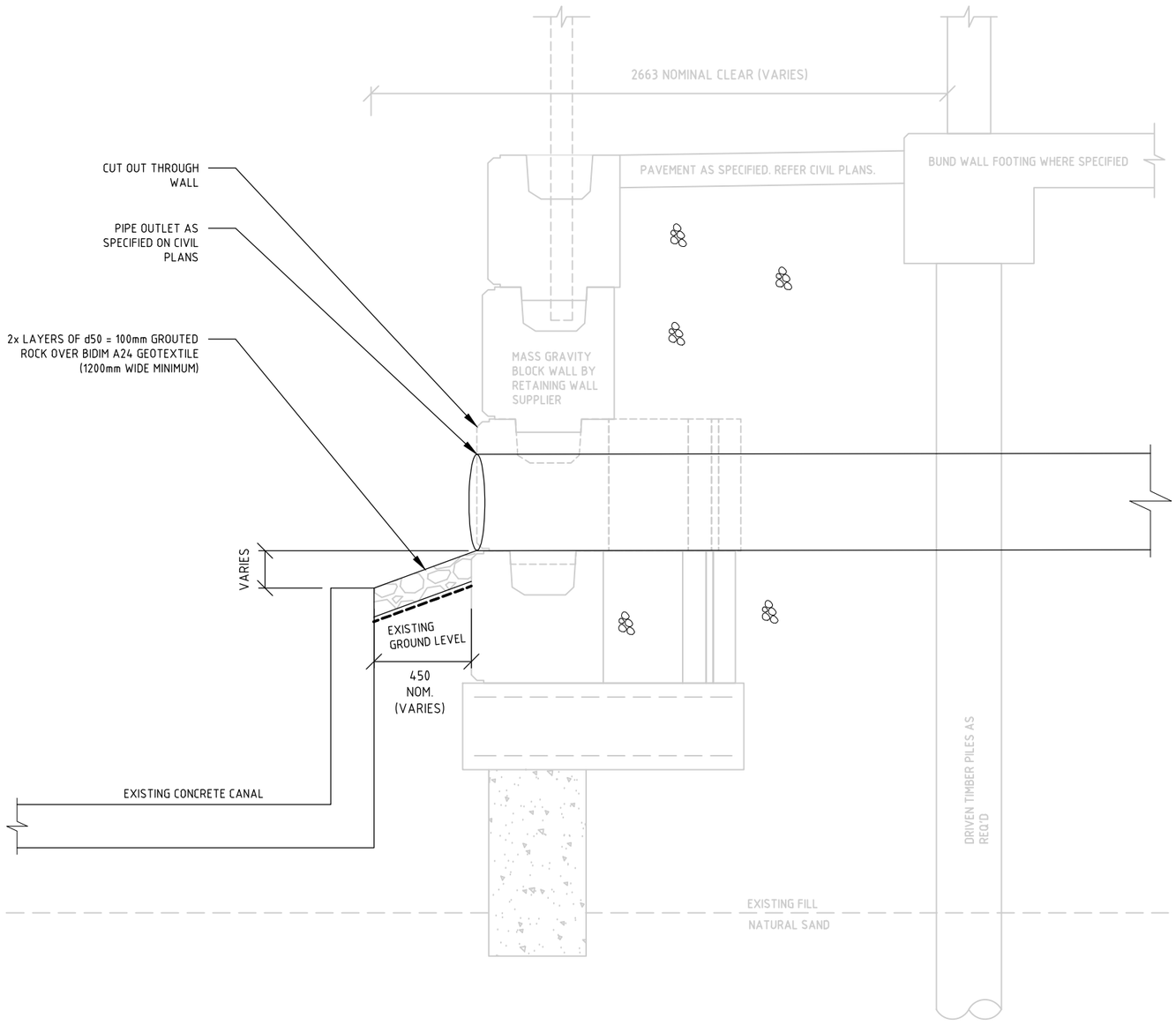
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20399-C05	A



B – OUTLET PROTECTION SECTION DETAIL
1 : 40



TYPICAL OUTLET PROTECTION DETAIL
SCALE 1 : 25
(REFER TO DRW C02, C03 & C04 FOR HEADWALL SIZES)



PIPE OUTLET DETAIL
SCALE 1:25

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250 0 500 1000 1250mm
Millimetres

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	22.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT
MANILDRA GROUP
100% AUSTRALIAN OWNED

PROJECT DETAILS
MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE
DISCHARGE OUTLET
CONSTRUCTION DETAILS

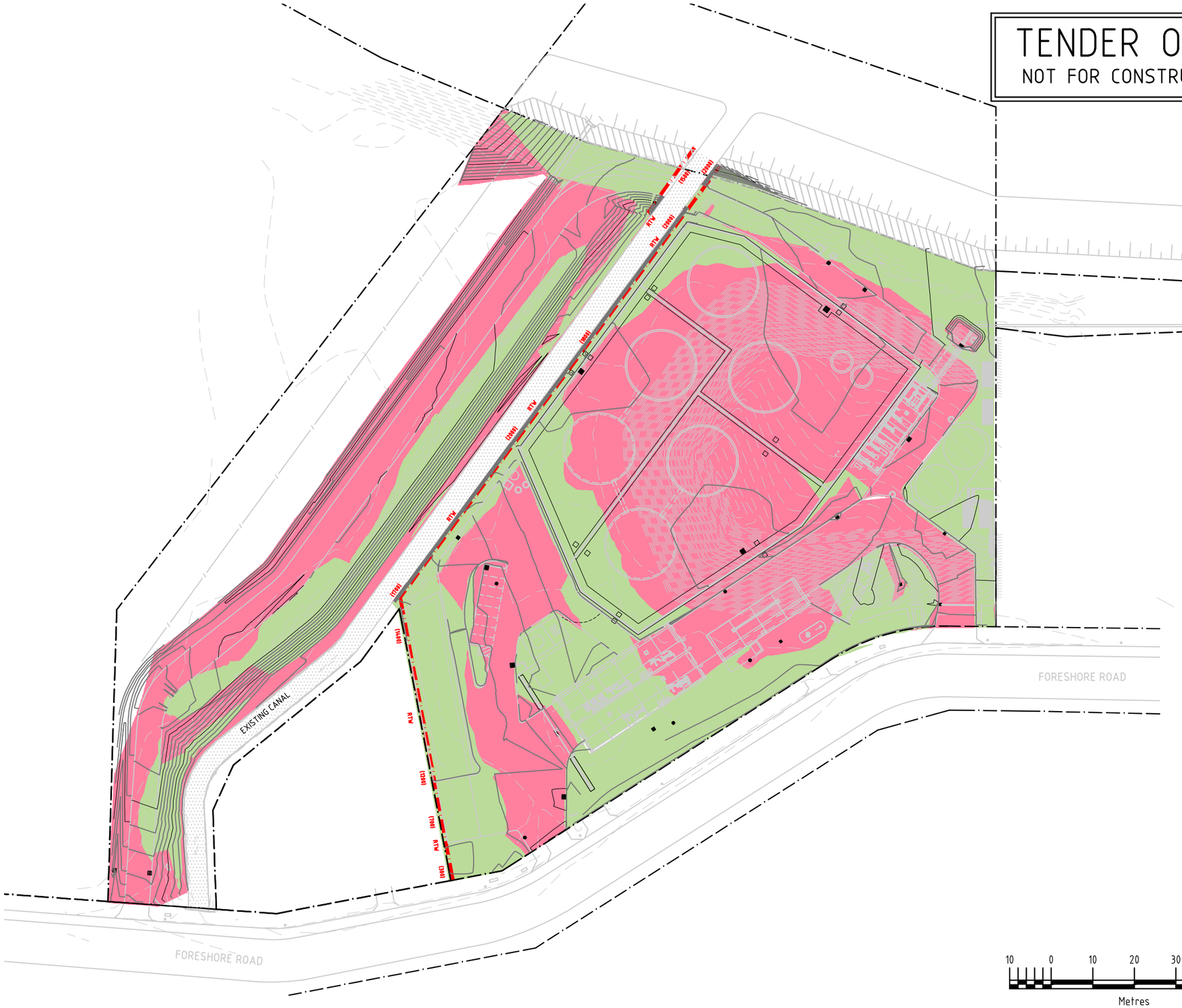
STATUS
TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
22.11.2021	1:25	A3

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20399-C06	A

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PLANT NORTH
TRUE NORTH
36.6°

LEGEND

- PROPERTY BOUNDARY
- PROPOSED RETAINING WALL. REFER STRUCTURAL DRAWINGS FOR DETAILS
- 3.50 PROPOSED EARTHWORKS LEVEL CONTOUR (0.2m INTERVALS)
- EXISTING LEVEL CONTOUR (0.25m INTERVALS)
- (800) APPROXIMATE RETAINING WALL HEIGHT
- ESTIMATED CUT AREA
- ESTIMATED FILL AREA

EARTHWORKS VOLUME:

TOTAL CUT (APPROX.)	=2,422m³
TOTAL FILL (APPROX.)	=3,429m³
REQUIRED FILL	=1,007m³

NOTES:

1. RETAINING WALL TO BE TERMINATED 150mm ABOVE BULK EARTHWORKS SURFACE

10 0 10 20 30 40 50m
Metres

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	22.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE: BULK EARTHWORKS PLAN

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
22.11.2021	1:1000	A3

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DRAWING NO	REV
20399-C07	A

CONSTRUCTION EXIT - ROCK PAD MATERIALS:

1. ROCK : WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, NOMINAL DIAMETER OF 50 TO 75mm (SMALL DISTURBANCES) OR 100 TO 150mm (LARGE DISTURBANCES). ALL REASONABLE MEASURES MUST BE TAKEN TO OBTAIN ROCK OF NEAR UNIFORM SIZE.
2. FOOTPATH STABILISING AGGREGATE : 25 TO 50mm GRAVEL OR AGGREGATE.
3. GEOTEXTILE FABRIC : HEAVY-DUTY, NEEDLE -PUNCHED, NON-WOVEN FILTER CLOTH ('BIDIM' A24 OR EQUIVALENT).

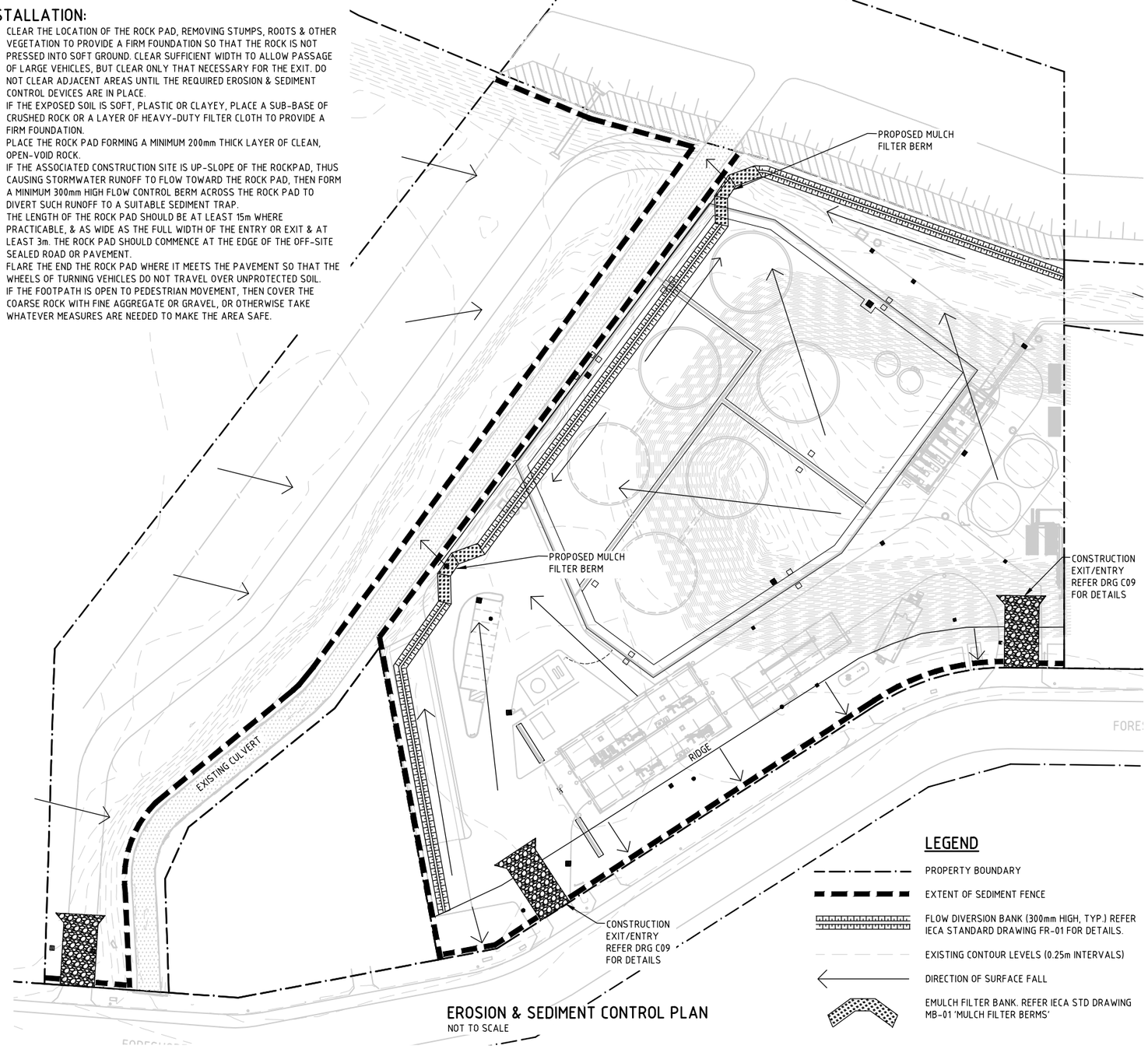
INSTALLATION:

1. CLEAR THE LOCATION OF THE ROCK PAD, REMOVING STUMPS, ROOTS & OTHER VEGETATION TO PROVIDE A FIRM FOUNDATION SO THAT THE ROCK IS NOT PRESSED INTO SOFT GROUND. CLEAR SUFFICIENT WIDTH TO ALLOW PASSAGE OF LARGE VEHICLES, BUT CLEAR ONLY THAT NECESSARY FOR THE EXIT. DO NOT CLEAR ADJACENT AREAS UNTIL THE REQUIRED EROSION & SEDIMENT CONTROL DEVICES ARE IN PLACE.
2. IF THE EXPOSED SOIL IS SOFT, PLASTIC OR CLAYEY, PLACE A SUB-BASE OF CRUSHED ROCK OR A LAYER OF HEAVY-DUTY FILTER CLOTH TO PROVIDE A FIRM FOUNDATION.
3. PLACE THE ROCK PAD FORMING A MINIMUM 200mm THICK LAYER OF CLEAN, OPEN-VOID ROCK.
4. IF THE ASSOCIATED CONSTRUCTION SITE IS UP-SLOPE OF THE ROCKPAD, THUS CAUSING STORMWATER RUNOFF TO FLOW TOWARD THE ROCK PAD, THEN FORM A MINIMUM 300mm HIGH FLOW CONTROL BERM ACROSS THE ROCK PAD TO DIVERT SUCH RUNOFF TO A SUITABLE SEDIMENT TRAP.
5. THE LENGTH OF THE ROCK PAD SHOULD BE AT LEAST 15m WHERE PRACTICABLE, & AS WIDE AS THE FULL WIDTH OF THE ENTRY OR EXIT & AT LEAST 3m. THE ROCK PAD SHOULD COMMENCE AT THE EDGE OF THE OFF-SITE SEALED ROAD OR PAVEMENT.
6. FLARE THE END THE ROCK PAD WHERE IT MEETS THE PAVEMENT SO THAT THE WHEELS OF TURNING VEHICLES DO NOT TRAVEL OVER UNPROTECTED SOIL.
7. IF THE FOOTPATH IS OPEN TO PEDESTRIAN MOVEMENT, THEN COVER THE COARSE ROCK WITH FINE AGGREGATE OR GRAVEL, OR OTHERWISE TAKE WHATEVER MEASURES ARE NEEDED TO MAKE THE AREA SAFE.

NOTES:

1. **EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE DESIGNED AND INSTALLED IN ACCORDANCE WITH THE INTERNATIONAL EROSION CONTROL ASSOCIATION AUSTRALASIA (I.E.C.A.) - "BEST PRACTICE FOR EROSION AND SEDIMENT CONTROL." REFER STANDARD DRAWINGS BY I.E.C.A. FOR DETAILED CONSTRUCTION METHODOLOGY AND REQUIREMENTS.**
2. **REFER TO DESIGN ENGINEER IF CONSTRUCTION ENTRY/EXIT IS TO BE RELOCATED.**

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EROSION & SEDIMENT CONTROL PLAN
NOT TO SCALE

SEDIMENT AND EROSION CONTROL NOTES:

1. ALL THE SEDIMENT & EROSION CONTROL MEASURES TO BE IN ACCORDANCE WITH LOCAL COUNCIL'S GUIDE LINES.

PRIOR TO THE COMMENCEMENT OF CONSTRUCTION:

1. AVOID STRIPPING & EXCAVATING UNTIL READY TO BUILD .
2. INSTALL SEDIMENT FENCES .

SPECIFICATION:

1. SILT FENCE SHALL NOT BE REMOVED UNTIL SITE HAS BEEN PAVED & SURFACED.
2. BUND WALLS SHALL BE LOCATED AROUND ALL PITS & MAINTAINED UNTIL THE CATCHMENT AREA HAS BEEN PAVED.
3. KERB DRAIN EXCLUDER SHALL INCORPORATE TRAFFIC CONTROL BARRICADES IN ACCORDANCE WITH AS1742.3 - 1985, & SHALL NOT BE PLACED UNTIL WORKS ARE BEING CARRIED OUT ON THE FOOTPATH AREA, OR AS OTHERWISE DIRECTED BY COUNCIL.
4. ALL SEDIMENT TRAPS, EXCLUDERS, BUND WALLS SHALL BE INSPECTED & CLEANED AFTER EACH STORM EVENT. DAMAGED OR CLOGGED BUNDING ARE TO BE REMOVED AND REPLACED.
5. THE BUILDER SHALL CARRY OUT ANY ADDITIONAL WORKS DEEMED NECESSARY AND DIRECTED BY COUNCIL TO BE CARRIED OUT.
6. THE SEDIMENT CONTROL PLAN SHALL BE IMPLEMENTED PRIOR TO ANY WORKS BEING CARRIED OUT ON SITE.

HOLD POINTS:

INSPECTION OF EROSION AND SEDIMENT CONTROL DEVICES MUST BE UNDERTAKEN BY THE SUPERVISING OR SUPERINTENDENT ENGINEER AT A MINIMUM AT THE FOLLOWING HOLD POINTS:

1. PRIOR TO COMMENCEMENT OF BULK EARTHWORKS.
2. PRIOR TO LIVE CONNECTION OF NEW STORMWATER DRAINAGE TO THE EXISTING SYSTEM.
3. PRIOR TO ANY IN STREAM WORKS.
4. PRIOR TO ON MAINTENANCE OR OFF MAINTENANCE INSPECTION.
5. AT INTERVALS NOT EXCEEDING ONE MONTH.

COPIES OF INSPECTION REPORTS SHALL BE KEPT ON SITE.

SEDIMENT BARRIERS:

SEDIMENT FENCE

- INSTALL SEDIMENT FENCE(S) ALONG THE LOW SIDE OF THE SITE, AND IDEALLY ALONG A LINE OF CONSTANT LAND LEVEL TO PREVENT THE CONCENTRATION OF STORMWATER RUNOFF.
  IN AREAS WHERE IT IS EITHER UNDESIRABLE OR IMPRACTICAL TO BURY THE LOWER EDGE OF THE SEDIMENT FENCE, THE LOWER 200mm (MIN) PORTION OF THE FABRIC SHOULD BE PLACED 0 THE GROUND UP-SLOPE OF THE FENCE AND BURIED UNDER A 100mm (MIN)LAYER OF AGGREGATE.
  SEDIMENT FENCES ON BUILDING SITES CAN BE STAPLED TO APPROXIMATELY 40mm SQUARE HARDWOOD POSTS OR WIRE TIED TO STEEL POSTS.

FIELD INLET GULLIES

- SEDIMENT CONTROLS FOR STORMWATER INLETS LOCATED WITHIN THE PROPERTY BOUNDARIES MAY CONSIST OF GEOTEXTILE FABRIC PLACED EITHER DIRECTLY OVER THE GRATED INLET OR AROUND THE INLET SUPPORT BY A TIMBER FRAME. FIELD INLET PROTECTION IS NECESSARY WHERE INLETS DRAIN AREAS OF BARE AND UNPROTECTED SOIL. DURING STORMS, PONDING SHOULD BE ALLOWED TO OCCUR AROUND THE STORMWATER INLET TO ASSIST IN THE SETTING OUT OF SEDIMENTS.

PAVEMENT INLET GULLY

- A ROADSIDE INLET BARRIER IS TO BE INSTALLED, SO THAT IT SHOULD NOT BE ALLOWED TO FULLY BLOCK THE INLET STRUCTURE. ON A HILLSIDE, SEDIMENT BARRIERS MAY CONSIST OF A TEMPORARY DAM CONSTRUCTED FROM SAND AND GRAVEL BAGS AT LEAST 4 METRES UP SLOPE FROM THE GULLY INLET.

BUILDING OPERATIONS:

1. ERODABLE MATERIAL MISTAKENLY PLACED WITHIN THE ROAD RESERVE (INCLUDING ACCIDENTAL SPILLAGE AND TRACKING OF SUCH MATERIALS ONTO THE ROAD) THAT CAN NOT BE PREVENTED THROUGH REASONABLE MEANS, MUST BE:
   (a) REMOVED IMMEDIATELY IF RAINFALL IS IMMINENT OR OCCURRING.
   (b) REMOVED PRIOR TO THE END OF THE DAY'S WORK IF RAINFALL NOT EXPECTED. MATERIALS SHOULD BE SWEPT FROM THE ROAD, NOT WASHED DOWN THE GUTTER.
2. ALL SOLID WASTE SHOULD BE STORED ON SITE IN SUCH A MANNER THAT IT IS PREVENTED FROM LEAVING THE SITE EITHER BY THE ACTION OF WIND OR WATER.
3. SMALLER MATERIALS, SUCH AS LITTER, SHOULD BE CONTAINED IN COVERED BINS OR LITTER TRAPS FORMED ON THREE SIDES BY A GEOTEXTILE WIND BREAK.
4. CONCRETE WASTE WASTED FROM TRUCKS AND MIXERS UNITS SHALL BE CONTAINED ON SITE AND SHALL NOT BE PLACED IN A POSITION WHERE IT COULD REASONABLY BE EXPECTED TO WASH FROM THE SITE AND HARM THE ENVIRONMENT.
5. DUST SUPPRESSION OPERATIONS SHALL BE UNDERTAKEN TO MINIMISE THE RISK OF DUST RISE, INCLUDING WATER TRUCKS, MULCHING, EROSION CONTROL BLANKETS, SOIL BINDERS, VEHICLE SPEED LIMITS & STOCKPILE STABILISATION.

BULK EARTHWORKS:

1. AVOID STRIPPING & EXCAVATING UNTIL READY TO BUILD.
2. CONSTRUCTION OF AN ENTRY/EXIT POINT TO THE SITE SHOULD BE MANAGED SO THAT SEDIMENT IS NOT TRACKED OFF THE SITE.
3. TOP SOIL SHOULD BE STOCKPILED ON SITE FOR LATER USE.
4. WHERE PRACTICABLE MAINTAIN KERB VEGETATION IN A HEALTHY STATE DURING THE CONSTRUCTION PROGRESS.
5. WHEN UP SLOPE WATER IS DIVERTED AROUND A WORK SITE IT IDEALLY SHOULD BE DISCHARGED AS SHEET FLOW THROUGH AN UNDISTURBED AREA BESIDE THE WORKS.

STOCKPILES:

1. STOCKPILES ARE NOT TO BE STORED ON THE FOOTPATH OR THE ROAD RESERVE.
2. WHERE NECESSARY STOCKPILE LOSSES CAN BE MINIMISED WITH THE USE OF COVERS.
3. ALL STOCKPILES AND BUILDING MATERIAL SHOULD BE LOCATED WITHIN SEDIMENT CONTROL ZONE.
4. TO MINIMISE EROSION AND THE LOSS OF SAND AND SOIL, STOCKPILES SHOULD BE NOT LOCATED WITHIN AN OVERLAND FLOW PATH. IF IT IS IMPRACTICAL TO AVOID STORMWATER RUNOFF BEING DIRECTED TO A STOCKPILE, THEN A PERIMETER BANK SHALL BE CONSTRUCTED UP SLOPE OF THE STOCKPILE TO DIRECT RUNOFF IN A CONTROLLED MANNER AROUND THE STOCKPILE.

GENERAL MAINTENANCE:

1. SEDIMENT FENCES SHOULD BE REPLACED IF THE FABRIC IS RIPPED OR OTHERWISE DAMAGED. THE MAINTENANCE OF THE SEDIMENT FENCES INCLUDES THE REMOVAL OF SEDIMENT DEPOSITED UP SLOPE OF THE FENCE AND RETRENCHING THE FABRIC WHEN THE FENCE IS 25% FULL.
2. FOLLOWING STORM EVENTS, THE ROAD RESERVE AND ALL SEDIMENT BARRIERS SHOULD BE INSPECTED AND ANY EXCESSIVE RESIDUE SHOULD BE APPROPRIATELY REMOVED.

SITE REHABILITATION:

1. ALL GROUND DISTURBED BY THE CONSTRUCTION ACTIVITY SHOULD BE PROMPTLY AND PROGRESSIVELY STABILISED SO IT CAN NO LONGER ACT AS A SOURCE OF SEDIMENT.

SERVICES TRENCHES:

1. TO AVOID UNNECESSARY SOIL EROSION, SERVICE TRENCHES SHOULD BE BACK FILLED, CAPPED AND COMPACTED TO A LEVEL AT LEAST 75-100mm ABOVE THE ADJOINING GROUND LEVEL.

OPERATION & MAINTENANCE

1. EROSION & SEDIMENT CONTROL MEASURES SHALL BE INSPECTED:
   A. DAILY (WHEN WORK IS OCCURRING ON SITE) OR WEEKLY (WHEN WORK IS NOT OCCURRING ON SITE)
   B. WITHIN 24 HOURS OF EXPECTED RAIN
   C. WITHIN 18 HOURS OF A RAINFALL EVENT (ie AN EVENT OF SUFFICIENT INTENSITY AND DURATION TO CAUSE RUNOFF).
2. EROSION & SEDIMENT CONTROL MAINTENANCE MEASURES SHALL BE TRIGGERED WHEN THE CAPACITY OF THE MEASURE FALLS BELOW 75%. THE MAINTENANCE SHALL BE PERFORMED BY THE END OF THE DAY.
3. PRIOR TO LONG PERIODS OF SHUT DOWN (GREATER THAN 5 DAYS) THE SITE SHALL EITHER TO BE PROVIDED WITH TEMPORARY GROUND COVER (AT LEAST 70% EFFECTIVE COVER) OR HAVE ALL EROSION AND SEDIMENT CONTROL MEASURES TO BE CONTINUALLY OPERATED DURING THE SHUTDOWN, INCLUDING ONGOING MONITORING AND SEDIMENT BASIN CLEANOUTS.
4. SHUTDOWN PERIODS IN EXCESS OF 3 MONTHS ARE TO HAVE 100% LONG TERM SITE COVERAGE SUCH AS HYDROMULCH OR GEOFABRIC.
5. STORMWATER RELEASE LIMITS:
   ALL RELEASES OF STORMWATER CAPTURED ON-SITE, UNLESS OTHERWISE NOTED MUST NOT EXCEED THE FOLLOWING LIMITS:
   A. 50mg/L OF TOTAL SUSPENDED SOLIDS (TSS) AS A MAXIMUM CONCENTRATION.
   B. TURBIDITY (NTU) VALUE LESS THAN 10% ABOVE BACKGROUND
   C. pH VALUE MUST BE IN THE RANGE 6.5 TO 8.5 EXCEPT WHERE, AND TO THE EXTENT THAT, THE NATURAL RECEIVING WATERS LIE OUTSIDE THIS RANGE.
6. WEATHER FORECASTS SHALL BE MONITORED AND IN THE EVENT OF HEAVY RAIN FORECAST ALL MAINTENANCE AND PREVENTION METHODS SHALL BE IMPLEMENTED

STOCKPILE MANAGEMENT

SAND MATERIAL:

A. NO COVER REQUIRED WHEN WIND EROSION AND DUST CONTROL IS NOT AN ISSUE
B. SYNTHETIC COVER IS REQUIRED WHEN THE CONTROL OF WIND EROSION IS REQUIRED FOR SAFETY, TO BE INSTALLED BY THE END OF THE DAY.

SOIL MATERIAL

A. NO COVER REQUIRED WHEN WIND EROSION AND DUST CONTROL IS NOT AN ISSUE.
B. MULCHING, CHEMICAL STABILISERS, SOIL BINDERS, IMPERVIOUS BLANKETS OR VEGETATIVE COVER IS REQUIRED WHEN:
   - >28 DAY STOCKPILING OF DISPERSIVE SOILS
   - >28 DAY STOCKPILING OF CLAYEY SOILS WHERE TURBIDITY CONTROL IS DESIRABLE
   - >5/10 DAY STOCKPILING OF SOILS DURING MONTHS OF EXTREME/HIGH EROSION RISK (JAN, FEB, MAR, APR, NOV, DEC)
   - ALL STOCKPILES OF CLAYEY SOILS WHEN TURBIDITY CONTROL IS ESSENTIAL.

REV	DATE	BY	DESCRIPTION	CHK	APP
A	14.09.2021	LS	ISSUED FOR TENDER		
B	23.11.2021	LS	SITE LAYOUT UPDATED		

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PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS:
MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE:
CONCEPTUAL EROSION & SEDIMENT CONTROL PLAN

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
14.09.2021	AS SHOWN	A3

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DRAWING NO	REV
20399-C08	B

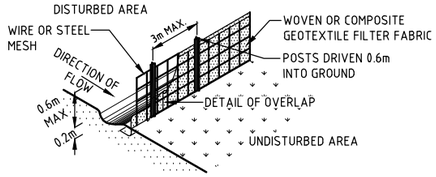


FIG. 1. - SEDIMENT FENCE

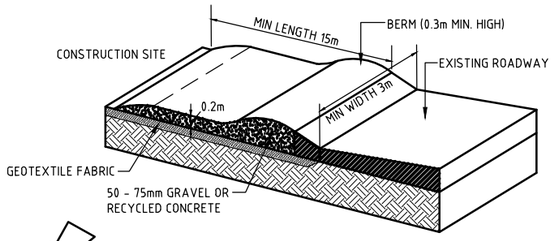
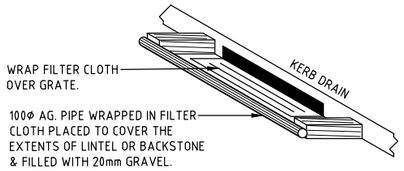


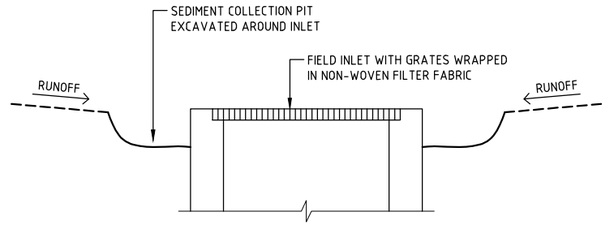
FIG. 2. - CONSTRUCTION EXIT/ENTRY

MAINTENANCE:

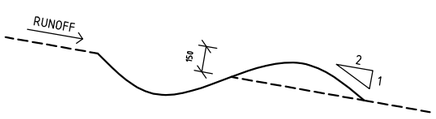
1. THE ENTRANCE SHOULD BE MAINTAINED SO THAT IT PREVENTS TYRES FROM TRACKING.
2. DRESSING WITH ADDITIONAL AGGREGATE IF REQUIRED.
3. REGULARLY REMOVE SEDIMENT FROM ROADWAY.



KERB INLET PROTECTION DETAIL

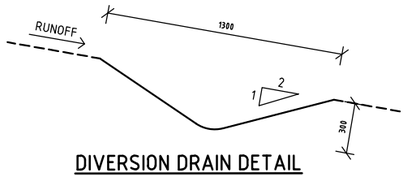


GRATED INLET SEDIMENT TRAP DETAIL



CATCH DRAIN DETAIL

CATCH DRAINS TO BE RUN AT MAX. 0.5% GRADE

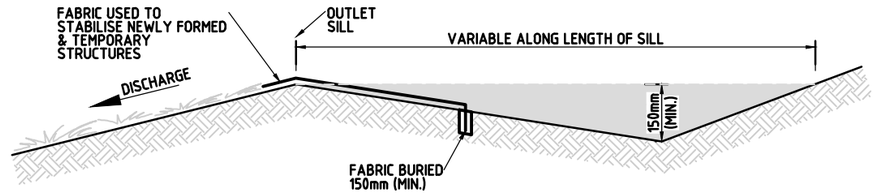


DIVERSION DRAIN DETAIL

DIVERSION DRAIN TO BE LINE WITH GEOFABRIC

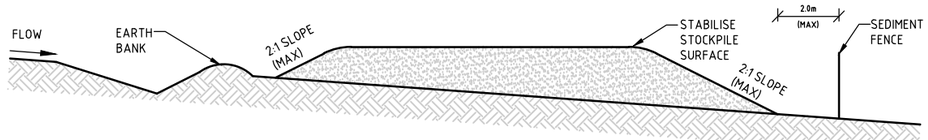
LEVEL SPREADER INSTALLATION:

1. THE OUTLET SILL OF THE SPREADER SHOULD BE PROTECTED WITH EROSION CONTROL MATTING TO PREVENT EROSION DURING THE ESTABLISHMENT OF VEGETATION. THE MATTING SHOULD BE A MINIMUM OF 1200mm WIDE EXTENDING AT LEAST 300mm UPSTREAM OF THE EDGE OF THE OUTLET CREST & BURIED AT LEAST 150mm IN A VERTICAL TRENCH. THE DOWNSTREAM EDGE SHOULD BE SECURELY HELD IN PLACE WITH CLOSELY SPACED HEAVY-DUTY WIRE STAPLES AT LEAST 150mm LONG.
2. ENSURE THAT THE OUTLET SILL (CREST) IS LEVEL FOR THE SPECIFIED LENGTH.
3. IMMEDIATELY AFTER CONSTRUCTION, TURF, OR SEED & MULCH WHERE APPROPRIATE, THE LEVEL SPREADER.

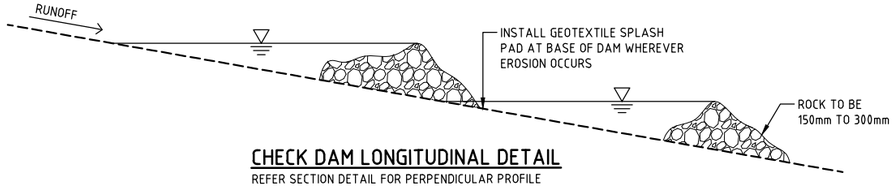


TYPICAL PROFILE OF THE OUTLET WEIR

LEVEL SPREADER

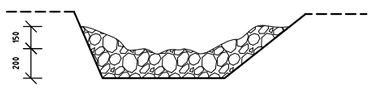


TYPICAL STOCKPILE CONFIGURATION

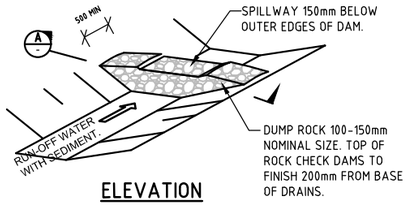


CHECK DAM LONGITUDINAL DETAIL

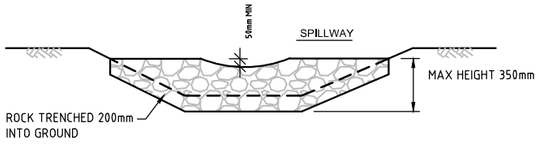
REFER SECTION DETAIL FOR PERPENDICULAR PROFILE



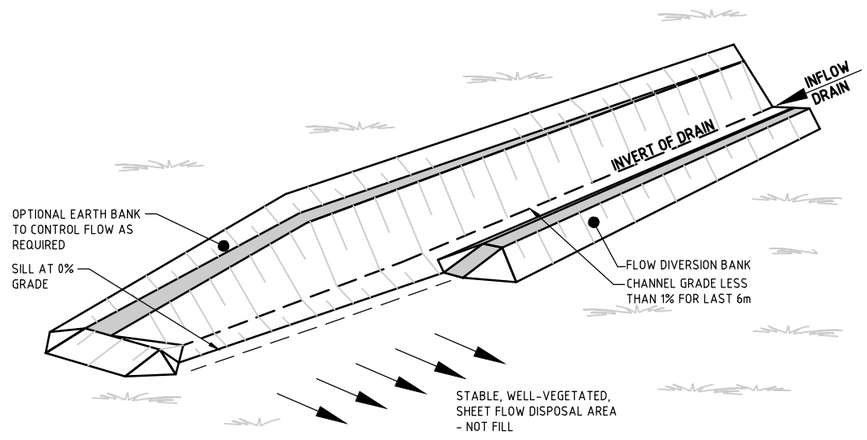
CHECK DAM SECTION DETAIL



ELEVATION



TENDER ONLY
NOT FOR CONSTRUCTION



TYPICAL LAYOUT OF LEVEL SPREADER

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	14.09.21	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE: EROSION & SEDIMENT CONTROL PLAN CONSTRUCTION DETAILS

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
14.09.2021	AS SHOWN	A3

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20399-C09	A

LEGEND:

K1 200mm HIGH KERB

K 150mm HIGH KERB



BUND FLOOR:
150mm THICK CONCRETE SLAB WITH SL82 MESH AT 50 TOP & BTM.
COVER ON 0.2mm POLYTHENE OVER 50mm CLEAN SAND BEDDING.
JOINTS AT 5m CENTRES TYPICAL WITH "EARTHSHIELD T-PER REAR GUARD WATER STOPS. JOINT SEALANT AS PER TYPICAL DETAIL.
APPROXIMATE AREA 3270m^2



GRAVEL HARDSTAND (REMAINDER OF SITE)
150mm THICK 20mm DRAINAGE GRAVEL
ON GEOFABRIC LINER OVER COMPACTED SUBGRADE.
APPROXIMATE AREA 2800m^2



HEAVY DUTY VEHICLE PAVEMENT:
200mm THICK CONCRETE SLAB WITH SL92 MESH AT 50 TOP COVER
ON 0.2mm POLYTHENE OVER 150mm THICK CBR45 BASE (DGS20)
APPROXIMATE AREA 1490m^2



LIGHT DUTY VEHICLE PAVEMENT:
150mm THICK CONCRETE SLAB WITH SL82 MESH AT 50 TOP COVER
ON 0.2mm POLYTHENE OVER 150mm THICK CBR45 BASE (DGS20)
APPROXIMATE AREA 1260m^2



2-COAT SPRAY SEAL FOOTPATH
100 O/A THICKNESS:
2-COAT BITUMEN SPRAY SEAL WITH CHIP COAT (C170 20/7mm) ON
100mm CBR80 (SOAKED) BASE (DGB20) OVER
APPROXIMATE AREA 661m^2



CROSSOVER PAVEMENT:
200mm THICK CONCRETE FOOTPATH CROSSOVER WITH SL92 MESH AT
50 TOP COVER ON 0.2mm POLYTHENE OVER 150mm THICK CBR45 BASE (DGS20).
APPROXIMATE AREA 120m^2



FOOTPATH:
100mm THICK CONCRETE SLAB (BROOM FINISH) WITH SL72 MESH AT 40
TOP COVER ON 0.2mm POLYTHENE OVER 50mm SAND BEDDING MATERIAL
APPROXIMATE AREA 150m^2



2-COAT SPRAY SEAL DRIVEWAY/ROAD:
250 O/A THICKNESS:
2-COAT BITUMEN SPRAY SEAL WITH CHIP COAT (C170 20/7mm) ON
100mm CBR80 (SOAKED) BASE (DGB20) OVER
150mm CBR45 (SOAKED) BASE (DGS20)
APPROXIMATE AREA 2317m^2



BUND FOOTINGS
AS DETAILED
APPROXIMATE AREA 760m^2



LANDSCAPING:
APPROXIMATE AREA 1353m^2



BUILDING/GANTRY/STRUCTURE SLABS:
AS DETAILED. TYPICALLY 200mm CONCRETE SLAB WITH SL92 MESH AT 50 TOP
COVER ON 0.2mm POLYTHENE OVER 150mm THICK CBR45 BASE 9DGS20).
APPROXIMATE AREA 1560m^2

CONCRETE NOTES:

1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3600.
2. CONCRETE QUALITY:

ELEMENT	SLUMP	MAX. SIZE AGG.	CEMENT TYPE	AS 3600 F'C	ADMIX
BUILDING SLABS, FOOTINGS, PAVEMENTS	80	20	GP	N40	NIL
TANK BASES, BUND FLOOR/WALLS	80	20	GP	N40	XYPEX C-5000
MASS CONCRETE BLINDING	100	20	GP	N20	NIL

3. SIZES OF CONCRETE DO NOT INCLUDE THICKNESS OF APPLIED FINISHES.
4. CONSTRUCTION JOINTS WHERE NOT SHOWN SHALL BE LOCATED TO THE APPROVAL OF THE ENGINEER.
5. NO HOLES OR CHASES OTHER THAN THAT SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS WITHOUT THE PRIOR APPROVAL OF THE ENGINEER.
6. REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY. IT IS NOT NECESSARILY SHOWN OF TRUE PROJECTIONS.
7. SPLICES IN REINFORCEMENT SHALL BE MADE ONLY ON THE POSITIONS SHOWN. THE WRITTEN APPROVAL OF THE ENGINEER SHALL BE OBTAINED FOR ANY OTHER SPLICES. WHERE LAP LENGTHS ARE NOT SHOWN, THEY SHALL SATISFY THE REQUIREMENTS OF AS3600 OR AS FOLLOWS:-
   FABRIC - 1 SQUARE +25mm

f'c	N12	N16	N20	N28	N32
25	850	1150	1500	2200	2600
32	750	1000	1300	1950	2300
40	650	900	1150	1750	2100

8. PIPES OR CONDUITS SHALL NOT BE PLACED WITHIN THE CONCRETE COVER TO REINFORCEMENT WITHOUT THE APPROVAL OF THE ENGINEER.
9. ALL STEEL WIRE MESH SHALL BE SUPPLIED IN FLAT SHEETS.
10. THE CONTRACTOR SHALL NOTIFY THE ENGINEER 24 HOURS BEFORE REINFORCEMENT IS COMPLETED. THE CONTRACTOR SHALL ALLOW AFTER COMPLETION OF THE REINFORCEMENT, TWO HOURS FOR THE ENGINEERS INSPECTION.
11. CONCRETE SHALL NOT BE ORDERED UNTIL REINFORCEMENT IS APPROVED BY THE ENGINEER.
12. CONCRETE FINISHING, CURING AND STRIPPING TO BE IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS. CONCRETE TO BE CURED A MINIMUM OF 7 DAYS AFTER POURING BY EITHER APPLYING A SPRAYED MEMBRANE FORMING CURING COMPOUND COMPATIBLE WITH ANY SUBSEQUENT FINISHES TO BE APPLIED TO THE CONCRETE SURFACES, OR COVERING WITH POLYTHENE SHEETING SECURELY HELD IN POSITION.
13. CLEAR CONCRETE COVER TO REINFORCEMENT SHALL BE AS INDICATED.
14. ALL REINFORCEMENT SHALL BE SUPPORTED ON APPROVED CHAIRS AT A MAXIMUM SPACING OF 1000mm CENTRES IN EACH DIRECTION TO PROVIDE THE CORRECT COVER.
15. THE SUPPLY, DELIVERY, SAMPLING AND TESTING OF CONCRETE SHALL BE IN ACCORDANCE WITH AS1379. RESULTS OF CONCRETE CYLINDER SAMPLE TESTING SHALL BE FORWARDED TO THE ENGINEER FOR REVIEW & APPROVAL.

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	22.11.21	DH	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS:
MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

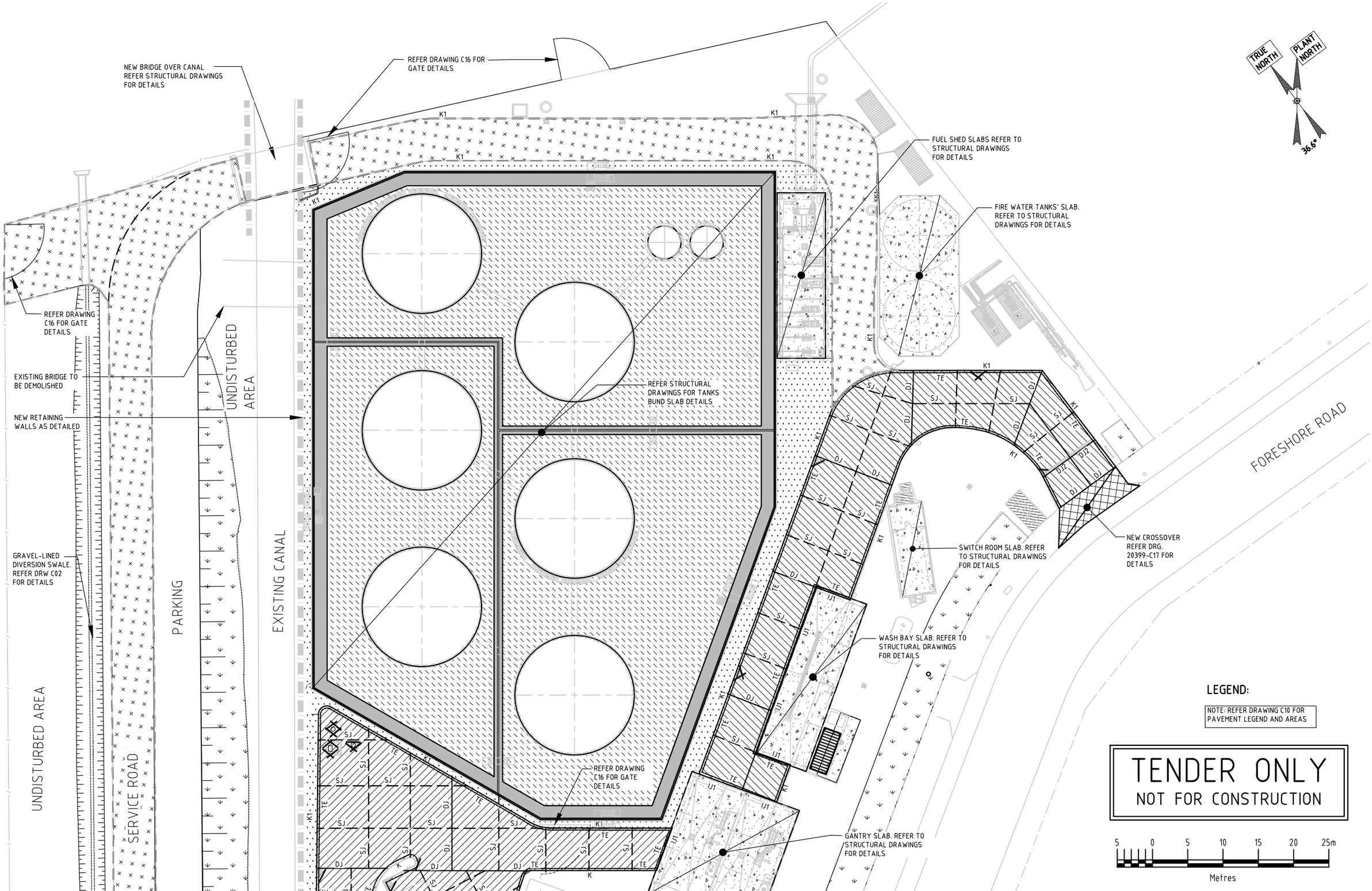
DRAWING TITLE:
CONCRETE PAVEMENT
LEGEND & CONSTRUCTION
NOTES

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
22.11.21	NTS	A3

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	22.11.21	DH	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP
100% AUSTRALIAN OWNED

PROJECT DETAILS:
MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

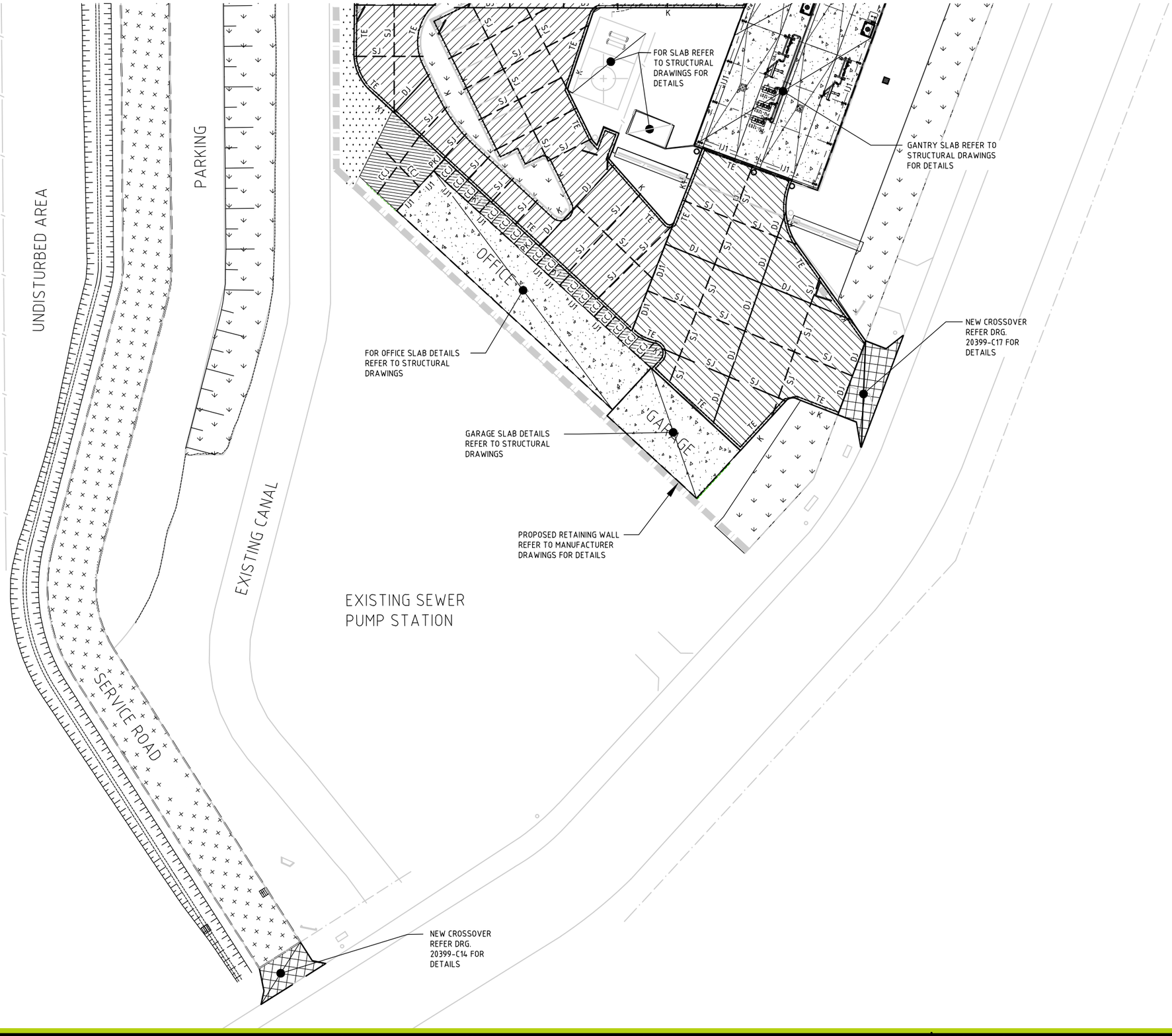
DRAWING TITLE:
SITE PAVEMENT PLAN
SHEET 1 OF 2

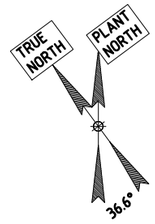
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DATE CREATED	ORIGINAL SCALE	SHEET
22.11.21	1:500	A3

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20399 - C11	A





LEGEND:

NOTE: REFER DRAWING C10 FOR PAVEMENT LEGEND AND AREAS

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Email: enquiry@tfa.com.au Web: www.TFA.com.au

REV	DATE	BY	DESCRIPTION	CHK	APP
A	22.11.21	DH	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS:
MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

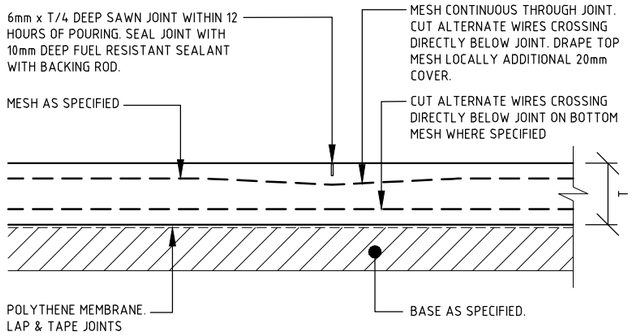
DRAWING TITLE:
SITE PAVEMENT PLAN
SHEET 2 OF 2

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
22.11.21	1:500	A3

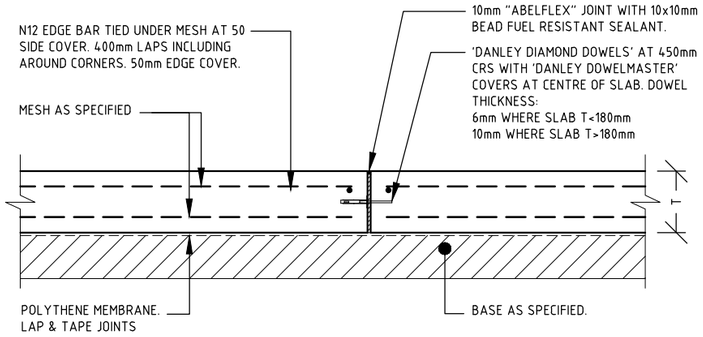
DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C12	A



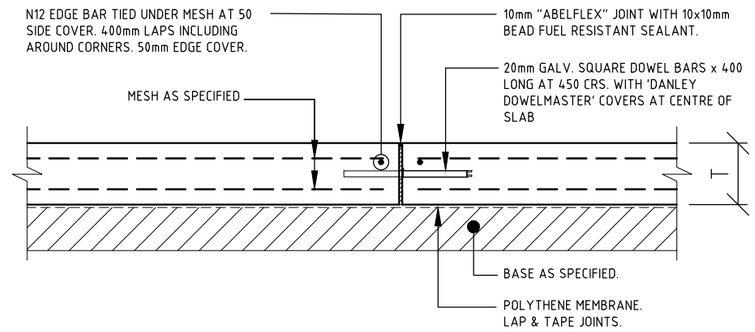
TYPICAL SAW JOINT (SJ)

SCALE 1 : 20



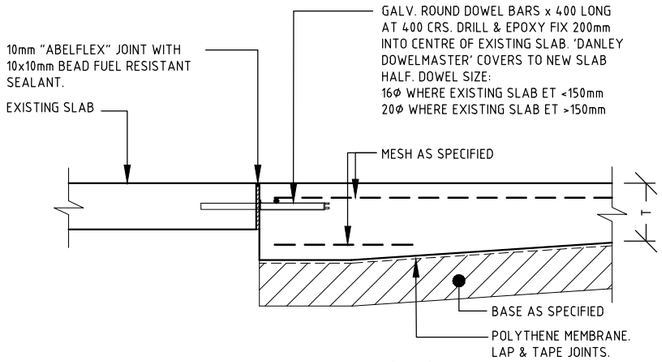
DOWEL JOINT (DJ)

SCALE 1 : 20



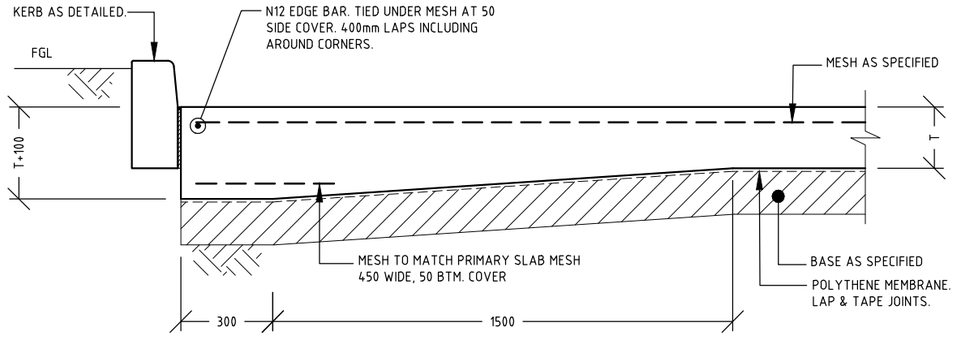
ALTERNATIVE DOWEL JOINT (DJ)

SCALE 1 : 20



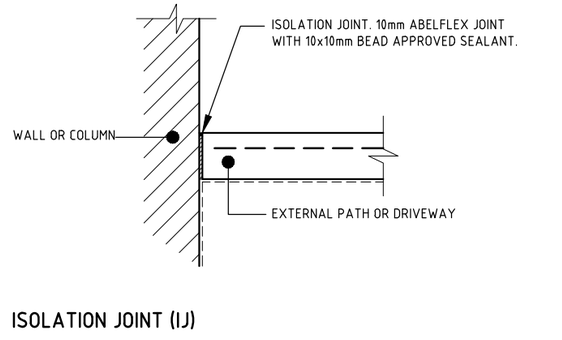
DOWEL JOINT (DJ3)

SCALE 1 : 20



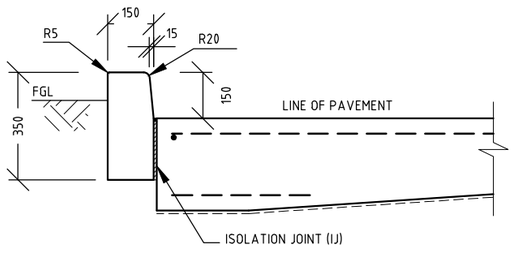
TYPICAL THICKENED EDGE (TE)

SCALE 1 : 20



ISOLATION JOINT (IJ)

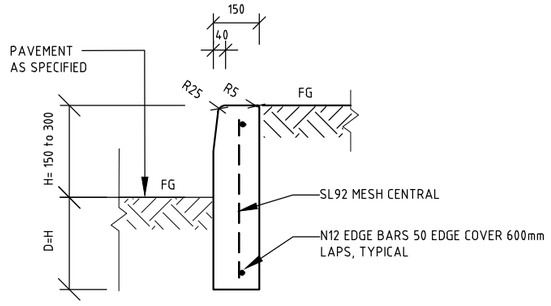
SCALE 1 : 20



BARRIER KERB DETAIL (K)

SCALE 1 : 20

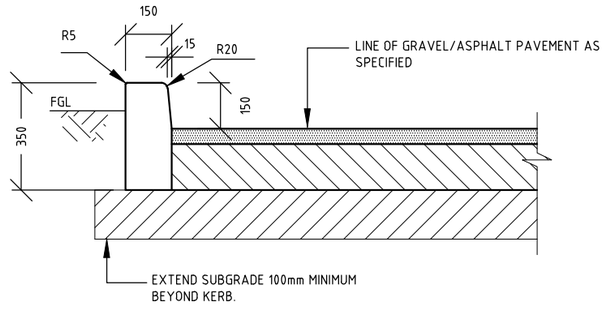
TENDER ONLY
NOT FOR CONSTRUCTION



BARRIER KERB DETAIL (K1)

PROVIDE JOINTS IN KERB TO MATCH JOINTS IN PAVEMENT

SCALE 1 : 20



BARRIER KERB DETAIL (K)

SCALE 1 : 20

200 0 500 1000mm

Millimetres

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A	19.11.2021	DH	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

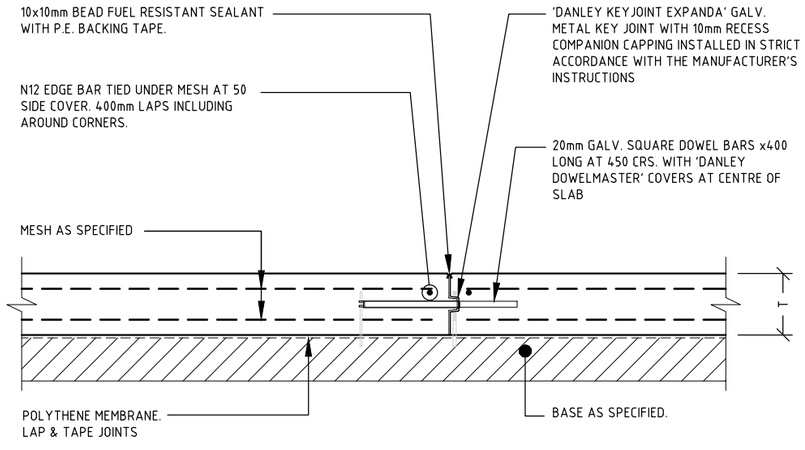
DRAWING TITLE: SITE PAVEMENT DETAILS
SHEET 1 OF 2

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
19.11.2021	1:20	A3

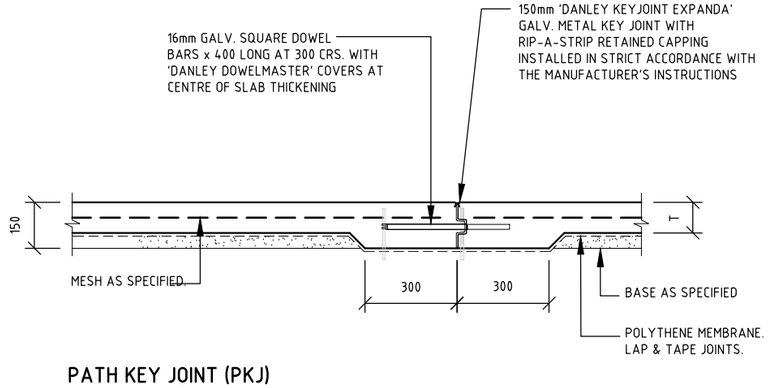
DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C13	A



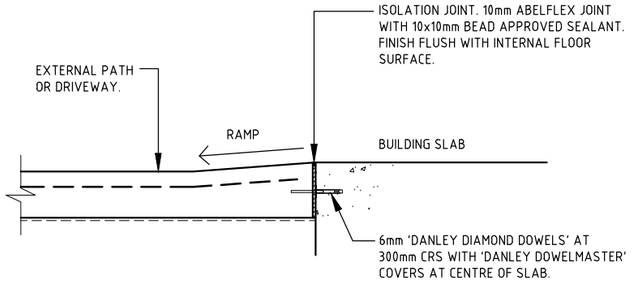
KEY JOINT (KJ)

SCALE 1 : 20



PATH KEY JOINT (PKJ)

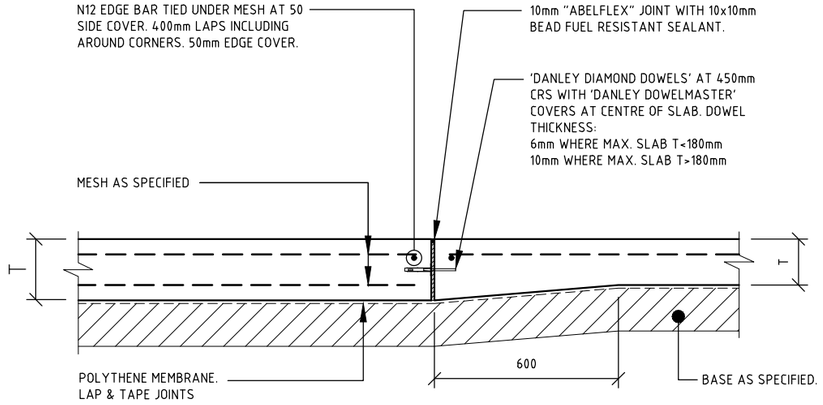
SCALE 1 : 20



ISOLATION JOINT (IJ1)

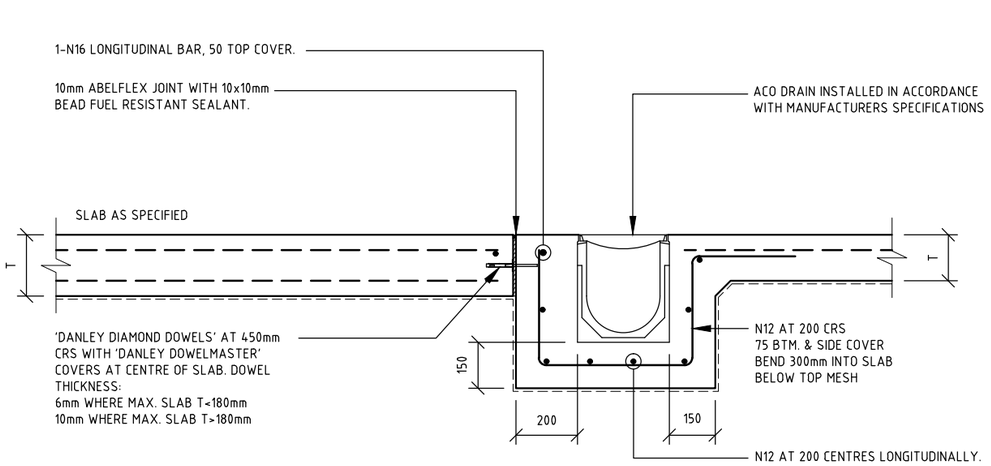
(AT DOORWAY ONLY)

SCALE 1 : 20



DOWEL JOINT (DJ1)

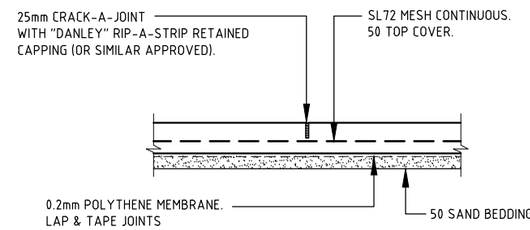
SCALE 1 : 20



DOWEL JOINT (DJ2)

ACO TRENCH DRAIN SECTION WITH DOWEL JOINT

SCALE 1 : 20



PATH CRACK CONTROL JOINT (CCJ)

SCALE 1 : 20

TENDER ONLY
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200 0 500 1000mm
Millimetres

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A	19.11.2021	DH	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

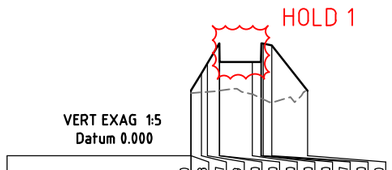
DRAWING TITLE: SITE PAVEMENT DETAILS SHEET 2 OF 2

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
19.11.2021	1:20	A3

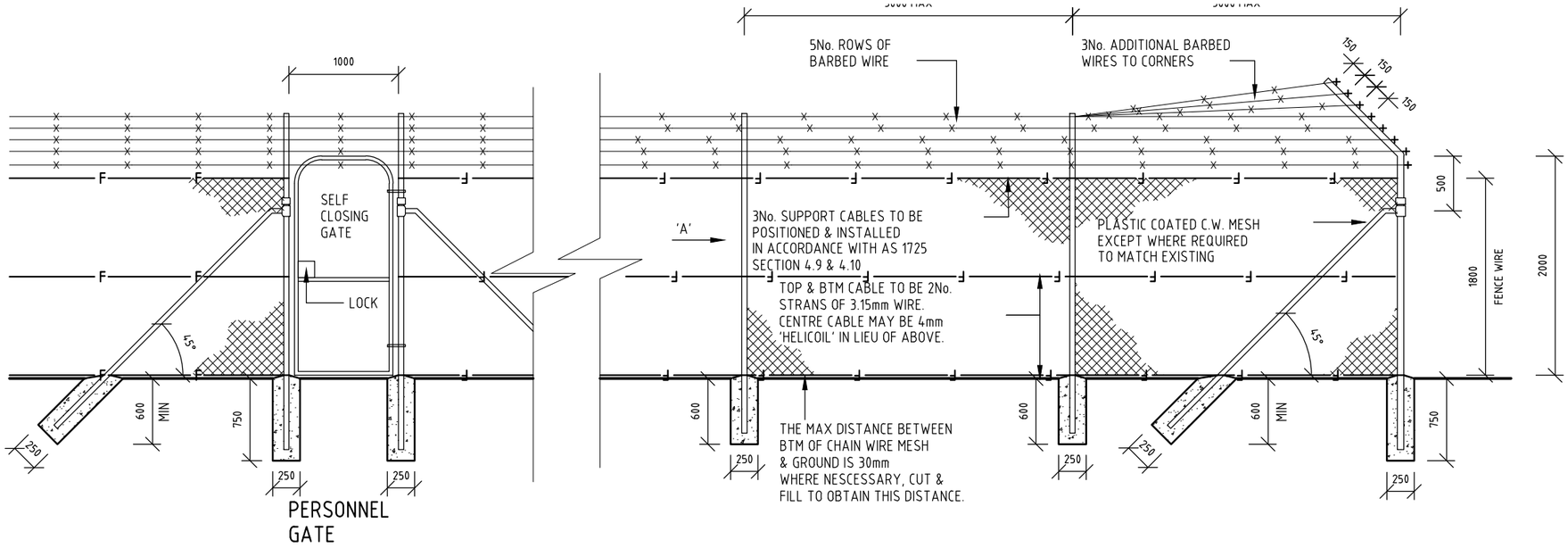
DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C14	A

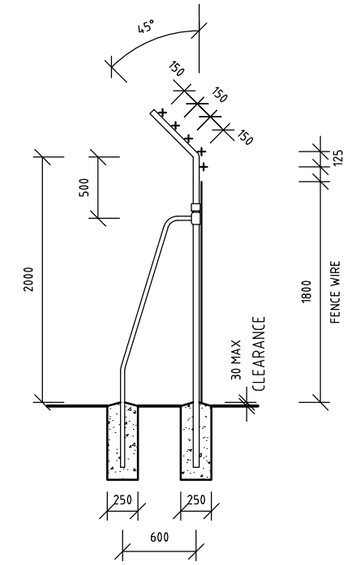


VERT EXAG 1:5
Datum 0.000

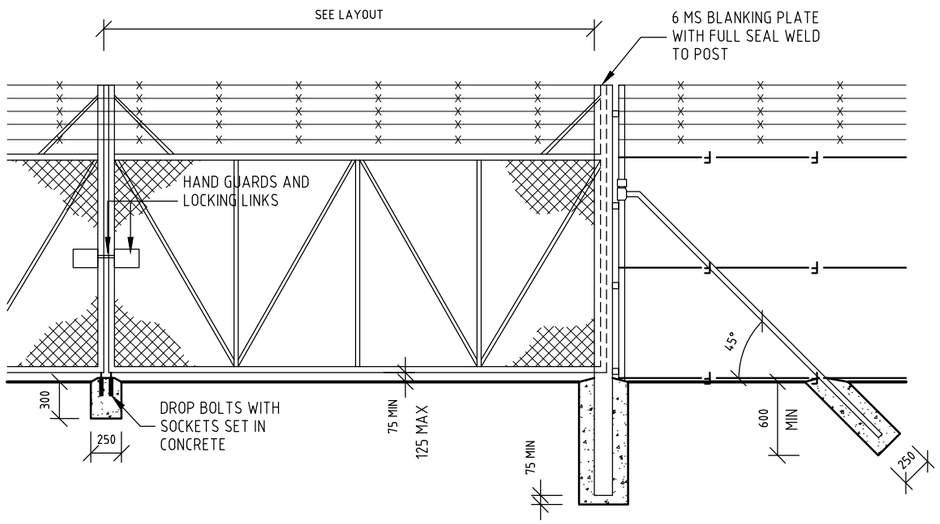
| | | |



CORNER AND INTERMEDIATE PANELS



VERTICAL BRACE
VIEW 'A'



LARGE GATES
INTERNAL & EMERGENCY ACCESS ONLY

NOTE:
PALISADE GATES WITH SPIKES (MAIN TRUCK ENTRY/EXIT)

GATES — GALVANISED MEDIUM WEIGHT PIPE

GATE OPENING	NOMINAL LEAF WIDTH	TYPE	OUTER FRAME TUBE	INNER FRAME TUBE	DIAGONAL BRACING		TOP DIAGONAL BRACING FOR WIRE	GATE POST	GATE POST FOOTING	
			N.B.	N.B.	O.D.	TYPE	N.B.	N.B.	N.B.	DEPTH
1000	1000		25	25	-		15	50	250	750
6000	3000		32	25	-		15	80	400	1000
6000 - 8000	3000 - 4000 A		32	25	25 x 5	GALV. CARB. STEEL FLAT	15	100	400	1000
8000 - 10000	4000 - 5000		40	25	26.9	2.6	15	150	400	1000
10000 - 12000	5000 - 6000		40	25	26.9	2.6	15	152 x 4.9 SHS	400	1000

FENCES — GALVANISED STEEL PIPE

CORNER POST	50 N.B. MEDIUM PIPE
INTERMEDIATE POST	40 N.B. LIGHT PIPE
DIAGONAL STAYS AND BRACES	32 N.B. LIGHT PIPE
VERTICAL BRACES	25 N.B. LIGHT PIPE

NOTES:
1. ALL FENCE COMPONENTS TO BE PAINTED BLACK
2. CHAIN WIRE TO BE BLACK PLASTIC COATED

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	17.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE: SECURITY FENCING DETAILS

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
17.11.2021	AS SHOWN	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C16	A

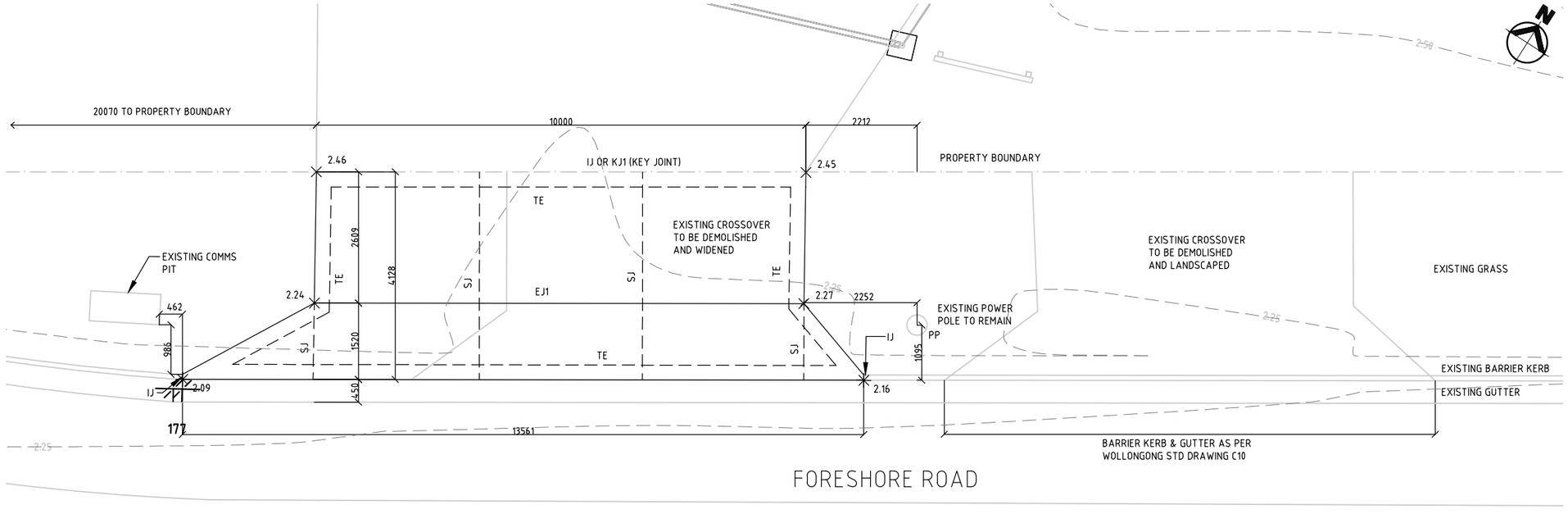
LEGEND:

- PROPERTY BOUNDARY
- EJ1 — EXPANSION JOINT
- SJ — SAW JOINT
- TE — THICKENED EDGE
- EXISTING CONTOURS (0.25m INTERVALS)
- IJ — ISOLATION JOINT
- PP — EXISTING POWER POLE
- 3.33 — PROPOSED SPOT HEIGHT (mAHD)
- 3.33 — EXISTING SPOT HEIGHT (mAHD)

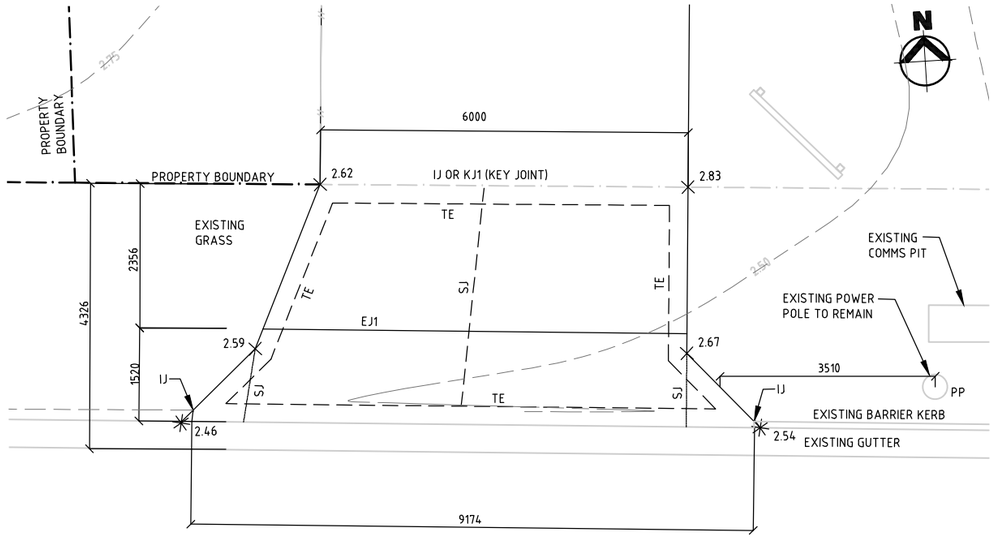
FOR PAVEMENT DRAWING DETAILS REFER WOLLONGONG CITY COUNCIL ENGINEERING STANDARD DRAWINGS

CONCRETE CROSSOVERS SHALL BE 200mm THICK CONCRETE N32 CONCRETE WITH SL92 MESH AT 40 TOP COVER OVER 0.2mm POLYMER OVER CBR 45 SUBBASE (DGB20)

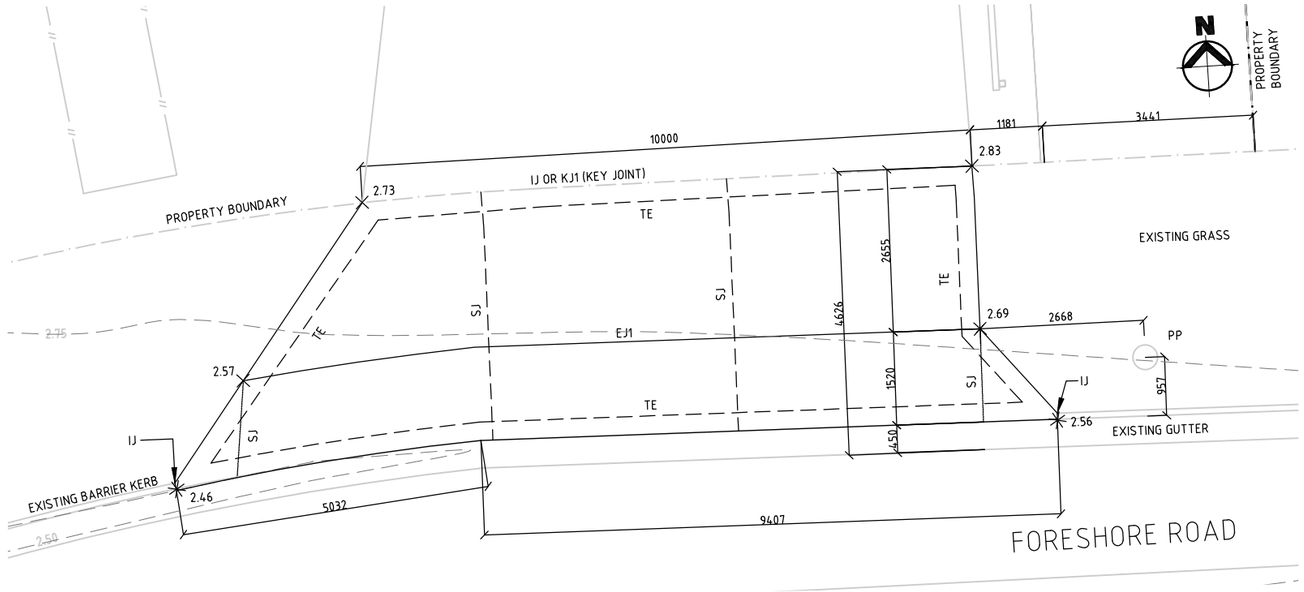
TENDER ONLY
NOT FOR CONSTRUCTION



WESTERN CROSSOVER DETAIL
SCALE 1:100



SERVICE ROAD CROSSOVER DETAIL
SCALE 1:100



EASTERN CROSSOVER DETAIL
SCALE 1:100

1 0 1 2 3 4 5m
Metres

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	19.11.2021	LS	ISSUED FOR TENDER		

PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

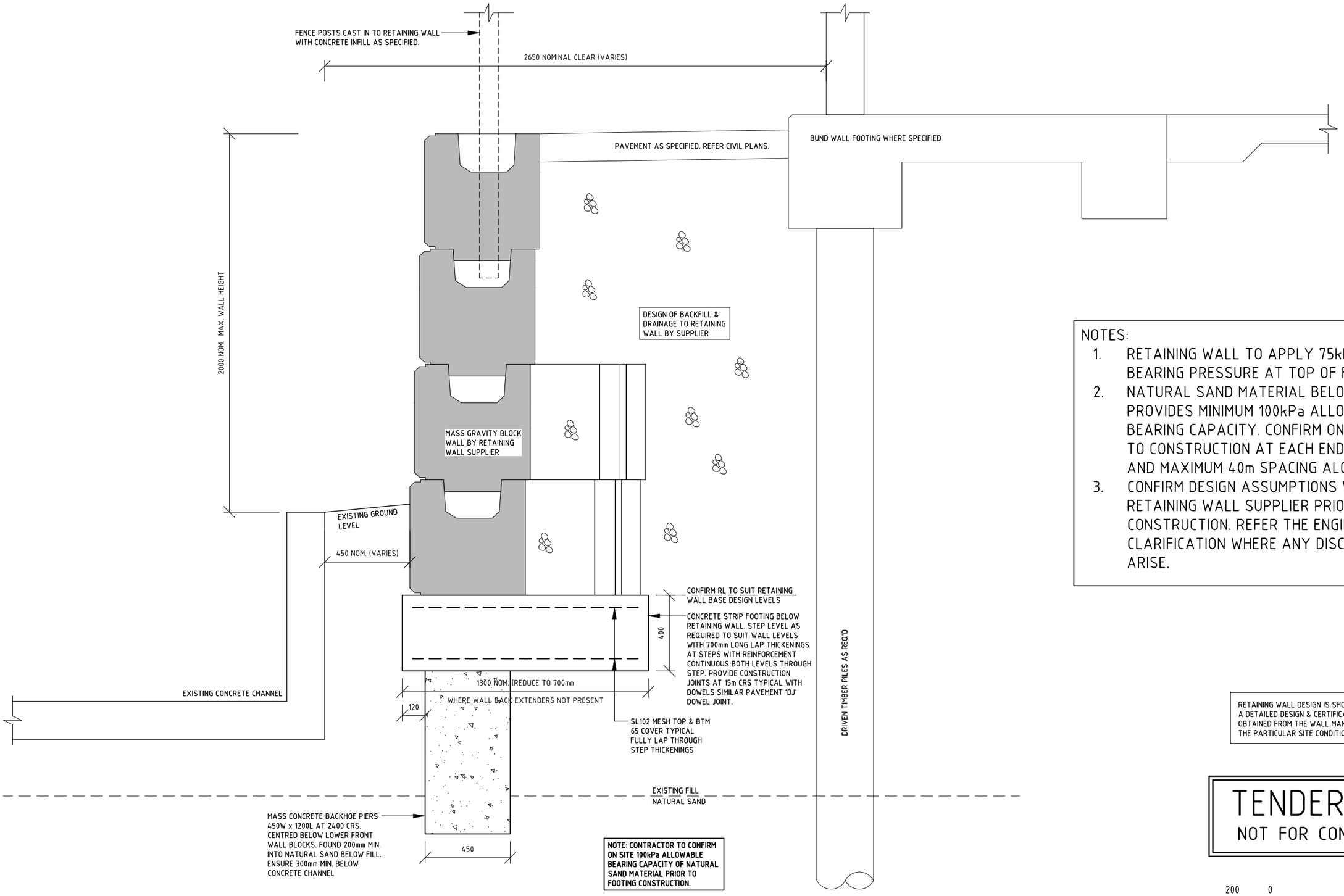
DRAWING TITLE: PROPOSED DRIVEWAY CROSSOVER PLAN

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
19.11.2021	1:100	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C17	A



NOTES:

1. RETAINING WALL TO APPLY 75kPa MAXIMUM BEARING PRESSURE AT TOP OF FOOTING.
2. NATURAL SAND MATERIAL BELOW FILL PROVIDES MINIMUM 100kPa ALLOWABLE BEARING CAPACITY. CONFIRM ON SITE PRIOR TO CONSTRUCTION AT EACH END OF WALLS AND MAXIMUM 40m SPACING ALONG WALLS.
3. CONFIRM DESIGN ASSUMPTIONS WITH RETAINING WALL SUPPLIER PRIOR TO CONSTRUCTION. REFER THE ENGINEER FOR CLARIFICATION WHERE ANY DISCREPANCIES ARISE.

RETAINING WALL DESIGN IS SHOWN NOMINALLY ONLY. A DETAILED DESIGN & CERTIFICATION SHALL BE OBTAINED FROM THE WALL MANUFACTURER TO SUIT THE PARTICULAR SITE CONDITIONS

TENDER ONLY
NOT FOR CONSTRUCTION

200 0 500 1000mm
Millimetres

NOMINAL GRAVITY RETAINING WALL SECTION

EASTERN AND WESTERN WALLS SIMILAR
SCALE 1:20

REV	DATE	BY	DESCRIPTION	CHK	APP
A	15.11.21	JT	ISSUED FOR TENDER	JA	JT

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PROJECT CLIENT: MANILDRA GROUP 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

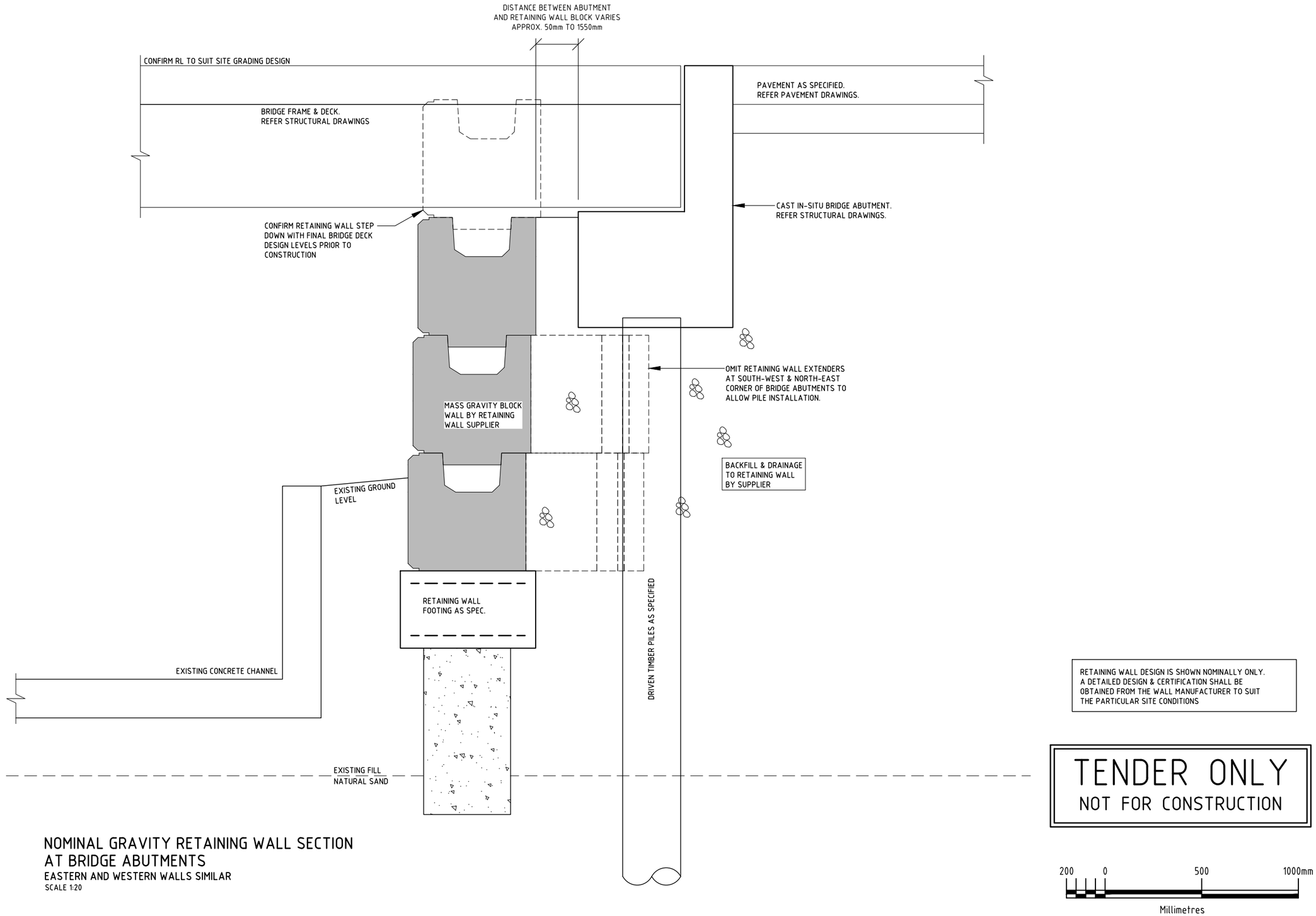
DRAWING TITLE: RETAINING WALL DETAILS SHEET 2

STATUS: TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
04.11.2021	1:20	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C20	A



NOMINAL GRAVITY RETAINING WALL SECTION
AT BRIDGE ABUTMENTS
EASTERN AND WESTERN WALLS SIMILAR
SCALE 1:20

RETAINING WALL DESIGN IS SHOWN NOMINALLY ONLY.
A DETAILED DESIGN & CERTIFICATION SHALL BE
OBTAINED FROM THE WALL MANUFACTURER TO SUIT
THE PARTICULAR SITE CONDITIONS

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200 0 500 1000mm
Millimetres

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PROJECT CLIENT
MANILDRA GROUP
100% AUSTRALIAN OWNED

PROJECT DETAILS
MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

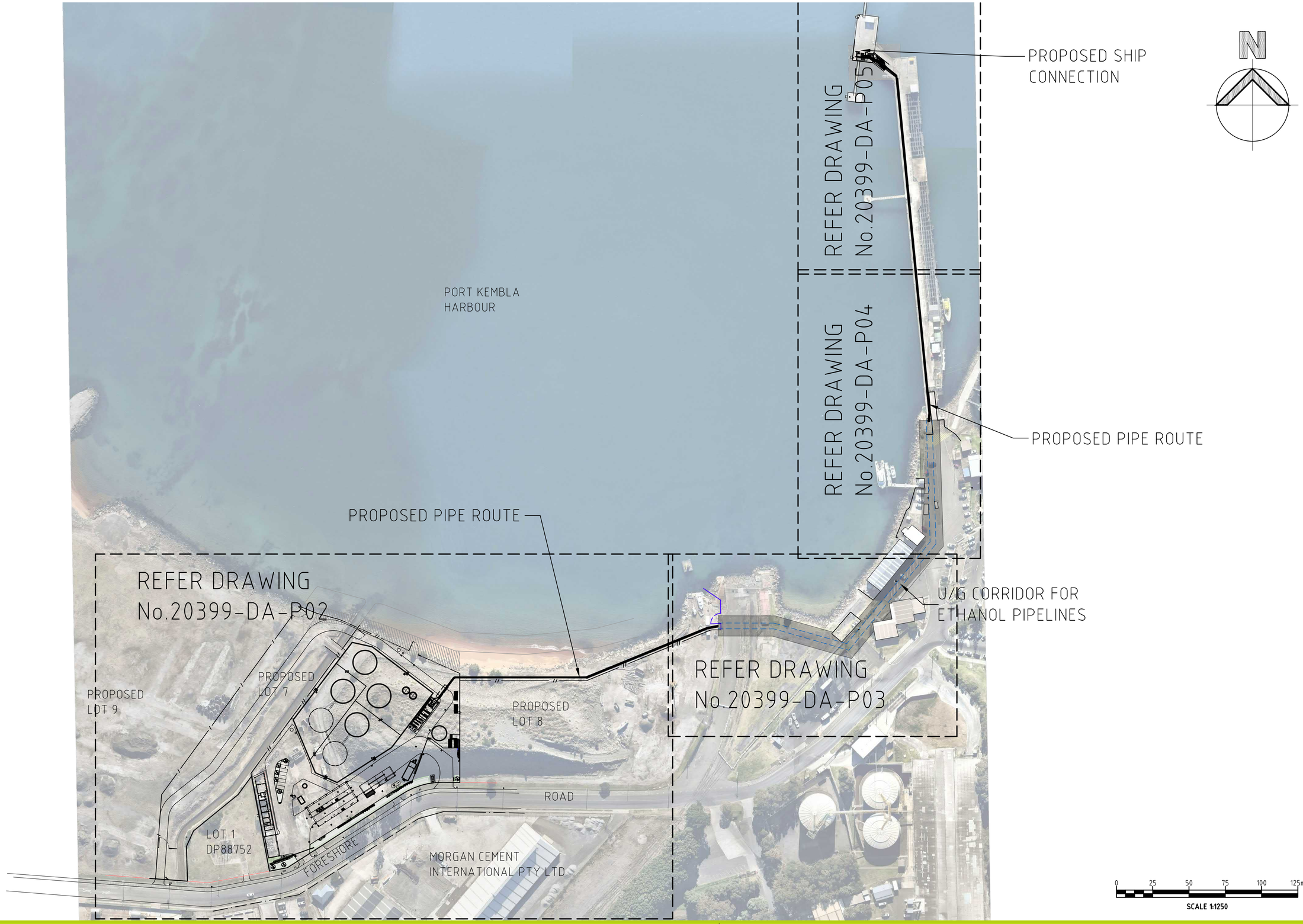
DRAWING TITLE
RETAINING WALL DETAILS
SHEET 2

STATUS
TENDER

DATE CREATED	ORIGINAL SCALE	SHEET
04.11.2021	1:20	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-C21	A



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REV	DATE	BY	DESCRIPTION	CHK	APP
H	10.08.22	HE	REVISED ROUTE DETAILS	BV	BP
B	12.07.21	LCC	PRELIMINARY ISSUE		
C	26.07.21	LCC	PRELIMINARY ISSUE		
D	29.07.21	LCC	APPROVAL		
E	20.08.21	LCC	D.A. ISSUE	BV	BP
F	14.10.21	CC	RE-ISSUE FOR D.A.	BV	BP
G	03.11.21	LCN	REVISED FOR U/G ROUTE FOR D.A.	BV	BP

PROJECT CLIENT

MANILDRA GROUP
100% AUSTRALIAN OWNED

PROJECT DETAILS

MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

PROPOSED PIPELINE ROUTE AND KEY PLAN

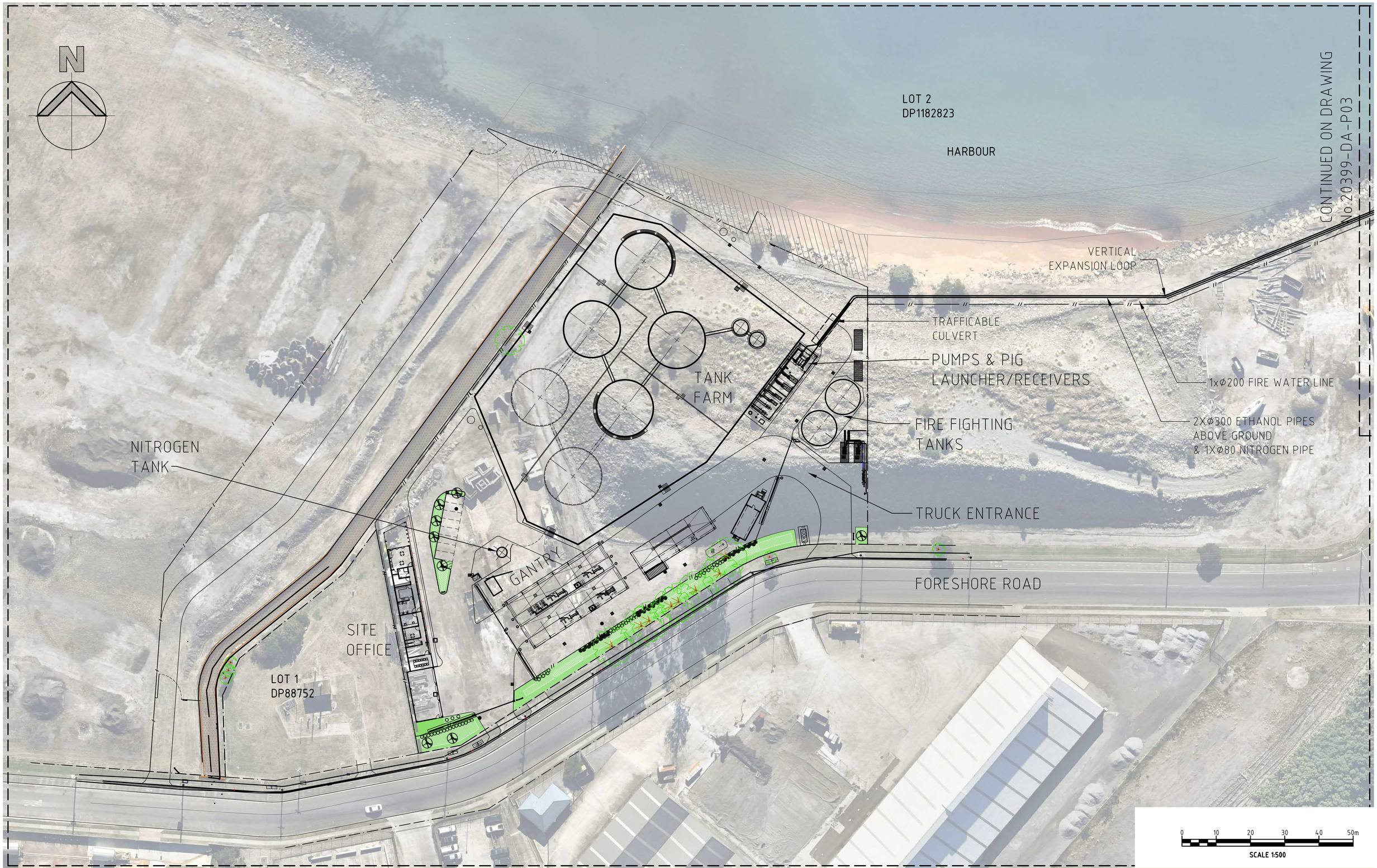
STATUS

D.A. ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
24.06.21	1:1250	A1

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DRAWING NO	REV
20399-DA-P01	H



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A	24.06.21	LCC	PRELIMINARY ISSUE		
B	26.07.21	LCC	PRELIMINARY ISSUE		
C	29.07.21	LCC	APPROVAL		
D	20.08.21	LCC	D.A. ISSUE	BV	BP
E	14.10.21	CC	RE-ISSUE FOR D.A.	BV	BP
F	10.03.22	HE	REVISED ROUTE DETAILS	BV	BP

PROJECT CLIENT

MANILDRA GROUP
100% AUSTRALIAN OWNED

PROJECT DETAILS

MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

PROPOSED SITE OPERATIONS

STATUS

D.A. ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
24.06.21	1:500	A1

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DRAWING NO	REV
20399-DA-P02	F



0 5 10 15 20 25m

SCALE 1:250

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

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G	03.11.21	LCN	REVISED TO U/G ROUTE FOR D.A.	BV	BP

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PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

PROPOSED SITE ROUTE
SHEET 1

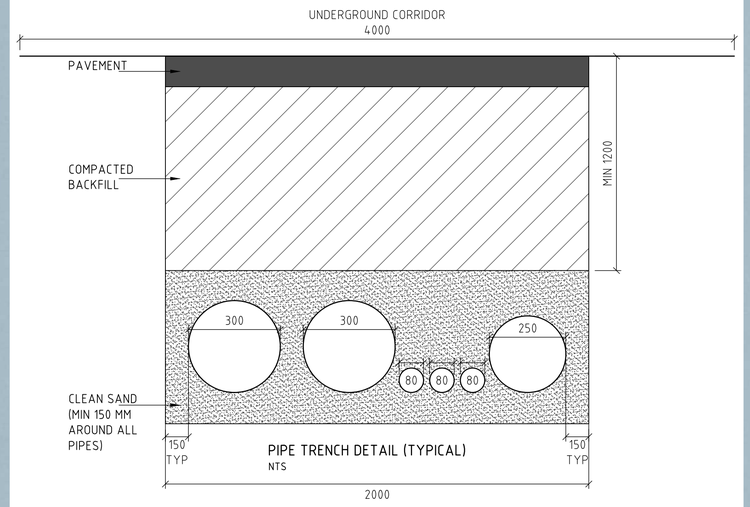
STATUS

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20399-DA-P03	H



PIPE TRENCH DETAIL (TYPICAL)
NTS

CONTINUED ON DRAWING No.20399-DA-P03

CONTINUED ON DRAWING No.20399-DA-P05

N

EXISTING CHAIN WIRE FENCE

PP

2xΦ300 PIPES ABOVE WHARF

ISOLATION SHORE VALVES & INSULATING FLANGES

VERTICAL EXPANSION LOOPS ALONG BERTH TYPICALLY EVERY 100m

WHARF

U/G CORRIDOR FOR ETHANOL PIPELINES 4m WIDE (2xΦ300 PIPES, 1xΦ80 NITROGEN PIPE, 1xΦ250 FIRE WATER & 2xΦ80 CONDUITS)

CONSTRUCTION ACCESS ZONE (TYP. 6M FROM TRENCH)

EXISTING CHAIN WIRE FENCE

Φ200 FIRE WATER LINE

HARBOUR BREAKWATER WALL

0 5 10 15 20 25m

SCALE 1:250

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PROJECT DETAILS

MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

PROPOSED SITE ROUTE
SHEET 2

STATUS

D.A. ISSUE

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20399-DA-P04	H

CONTINUED ON DRAWING No.20399-DA-P04

N

PROPOSED SHIPS
CONNECTION POINT

2xØ300 ETHANOL
PIPES ABOVE
WHARF

PROPOSED PIPING
PIG STATION

VERTICAL EXPANSION
LOOPS ALONG BERTH
TYPICALLY EVERY 100m

WHARF

Ø200 FIRE WATER LINE

0 5 10 15 20 25m

SCALE 1:250

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

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MANILDRA GROUP
100% AUSTRALIAN OWNED

PROJECT DETAILS

MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

PROPOSED SITE ROUTE
SHEET 3

STATUS

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Appendix E. Dewatering factsheet

WaterNSW (2020) Fact Sheet, Water access licence exemption for aquifer interference activities taking 3ML or less groundwater per year, ref 250920, accessed 1 November 2021, URL Construction dewatering - WaterNSW

Fact sheet

Water access licence exemption

for aquifer interference activities taking 3ML or less of groundwater per year

In December 2019 the NSW government introduced an exemption in the Water Management (General) Regulation 2018 that allows a small volume of groundwater to be taken through certain aquifer interference activities without the need for a water access licence.

Exemption from needing a water access licence

Under the exemption, a person can take up to 3 megalitres of groundwater through an aquifer interference activity per authorised project per water year without needing to obtain a water access licence, provided:

a) the water is not taken primarily for consumption or supply; and
b) the person claiming the exemption keeps a record of the water taken under the exemption and provides this to the Minister within 28 days of the end of the water year; and
c) the records are kept for 5 years.

Examples of aquifer interference activities to which the exemption may apply include:

- quarrying, excavating, dredging or exploring for stone, aggregate, sand or gravel;
- exploring for minerals, (including coal) or petroleum;
- excavation to construct or maintain a building, road or infrastructure;
- remediation of groundwater contamination;
- conducting pumping tests to investigate bore capacity or groundwater system characteristics;
- sampling for water quality from monitoring bores;
- ongoing dewatering of basements;
- creation of an artificial lake that intersects with groundwater and allows evaporation from it;
- investigation of groundwater resources or geotechnical investigation;
- operation of ground source heating or cooling systems.

The exemption provides a consistent, volume-based approach for the take of small volumes of groundwater and reduces red tape, delays and costs for businesses undertaking these aquifer interference activities.

Three megalitres per year is similar to the volume taken by landholders in accordance with domestic and stock rights held under section 52 of the *Water Management Act 2000*, for which a water access licence is not required to be held.

For mining and petroleum (including coal seam gas) activities, the exemption only applies to groundwater taken at the exploration stage. It does not apply to water taken during the production stage of mining and petroleum activities.

Fact sheet

Water access licence exemption

for aquifer interference activities taking 3ML or less of groundwater per year

Claiming the exemption

The exemption only applies where groundwater is taken incidentally so that the aquifer interference activity can occur. That is, the purpose of taking the water must not be for its consumption or supply. The groundwater taken may subsequently be used for other purposes, for example for dust suppression or mixing concrete.

No application is needed to rely on the exemption, however proponents must record the water taken under the exemption on the approved recording and reporting form at the end of each period of take no later than 24 hours after the water is taken, for each water year in which an exemption is claimed. The form must be provided to the Minister's representative within 28 days of the end of the water year in which the water was taken.

Proponents must record the following information:

- The total amount of groundwater taken per year per authorised project under the exemption.
- The date or dates on which the groundwater was taken.
- A description of the method used to measure the volume of groundwater taken.
- The groundwater source from which the water was taken.
- The authority under which the water is being taken, for example water supply work approval, licence under the *Water Act 1912*, development consent, complying development or an approval exemption under legislation.
- The details of the person taking water.
- A description of the activity taking water.
- The location of the activity taking water.

Proponents of activities should check whether an approval and an assessment of impacts are required to carry out the activity regardless of whether this water access licence exemption applies.

More information

See FAQs for this exemption.

If you have any questions, please contact one of our friendly Customer Service team on 1300 662 077 or email Customer.Helpdesk@waternsw.com.au

[1] ***Authorised project*** *is defined in clause 7(5) of Schedule 4 to the Water Management (General) Regulation 2018, being an activity –*

a) that is the subject of a consent, approval or other lawful authority conferred by or under an Act, or

b) to which Division 5.1 of the Environmental Planning and Assessment Act 1979 applies, or

c) that is exempt development under that Act.

SMEC

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