Department of Planning, Housing and Infrastructure

Our ref: SSI-9471-PA-118

Alexandra Lovell
HSE Manager
Australian Industrial Energy

13/2/24

Subject: Emplacement Cell Report for Port Kembla Gas Terminal (SSI-9471)

Dear Ms. Lovell

I refer to your submission requesting review and approval of the revised Emplacement Cell Report for the Port Kembla Gas Terminal.

The major revision to the Emplacement Cell Report includes the use of Jet Grout Spoil as a capping material for the Emplacement Cell.

I note, in addition to the revised Emplacement Cell Report, the following documents have been submitted for review:

- GHD Technical Memorandum - Jet Grout Spoil – Use as capping for Emplacement Cell (29 January 2024)
- Senversa Letter Report - Interim Audit Advice #40 – Updated Emplacement Cell Report (Rev 11) and Jet Grout Spoil Technical Memorandum (2 February 2024)
- SMEC Geotechnical Memorandum - Jet Grout Spoil: Erodibility Assessment3 (1 January 2024)
- EPA Email– Port Kembla Gas Terminal – Emplacement Cell Report Rev 11 (13 February 2024)

The Department has carefully reviewed the document and is satisfied that it meets the requirements under SSI 9471 Schedule 3, Condition 9. Accordingly, as nominee of the Planning Secretary, I approve the Emplacement Cell Report (Rev 11, dated 29 January 2024).

Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 3406.

Yours sincerely

Stephen O'Donoghue
Director Resource Assessments
As nominee of the Planning Secretary

SMEC
Member of the Surbana Jurong Group

SMEC INTERNAL REF. 30013105

Port Kembla Gas Terminal Development

Port Kembla Gas Terminal Development – Emplacement Cell Report

Client Reference No. PKGT-SMC-OHC-GEO-RPT-0005 REV11

Prepared for Australian Industrial Energy

29/01/2024

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Revision No.	Date	Prepared By	Reviewed By	Approved for Issue By
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		Harshan Panchalingam		
10	04/7/2023	Geoffroi Renaud-Roy Anthony Folan Harshan Panchalingam	Paran Moyes Richard Kelly	Paran Moyes Richard Kelly
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SMEC Company Details

Approved by	Paran Moyes and Richard Kelly		
Address	Level 2, 6-8 Regent Street, Wollongong NSW 2500		
Telephone	+61 2 4243 4402	**Website**	www.smec.com
Email	Paran.Moyes@smec.com		
Signature	 pp		

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This report is confidential and is provided solely for the purposes of the Port Kembla Gas Terminal Development - Emplacement Cell Design. This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited ("SMEC") and Australian Industrial Energy, (AIE) under which SMEC undertook to perform a specific and limited task for AIE. 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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Executive Summary

Australian Industrial Energy (AIE) intends to develop a Gas Terminal at Berth 101 of Port Kembla, NSW. The infrastructure approval for this project was granted by the NSW Government on 24 April 2019 and has been declared Critical State Significant Infrastructure (CSSI) by the NSW Government. The works include removal of the existing berth structures at Berth 101 and dredging of a new berth pocket. The dredge materials are to be relocated to the Outer Harbour at Port Kembla.

SMEC has been engaged to provide site investigation services and concept and detailed design for the proposed emplacement cell at the Outer Harbour to receive the Berth 101 dredge materials. The Emplacement Cell works will be designed and constructed in accordance with the Development Approval, relevant statutory approvals, the Minimum Design Requirements and relevant Australian and International Standards. The emplacement cell will be designed as a spoil disposal area, not to be used for any other purpose, with no structures or industrial activity on the bund or cell.

At the time of the revision of this report, the emplacement cell construction has already commenced with the combined land-based excavation and dredging at Berth 101 at approximately 60% of completion. Analysis of the weekly dredging records during construction indicate that the anticipated bulking of the dredged material did not eventuate. This will result in a volume shortage of the dredging material generated at Berth 101. The shortage of material leads to a revised Emplacement Cell design to accommodate the reduced volumes of material.

This Emplacement Cell Report (ECR) has been prepared as a revision to the original ECR (SMEC's ECR PKGT-SMEC-OHC-CIV-ECR-002.Rev08, dated 16 June 2022) and is updated only to address the reduced emplacement cell footprint which will be referred herein as the Full Eastern Cell (FEC).

The emplacement cell will be designed and constructed to receive approximately 450,000m^3 of material which will be predominantly transported by barge to the Outer Harbour. Dredge materials include sand and gravel fill, estuarine sands, very soft to hard clays, contaminated harbour silts and muds, acid sulfate and potential acid sulfate soils, rock armour and a small volume of rock.

The emplacement cell comprises approximately 715 m of main perimeter bund and associated emplacement; and 340m of creek channel diversion to extend the existing Darcy Road outlet to the east perimeter of the bund. The bund will also be provided with a rock armour revetment structure extending to the toe of the main bund to provide protection to the bund structure against the coastal processes.

As for previous revision of the Emplacement Cell Report (ECR), this revision has been prepared by suitability qualified and experienced experts approved by the Planning Secretary; includes details of the emplacement cell design and construction methodology; and demonstrates how the design achieves the performance objectives specified in the approval conditions.

This ECR describes how relevant approval conditions are addressed in the emplacement cell design based on the outcomes of the 100% detailed design and includes assessment of bulked dredge volumes and cell capacity. Detailed design of the Emplacement Cell has been undertaken in accordance with the Minimum Design Requirements outlined in the Agreement for Lease between NSW Ports and AIE. The detailed design including revetment design, flooding and drainage assessment and geotechnical design of the cell is documented in separate design reports which are provided as appendices to the ECR.

Input from Heron Construction (Heron) has been provided during the detailed design, as part of an Early Contractor Involvement (ECI) process, to inform the design and develop the construction staging for the works. Heron have also provided inputs on construction methodology, and contingency measures in the event of a failure or deficiency during construction.

Revised bulking factors based on observations during construction are represented within this report as the 'Base Case'. A sensitivity analysis on these bulking factors has been included in this report, referred to as the 'Critical Case' analysis. They indicate that the FEC will be able to accommodate all materials within the above criteria. As such, the revised ECR provides information on the additional material from other sources which will be utilised if required.

The result of the volumetric assessment is that the Emplacement Cell can accommodate all dredge materials from Berth 101, including achieving the key objective of all ASS and contaminated materials below a level of +0.9m PKHD within the cell, so that these materials do not dry out. These materials will then be capped with a minimum 1m layer of sands, which are also being won from the Berth 101 dredging.

A key input into the volumetric assessment is the extent that the Berth 101 'bank' volumes are 'bulked' during the dredging process, hence input has been sought from industry experts in order to best assess these bulking factors. The resulting bulking factors are represented within this report as the 'Base Case'.

A further sensitivity analysis on these bulking factors has been included in this report, referred to as the 'Critical Case' analysis. Even for the 'Critical Case' bulking factors, it is expected that supplementary fill sources will be required to achieve the target finished surface levels. Suitable sources have been identified and are discussed in more detail within this report.

1 Introduction

1.1 Project Background

Australian Industrial Energy (AIE) intends to develop a Gas Terminal at Berth 101 of Port Kembla, New South Wales (NSW). The Infrastructure Approval for this project (application no. SSI 9471) was granted by the NSW Government on 24 April 2019. The project has been declared Critical State Significant Infrastructure (CSSI) by the NSW Government. The project's proposed scope of works includes:

- Dredging adjacent to the Existing Wharf (Berth 101) in the Inner Harbour
- Construction of an Emplacement Cell in the Outer Harbour Disposal Area

AIE has engaged SMEC to undertake the design of the proposed Emplacement Cell which was designed to accommodate material from dredging works during construction of the new quay wall at Berth 101. Based on AIE's Schedule 5, and consistent with the Project Environmental Impact Statement, the Emplacement Cell was designed and constructed to receive spoil from the dredging of sediments at Berth 101 and the emplacement cell footprint with no other use considered in its design.

During construction, there was a significant variation in the placed volume of material in the cell versus the design volumes. AIE has engaged SMEC to design a revised Emplacement Cell footprint referred to as the Full Eastern Cell (FEC). The FEC has a reduced footprint compared to the original Emplacement Cell design. This Revision 9 of the Emplacement Cell Report (ECR) addresses only the changes associated with the reduced cell footprint design and alternate construction methodology for the bund.

1.2 Purpose of this Report

The Infrastructure Approval [application no SSI 9471] issued for the "Port Kembla Gas Terminal" Project requires, an Emplacement Cell Report to be in place prior to the commencement of dredging, disposal and emplacement activities.

This document is to satisfy the requirement of an Emplacement Cell Report of the Infrastructure Approval [application no SSI 9471] Schedule 3, Condition 8 and Schedule 3, Condition 9(a), 9(b), 9(c), 9(d), 9(e) and 9(f) with regard to the emplacement cell.

The Emplacement Cell Report has been prepared by suitability qualified and experienced experts approved by the Planning Secretary, includes details of the emplacement cell design and construction methodology, and demonstrates how the design achieves the performance objectives specified in the approval conditions.

The design and construction methodology detailed in this document provides information which will assist AIE and the Emplacement Cell construction contractor meet their obligations under the Protection of Environment Obligation Act 1997 (including Section 120). Relevant details include the requirements for controls such as the installation of silt curtains and ongoing environmental monitoring.

1.3 Scope of this Report

The scope of this report includes the following:

- Overview of Port Kembla Gas Terminal Infrastructure Approval Conditions 8 & 9 from Schedule 3
- Site background including:
  - Outer Harbour site history
  - Geotechnical background
- Emplacement Cell design considerations including:
  - Physical containment of Acid Sulfate soils and contaminated sediment considerations
  - Civil design
  - Geotechnical design

  - Revetment design
  - Flooding and drainage design
- Cell capacity considerations Including:
  - Dredge volumes and material types
  - Bulking factors
  - System losses
  - Cell volumes
- Contractors proposed construction methodology
- Contingency Measures
- Environmental controls
- Instrumentation and monitoring

The detailed design for the Emplacement Cell is documented in the Detailed Design Report, Stormwater Channel Report and Supplementary Design Report which are provided in Appendix D, Appendix F and Appendix H respectively, and include the following:

- Civil design
- Geotechnical design including:
  - Geotechnical interpretation, model and design parameters
  - Perimeter bund global stability analysis
  - Perimeter bund vertical settlement assessment
  - Perimeter bund crest working platform assessment
  - Perimeter bund crest local stability assessment
  - Emplacement cell settlement assessment
  - Stormwater channel settlement assessment
  - Stormwater channel stability assessment
  - Stormwater channel outlet design
- Rock revetment design including:
  - Armourstone design
  - Crest and toe design
- Stormwater channel design including:
  - Flood modelling
  - Scour protection
  - Connection to existing stormwater drain
  - Summary of channel design parameters

1.4 Documents to be Read in Conjunction with this Report

This report has been developed in parallel with a number of other documents as part of the Port Kembla Emplacement Cell Design. This report should be read in conjunction with the reports presented in Table 1-1 below.

Table 1-1 : Available Geotechnical Reports

Document Name	Document Number	Revision	Date
SMEC Basis of Design Report	PKGT-SMC-OHC-GEO-RPT-004	Rev03	17/12/2021
SMEC Detailed Design Report	PKGT-SMC-OHC-CIV-RPT-003	Rev04	4/2/2022
SMEC Supplementary Design Report	PKGT-SMC-OHC-CIV-RPT-011	Rev02	28/06/2023
SMEC Stormwater Channel Design Report	PKGT-SMC-OHC-CIV-RPT-002	Rev03	24/09/2021
SMEC Geotechnical Investigation Report	PKGT-SMC-OHC-GEO-RPT-008	Rev01	01/10/2021

1.5 Site Location and Layout

The proposed Emplacement Cell is located on the southern bank within the Port Kembla Outer Harbour. A plan of the site layout is presented in Figure 1-1 below. The layout of the Emplacement Cell includes emerged fill areas, perimeter bund and stormwater drain extension as shown in Figure 1-2 below. The final Emplacement Cell design footprint has excluded use of the available submerged cell due to various factors, including its limited benefit to storage volumes.

Figure 1-1 Plan view of Site Layout. Extract from Basis of Design Outer Harbour Report

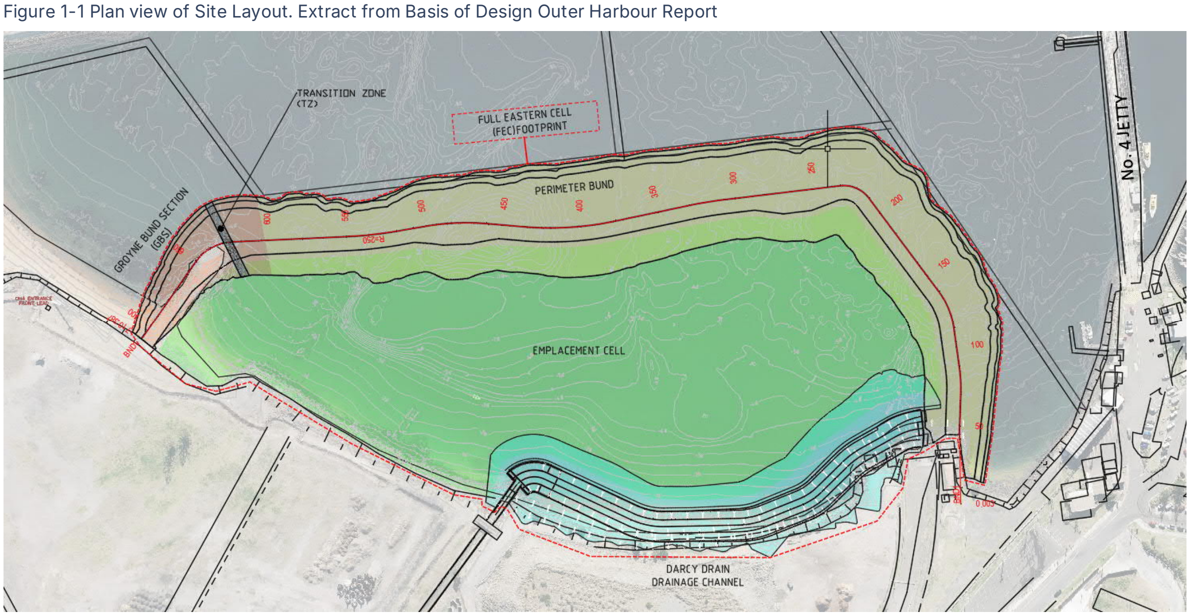


Figure 1-2 Plan View of Emplacement Cell

1.6 Terms and Abbreviations

The following terms and abbreviations are referred to throughout the report.

Term/Abbreviation	Description
AFL	Agreement for Lease
ANC	Acid Neutralising Capacity
ASS	Acid Sulfate Soils
BoD	Basis of Design Report
CPT	Cone Penetration Test
DDR	Detailed Design Report
DSGR	Designers Site Geotechnical Representative
ECR	Emplacement Cell Report
EMP	Environmental Management Plans
EMS	Environmental Management Strategy
EPL	Environmental Protection Licence
GIR	Geotechnical Investigation Report
HAT	Highest Astronomical Tide (2.1m PKHD)
IFC	Issued For Construction
IPA	Illawarra Ports Authority
LAT	Lowest Astronomical Tide (0m PKHD)
LNG	Liquid Natural Gas
MDR	Minimum Design Requirements
MSL	Mean Sea Level
PANSW	Port Authority of New South Wales
PCS	Post Construction Settlement
PKHD	Port Kembla Harbour Datum
SCR	Stormwater Channel Report
SMP	Spoil Management Plan
SMEC	SMEC Australia
WQMP	Water Quality Management Plan

2 Infrastructure Approval Conditions

As described earlier, this document is to satisfy the requirement of an Emplacement Cell Report of the Infrastructure Approval [application no SSI 9471] Schedule 3, Condition 8 and Schedule 3, Condition 9(a), 9(b), 9(c), 9(d), 9(e) and 9(f) with regard to the emplacement cell. Table 2-1 and Table 2-2 below describe how these relevant conditions are addressed in the emplacement cell design.

Table 2-1 Conditions of approval (Condition 8) – Emplacement Cell Design Objectives

Condition	How condition is addressed in the design
Condition 8: Emplacement cell must be designed and constructed to:	
a) prevent dispersal of sediments	• The emplacement cell bund has been designed to form a physical barrier between emplaced material and the Port Kembla Outer Harbour. The physical barrier has been designed so that the emplaced sediment does not disperse into the harbour. At the interface between the rock revetment structure and the bund material, a filter has been incorporated into the design to prevent dispersal of sediments into the Harbour.
(b) minimise the potential for contaminant mobilisation	• The design will utilise soil units that have been assessed not to be contaminated for the emplacement cell bund construction with other materials (including approved contaminated materials) to be placed behind the bund. • The design uses the bund geometry as a physical barrier to limit movement of contamination. Whilst the bund is not designed specifically to prevent migration of dissolved contamination (by diffusion or other mechanisms), there is potential for reduced mobility due to: o the bund providing a separation from the emplaced waste. The width of the bund (the narrowest being approximately 25m wide at the top of emplaced waste) is likely to reduce advective flows from tidal forces and currents o contaminated sediment (as per Section 4.3) will be physically confined by the overburden, cap (vertically) and the bund (laterally) o capping being graded to encourage surface runoff, reducing infiltration and lateral groundwater flows o contaminants being more strongly bound to the sediment with higher organic content of the fill material o the higher pH and buffering capacity from sea water influence (for some metals) • Material placed within the emplacement cell and bund in accordance with the Spoil Management Plan and sub plans • Flux of contamination from the emplacement cell is expected to be very low, due to the flat hydraulic gradient that will develop across the cell and the comparatively low permeability of the contaminated materials placed within the cell. Such contamination as does migrate through the cell bund will be significantly diluted within the rock revetment layer, and is not considered to present a risk of harm to the receiving environment (GHD, 2021).
(c) prevent acid generation from emplaced materials	• The emplacement cell will be designed to place known soil units that have been assessed to be ASS within the emplacement cell

Condition	How condition is addressed in the design
	at a level below +0.9mPKHD as per the Minimum Design Requirements. This is a proven and successful management technique for disposal of high risk ASS. The combined buffering effects of both sea water and the material used as the bund, have been shown to be sufficient to account for the anticipated acid load and will not lead to oxidation of sulphides that would cause long term environmental harm (Fox Environmental Consulting, 2022) • The design includes a minimum 1m capping layer of non-ASS material to further reduce potential for oxidation • The Contractor will utilise split hopper barges that can transport material to the emplacement cell in typically less than 30 minutes and be unloaded in a short timeframe reducing potential oxidation. Contingency measures will be developed in the event of breakdown such as maintaining material moist.
(d) withstand dumping of dredge/excavated material, tidal movements and extreme weather events	• The perimeter bund has been designed to retain dredge/excavated materials placed up to +3.55mPKHD. Detailed design of the bund structure has considered settlement and stability based on findings of the CPT investigation, tidal effects, construction staging, long term and short-term loading conditions. • Selection of the crest level for the bund has considered tidal movements, storm surge, sea level rise, wave overtopping and post-construction settlement. • The rock revetment structure and armourstone sizing has been designed for extreme wave events (100-yr ARI extreme ULS event and 50-year ARI ULS design event)
(e) ensure that contaminated materials are not used for cell bunding and that the potential for acute and chronic toxicity impacts to marine life that might colonise the outer bunds is minimised	• The bund design utilises soil units that have been assessed not to be contaminated (i.e. contaminant concentrations unlikely to pose an unacceptable risk to health or the environment) for the emplacement cell bund construction. The soil profile at the dredge site has been modelled digitally using the multiple geotechnical investigations undertaken on the site. A 500mm buffer has then been incorporated into the dredge model to assist separation of unsuitable (potentially contaminated) materials from the uncontaminated materials to be used in the bund construction during dredging. Material be managed at the dredge site following protocols developed for spoil management which will be developed as per Schedule 3, Condition 11 of the Infrastructure Approval. • The design is based on the Contractor's dredging method and the available information regarding the volume and depth of the different materials that will be dredged from Berth 101. • Materials identified as contaminated or potentially contaminated will be placed within the emplacement cell. As part of the dredging plan appropriate depth intervals will be selected for the dredging to reduce the risk of excavation of contaminated or potentially contaminated material during the bund constructions stages. • As per GHD's Containment Cell Condition 8 (b) – supporting commentary Section 3.6, "the bund material will be separated from the rock revetment by a geotextile filter fabric, and hence marine organisms will not colonise the bund material but can be expected to colonise the rock revetment. Concentrations of

Condition	How condition is addressed in the design
	contaminants within the rock revetment are not expected to be significantly different than the Outer Harbour sea water, due to the significant attenuation (dilution) occurring within the rock revetment."

Table 2-2 Conditions of approval (Condition 9) – Emplacement Cell Report

Condition	How being addressed
Condition 9: Prior to commencement of dredging, disposal and emplacement activities, the Proponent must prepare an Emplacement Cell Report to the satisfaction of the Planning Secretary. This report must be prepared in consultation with the EPA, NSW Ports, DPIE Water, the Port Authority of NSW and an EPA accredited site auditor, and must:	
(a) be prepared by a suitably qualified and experienced expert/s approved by the Planning Secretary	Dr Richard Kelly from SMEC has already been approved in writing by the Planning Secretary for meeting this Condition. Richard will be a reviewer and signatory of the final design and the report. Garry Ward of Heron has also been approved by the Planning Secretary
(b) include details of the emplacement cell design and construction methodology, including the final shape, depth and capping	Our design process documented in following sections addresses this condition. SMEC has engaged with the Contractor to develop and model the proposed construction methodology based on the Contractors Dredging Plan. The construction methodology agreed with the Contractor has been modelled as part of the Detailed Design for the final Emplacement Cell Design.
(c) demonstrate that the design would achieve the performance objectives in Condition 8 of this schedule, including a description of the measures to be implemented to achieve this outcome	See Table 2-1 above in addition to the control measures described in Section 6
(d) includes details of the stormwater drainage design for managing runoff and tidal flows from and into stormwater systems discharging into the disposal area, including the Salt Creek and Darcy Road drains	SMEC has provided a stormwater channel design that is based on the design flood events specified in the MDR. Further details are provided in the SMEC 30013105-009 Flood Modelling Report.
(e) describe the contingency measures that would be implemented in the event of a failure	As part of the detailed design the following potential modes of failure have been identified: • Crest subsidence / settlement • Bund instability out of the cell into the Harbour • Bund instability into the cell Currently, the risk of this occurring is being managed in design, through consideration of the different material strengths, possible consolidation, foundation strengths and other engineering factors. The contingency for failure during construction will be the subject of Heron's Early Contractor Involvement methodology. Periodic inspection and maintenance of the Emplacement Cell will be undertaken during its design life. It is considered that the proposed post construction inspection and maintenance regime will be a suitable approach to identify damage and subsequent maintenance

Condition	How being addressed
	requirements, in order to avoid further deterioration and damage of the structure. Contingency measures are described in Section 7 and Environmental Controls are described in Section 6.
(f) include details of the process and timing for transferring responsibility for the long term monitoring and maintenance of the emplacement cells to NSW Ports or another entity	Handover of the Emplacement Cell to NSW Ports will follow Practical Completion. Handover documentation will include the following: • all Issued for Construction documentation, including drawings, technical specification and 3D models • all QA/QC records compiled, reviewed and approved during construction, as stipulated within the IFC documentation • all Work As Executed surveys and records, as stipulated within the IFC documentation • an Inspection and Maintenance Manual.

3 Site Background

3.1 Outer Harbour Site History

The port area of Port Kembla has been active since the late 1800s, with the first jetty being constructed in 1883 to assist with the export of coal from the regions increasing number of mines. Subsequently the government passed the Port Kembla Act in 1898, which formally identified the area as a working port. Construction of the two outer breakwaters which enclose the Outer Harbour to the north and east commenced in 1900 and were completed in 1937.

Planning for the Outer Harbour reclamation commenced in the early 1990s by the existing ports authority, the MSB Illawarra Ports Authority (IPA). At this time, larger port operations were almost exclusively being performed in the Inner Harbour, with only the No.6 jetty and the Oil Berth in the Outer Harbour being used for shipping. To address the issue, the IPA commenced planning the longer-term development of the Outer Harbour and significant work was done with geotechnical site investigations, hydrodynamic modelling and port development planning.

With the identification of a reclamation footprint, the area was subject to the disposal of dredged spoil that could not be taken out to sea for unconfined disposal, thereby commencing the reclamation process. In 2008 a major review of the development options for the Outer Harbour was performed which considered contemporary commercial and trade related scenarios and led to the proposed development being altered significantly from that of the previous development strategy.

Prior to this dredged spoil was deposited in the Outer Harbour within what was the footprint of the future reclamation. These activities resulted in a minimum of 460,000m^3 of dredged slag and spoil from the Inner Harbour being deposited within the Outer Harbour.

Existing port operations in the Outer Harbour and surrounding area, including the adjacent berth B206, will be ongoing during the execution of the Works.

3.2 Geotechnical Background

The Geotechnical Investigation Report (provided in Appendix E) presents an overview of the site geology, details of previous geotechnical investigations, details of existing fill materials deposited in the Outer Harbour during previous dredging disposal campaigns. It also presents the results of the overwater geotechnical investigation consisting of forty-five CPTs and land based geotechnical investigation consisting of six test pits, and associated laboratory testing.

The geotechnical investigation and associated interpretation has been used to develop and refine the emplacement cell and perimeter bund design. Refer to the Detailed Design Report provided in Appendix D for further details.

4 Key Features of the Emplacement Cell

4.1 Emplacement Cell Overview

Key features of the emplacement cell are summarised below:

- All potential acid sulfate soils will be placed within the emplacement cell below maximum +0.9m PKHD
- HM & HS materials will generally be deposited lower than -1.0m PKHD, but in no instances above LAT
- The design bund crest level was derived based on tide, storm surge, sea level rise and wave overtopping and assumed to be +3.55m PKHD. The adopted crest level also includes allowance for predicted post-construction settlement of up to 250mm
- Minimum crest width of 6m and 11m at passing bays
- Maximum permanent batter slopes of 1V:3H for seaward slopes and 1V:2H for landward/internal slopes
- Final emplacement fill levels graded towards the proposed stormwater channel
- Stormwater channel to extend from the existing Darcy Road drain outlet to the eastern side of the emplacement cell
- Stormwater channel outlet is to comprise a box culvert structure on the eastern end of the emplacement cell, providing vehicular access onto the bund at the Jetty 3 abutment and within the NSW Ports property boundary
- Rock revetment structure extending to the toe of the main bund to provide protection to the bund structure against the coastal processes.
- The bund is to accommodate a 110t long reach excavator, fully loaded semi-trailer and temporary material stockpiles
- Design life of 15 years
- The basic difference between the previously approved emplacement cell footprint and the revised FEC footprint is that the section to the west of the groyne has been excluded (previously identified as the Western Cell). As detailed above, the Western Cell was assessed as not required given that the observed bulking of the dredged material had been much lower than the original design anticipated. As such, the bund alignment will encapsulate the existing groyne structure. The material composition of the existing groyne is considered a suitable alternative to Unit 1 sands from a geotechnical perspective to satisfy the original design objectives of the containment bund.
- The key trench has been completed for the (now removed) Western Cell. The trench has been backfilled with Unit 1 sands to match the pre-existing seabed profile.
- The final Emplacement Cell design footprint has excluded the use of the available submerged cell north of the main bund. The design of the submerged cell was previously excluded due to various factors, including its limited benefit to storage volumes.

4.2 Acid Sulfate Soils (ASS)

Previous assessments have identified the presence of ASS within the dredge area. The dredge material units are summarised later in Table 5-1 (Section 5.1) and these were given an ASS risk category (Fox Environmental Consulting, 2022) as follows:

Fill	Non ASS
Unit 1A*	Low Risk

Unit 1B*	Low Risk
Unit 2	**High Risk**
Unit 3	Non coastal ASS (sulfidic residual soil and pyrite in weathered rock)
Harbour Mud (HM) Harbour Silt	**High Risk**

**** Some thinner localised layers of high risk ASS ,may be present in these units (the ASS component herein referred to as Unit 1C).***

The localised and isolated nature of the Unit 1C materials, along with their relatively small quantities, are deemed impractical to be dredged separately to, and segregate from, surrounding materials.

Expert advice from Fox Environmental Consulting (dated 25 January 2022) on ASS being placed in the emplacement cell and provides multiple lines of evidence, including the following key points:

- Placement below mean sea level (+0.9m Chart Datum) is a proven and successful management technique for disposal of high risk ASS, provided that the sediments remain saturated during excavation, transport and placement. The disposal method has been successfully achieved in Gladstone Harbour Queensland for disposal of ASS during capital dredging works.
- Units 1A and 1B will be removed during a single dredging operation meaning that the high risk ASS layers within both of these Units will be excavated without segregation. Based on the expected low volumes of high risk ASS material and the average acid neutralising capacity (ANC) within both Units 1A and 1B, co-disposal of the high risk material is unlikely to have an adverse impact on the acidity levels within the bund area. Should additional high risk ASS material be encountered during dredging, this will be managed as an unexpected find which is to form part of the Stage 2A/B Management Plans that will be developed specifically for this activity.
- Based on the current configuration of the emplacement cell, it is considered that placement of the high risk ASS (Unit 2) below mean sea level 0.9m Chart Datum (0.0m AHD) will not lead to oxidation of sulphides that would cause long term environmental harm. The mechanisms that could produce acidification during excavation, transport and placement, are not considered probable given the short duration of exposure (generally within 12hrs of excavation). Once placed, the combined buffering effects of both sea water and the material used as the bund, have been shown to be sufficient to account for the anticipated acid load.

Based on the early contractor input, the HM & HS materials will be deposited in the Emplacement Cell early in the dredging campaign, once the bund is sufficiently advanced to provide containment. On that basis the HM & HS materials will therefore generally be deposited lower than -1.0m PKHD, but in no instances above LAT.

Due to the difficulty in differentiating between Unit 2 and 3 during dredging operations, and the relatively small volume of Unit 3, it is assumed that both Unit 2 and 3 will be considered as containing ASS materials.

4.3 Spoil Contaminant Quality

4.3.1 Assessment of Risk of Contamination at Emplacement Cell

Previous site investigations and assessments have identified contaminated sediment in the existing harbour floor, in the dredge area of Berth 101 and also in the Outer Harbour. Those assessments mainly targeted HM and HS units, with some testing of other units. The assessments have shown a range of contaminants within the material, such as heavy metals, tributyltin, polycyclic aromatic hydrocarbons and dioxins.

Further recent investigations and assessments have been undertaken to further examine the contamination risks, in support to the Emplacement Cell design:

- Targeted Site Investigation by GHD, December 2021 – which was performed to complete the understanding of the contamination at Berth 101 and to assess the potential implications of identified contamination with respect to the planned reuse of fill and alluvium in the emplacement cell;

- Berth 101 Dioxin Characterisation Assessment by GHD, December 2021 – included a further site investigation of both the Terminal Site and the Outer Harbour Disposal Area and included testing and analysis of other geological units, specifically to further understand the existence or otherwise of dioxins. The summary findings of this recent assessment indicated that the dioxins are likely to be of a natural source.

The ecological and health risk assessments within these reports have concluded the following with respect to use of the Berth 101 spoil materials within the emplacement cell as per the SMEC design:

- The dioxin concentrations identified in the Berth 101 materials are not considered to present any unacceptable risk to workers that may be exposed to them during the various PKGT construction activities. Health risks will be further reduced by implementing standard contaminated site hygiene and OH&S measures.
- The dioxin concentrations identified in the Berth 101 materials are not considered to present any unacceptable risk to occasional revetment maintenance workers
- The lines of evidence considered in the ecological risk assessment consistently indicate that there is unlikely to be an unacceptable ecological risk to the marine environment in association with use of the Berth 101 Unit 1A or 1B material in the emplacement cell bund.

4.3.2 Assessment of Contaminant Mobilisation and Risk

A review of the potential for contaminant mobilisation from within the emplacement cell has been undertaken, in support of the design (ref 'Containment Cell Condition 8 (b) – supporting commentary' by GHD, 23 November 2021). The report provides supporting information on expected site conditions at the outer Harbour and the potential for flux of dissolved contaminants through the containment bund. In summary, the following key points are made in the report:

- The Outer Harbour has been subject to deposition of materials from five previous dredging disposal campaigns prior to 2010, and subsequent placement of fill from the Berth 103 extension and possibly other sources. These sediments are likely to have similar contaminant conditions to contaminated material that will be placed into the cell. Contaminants in these sediments are currently exposed to the marine environment, and subject to disturbance from waves, currents (including tidal flow conditions), shipping traffic, bioturbation, groundwater discharge and surface water discharges into the Outer Harbour.
- The potential for mobilisation of contaminants by way of increased advective flow will be minimised by using materials with minimal contamination for the bund (which would be most subject to advective flows from tidal forces and currents); and the contaminated material will be placed within the cell
- Capping will divert surface water from contacting contaminated materials. As these materials will no longer be subject to the direct exposure and disturbing forces (i.e. tides, shipping, bioturbation etc) that currently affect the area of the emplacement cell, mobilisation and flux of contaminants will be substantially less after construction of the cell than is currently the case.
- Some initial discharge may occur due to displaced pore water. This is expected to occur primarily during construction and is likely to be relatively short term in duration. Longer term mobilisation is considered to be limited to that driven by infiltration or groundwater flow through the emplaced material, both of which are expected to be relatively low in magnitude.
- The groundwater body within the emplacement cell will be comparatively "stagnant", in which contaminant concentrations can be expected to rise to a point of equilibrium. This will result in a reduction of mobilisation of contaminants compared to the exposed environment of the existing sediments in the Outer Harbour where the sediments are continually flushed and contaminants will mobilise more readily into the more dilute pore water.
- Rapid dilution is expected at the revetment due to the open structure and high permeability
- Geotextile will separate rock revetment from bund material hence marine organisms will not colonise the bund material

- Based on a semi-quantitative assessment, GHD estimate a discharge attenuation of over 100 times within the rock revetment and over 1,000 times within 1m beyond the rock revetment.

The report made the following conclusions:

*"**The design and construction of the emplacement cell is considered to minimise the potential for contaminant mobility by containing contaminated materials within the bund, separated from the Outer Harbour by the bund materials (in excess of 25 m wide), a separation geotextile and a rock revetment layer. Construction of the emplacement cell is in fact expected to reduce contaminant flux into the environment when compared with the existing situation in the Outer Harbour. The flux of contamination from the emplacement cell cannot be easily calculated, but is expected to be very low, due to the flat hydraulic gradient that will develop across the cell and the comparatively low permeability of the contaminated materials placed within the cell. Such contamination as does migrate through the cell bund will be significantly diluted within the rock revetment layer, and is not considered to present a risk of harm to the receiving environment.**"*

4.3.3 Design Considerations

For the purposes of design SMEC has maintained the definition of Contaminated Sediment employed by GHD which is defined in the Spoil Management Plan Early Enabling Works (GHD, 2021). Units HM and HS at Berth 101 and materials in the Outer Harbour Key Trench are assumed to contain contaminated sediment. Due to the difficulty in differentiating between Unit HM and HS during dredging operations, it is assumed that both Unit HS and HM will be considered as being contaminated and will not be used in bund construction as per the conditions of approval.

The emplacement cell has been designed as a physical barrier, not a barrier that preludes movement of dissolved contaminants (by diffusion or other mechanisms), although the flux potential through the bund is considered to be very low as described above.

The encapsulation of the groyne as part of the bund is also considered to be a physical barrier that is equivalent to (or better than) elsewhere along the alignment where the bund comprises of Unit 1 sand only. Similarly, the flux potential through the groyne is expected to be no higher than elsewhere along the bund alignment.

4.4 Material Selection

Consistent with the Environmental Impact Statement for the Project, the project will involve dredging of sediments from Berth 101 and emplacement within the disposal area. Sediments dredged from the emplacement cell footprint as part of the bund construction will also be emplaced in the disposal area. Contaminated sediments will be placed within the disposal area and capped with clean sediments. Details for the management of this process will be documented in the Stage 2A/B Management Plans.

4.5 Revetment Design

The rock revetment structure provides protection to the bund structure against the coastal processes of wind, wave, current and varying water level. In addition to the coastal process loadings driven by the forces produced by the interaction of wind, wave, current and varying water level; design of the rock revetment has also considered loading from propeller wash, which may occur within the vicinity of the Emplacement Cell as part of current port operations.

This is detailed in SMEC's Detailed Design Report presented in Appendix D.

4.6 Flooding and Drainage

The works include a 340m long diversion channel extending the existing Darcy Road Outlet to discharge at the eastern side of the emplacement cell. The flooding and drainage design includes a hydraulic study to assess the flood impacts due to the proposed changes at the outlet discharge, design of the stormwater channel.

The stormwater channel has been positioned to align with NSW Ports lot and lease boundaries.

This is detailed in SMEC's Stormwater Channel Design Report presented in Appendix F.

4.7 Geotechnical Design

The geotechnical design for the proposed emplacement cell includes the following:

- Development of geotechnical models of the sediment and harbour floor along the bund alignment and in the emplacement cell area
- Development of design parameters for the proposed emplacement cell materials (including bund materials and rock armour) and foundation materials
- Assessment of loading conditions for stability and settlement analysis
- Geotechnical assessments for each of the identified critical cases
- Settlement assessment for the bund and emplacement cell including total and differential settlement assessment
- Working platform assessment for the bund crest including a local stability assessment

These are detailed in SMEC's Geotechnical Investigation Report and Detailed Design Report presented in Appendix D and Appendix E.

4.8 Civil Design

The general alignment of the bund structure, minimum crest widths and passing bay requirements are provided in accordance with the MDR. 12d software has been used for design of the bund structure and emplacement cell, and 'tin to tin' volume analysis used to calculate volumes.

This is detailed in SMEC's Detailed Design Report presented in Appendix D.

5 Emplacement Cell Capacity Assessment

The Emplacement Cell has been designed to ensure that proposed cell arrangement in the current lease area has sufficient capacity to contain the materials coming from the Berth 101 works. In addition to consideration of the overall volume, volumetric assessment of the capacity of the cell to emplace specific materials below the required levels has also been required. There is also an additional volume of material generated from dredging of marine sediments and previous uncontrolled dredge deposition material from the footprint of the bunds so that there is a suitable foundation for the bunds.

5.1 Dredge Materials

A summary of the geotechnical units comprising the dredge materials from Berth 101 is provided in Table 5-1. Additional dredge materials will also be generated from pre-trench excavations of unsuitable materials along the bund alignment.

Table 5-1 Dredge Materials

Unit ID	Origin	Description
FILL	-	Sand, with lesser amounts of Sandy Gravel / Gravelly SAND and Silty SAND
1A	(Marine/Aeolian)	“Beach” Sand, gap graded.
1B	(Estuarine)	Sand deposits with intermittent lenses of Clayey Sand
2	(Estuarine)	Low to High Plasticity Clays and Sandy Clay
3	(Residual Soil)	Mainly Sandy Clay with lesser amounts of Silty Clay, Silty/Clayey Sand and CLAY transitioning into weathered rock.
4	(Bedrock)	Mainly Weathered Siltstone (highly weathered to fresh)
Harbour Mud - HM	-	HM1 - Described as “Coal Sludge”
		HM2 - Clayey Mud
		HM3 - Silt Mud
Harbour Sediment - HS	-	HS1 - Fine Silty Sand
		HS2 - Gravelly, Silty/Clayey Sands

5.2 Additional Sources of Dredge and Excavated Materials

During the demolition work at Berth 101 (2021 - 2022) and the construction of the new onshore facilities (2022 to current), sources of materials other than the dredge units included in Table 5-1 were encountered and identified. These sources of material will be disposed of within the emplacement cell and are “additional” to the volume assessment comprised in the original emplacement cell design. They have been included to increase the finished surface level within the emplacement cell, which is expected to be greater than +2.0m PKHD with their inclusion. The volumes associated with each type of material were surveyed where possible. Where this was not possible, a “best estimate” was provided to SMEC by AIE to inform the current ECR revision. Table 5-2 provides a summary of the origin, description, volume and planned use for each of the new sources. It is noted that an identifier was nominated by SMEC for each of the material sources for the benefit of clarity.

Table 5-2 Summary of Additional Sources of Dredge and Excavated Materials

Source Identifier	Description	Origin	Volume (m^3)	Proposed Use within the Emplacement Cell
C6 Stockpile	Variably Gravelly, Clayey and Sandy Excavated Material comprises also of cobbles sized slag/ lightly bounded	Generated during Berth 101 Early Enabling Work	9,500[(1)]	Within the cell below a level of +1.0m PKHD and with a minimum

Source Identifier	Description	Origin	Volume (m³)	Proposed Use within the Emplacement Cell
	material fragments and has been identified as contaminated by asbestos material.	Stages, currently stockpiled		capping layer of 1m thickness
Grouting Returns Material (Unit 1 mixed with cement)	Sand cement spoil generated during jet grouting works. Sandy spoil and variably sand to cobble sized cemented grout (low strength) fragments.	Jet grouting operation from Berth 101	13,500(2)	Within the emplacement cell, suitable for general backfill (up to +0.9m PKHD) or/and cell capping (above +0.9m PKHD to FSL).
Mixed Unit 1 and Unit 2 Stockpile (non-ASS/PASS)	Variably Clayey to Sandy spoil created during the trenching work for the installation of the Quay Wall tie-rod at Berth 101	Trenching Spoil from Berth 101	2,600(1)	Within the cell below a level of +0.9m PKHD and with a minimum capping layer of 1m thickness
Unit 1 Stockpile	Sandy Spoil, poorly graded, fine to medium, blend of marine sand and past sandy fill,	Bulk Earthworks land-based excavation from Berth 101	6,000(1)	Perimeter bund wall or capping material
NSW Ports Rockfill Stockpile (GPT Rock)	Excavated sandstone fragments, variably sand to boulder sized, poorly graded. Material previously imported to site from a basement excavation project in Wollongong CBD, (circa 2011). This material has been previously referred to as GPT Rock(3).	Stockpiled at Outer Harbour Ports NSW's Site, adjacent to EC laydown site	Stockpile East of Darcy Drain – 27,600(1) Stockpile West of Darcy Drain – 11,000(1)	Within the cell below a level of +0.9m PKHD OR As capping material subject to be suitability characterise(5)
Capping Rockfill	Quarried product comprising of sandy, fine to medium gravel (weathered latite) with traces silts.	Rockfill product sourced from local, EPA licensed hard rock quarry comprising solely of crushed latite material	Estimated 8,000m³(4)	As capping material subject to suitability assessment (5)

Notes: (1) High level of confidence, volume assessed using photogrammetric drone survey by others,

(2) Most reliable estimate based on survey report dated 15 January 2024.

(3) Refer to AIE, ***Minimum Design Requirements Outer Harbour***, PKGT-AIE-SPC-0007, Rev0, dated 29 October 2020

(4) Estimated volume as being the likely upper-bound limit based on most recent projects volumes.

(5) As per Stage 2A/2B Spoil Management Plan

5.2.1 Assessment of the Additional Material Sources for Contamination

As described in Section 4.3.3. of the Infrastructure Approval (SSI 9471); the development consent of the Port Kembla Gas Terminal is required to be delivered in accordance with the EIS and in accordance with the conditions of the approval. Section 5 of the EIS provides specifics on spoil disposal activities where all material won from Land or Marine based earthworks operations at Berth 101 can be deposited in the Outer Harbour Emplacement Cell. All additional sources of material as described in Table 5, will be managed in accordance with the Project's approved Stage 2A/B Management plans including the Dredging and Excavation Management Plan, The Acid Sulfate Soils Management Plan, the Spoil Management Plan and the Unexpected Finds Protocol.

In addition to the above documentation, the following is noted:

- The C6 stockpile will placed in a dedicated area of the EC below RL +1.0m PKHD (as agreed with NSW Ports) and capped with a minimum 1m thickness of clean material.
- The Grouting Returns Material (Unit 1 sands mixed with cement) has been assessed by GHD and is considered generally in accordance with the EIS (reference GHD's Technical Memorandum Consistency Assessment for Berth 101 rectification works, ref 2127477, dated 22 February 2023 as confirmed by GHD's Technical Memorandum Consistency Assessment Jet Grout Spoil – Use as capping for Emplacement Cell, ref 2127477, dated 30 January 2024).
- The intended use for the two NSW Ports Rockfill Stockpile (GPT Rock) is to utilise the material as additional fill or capping for the EC. If the material is to be used for these purposes, it will be required to be assessed with reference to guidelines approved or endorsed by the NSW EPA. The assessment of these materials will be undertaken by AIE's Environmental Consultant or equivalent. From a geotechnical perspective, SMEC considers the use of the GPT Rock as suitable for the construction of the emplacement cell.
- The proposed Capping Rockfill will be imported on an as-needed basis to permit the completion of the placement of the minimum capping requirements over the emplacement cell. The import of this product arises from the project's shortage in available capping material. As such, the current estimate of 8,000m^3 is to be taken as an upper-bound projection and will most probably eventuate to be lower. The material will comprise of a crushed, weathered latite rock product sourced from a local EPA licensed, commercial quarry. SMEC has already reviewed the nominated Capping Rockfill datasheet. The Capping Rockfill will be tested and suitably characterised as per the SMP.

5.3 Berth 101 Dredge Volumes and Material Types

For the purposes of developing and evaluating the 100% Detailed Design independent dredge volumes have been calculated for Berth 101 based on the Worley Parson's marine and land based ground models presented in the 2018 Geotechnical Investigation Interpretive Report and associated 12d model, Alliance Geotechnical investigation data within the existing wharf footprint (Report Number 9775-GR-1-1 Rev D Dated 22 December 2020), and GHD vibracore data within the footprint of the existing berth box (EIS Appendix E3 Contamination – Dredging and Disposal Area, November 2018). These volumes are presented in Table 5-3 below.

Table 5-3 Dredge Volumes

Unit	Comment	Bank Volume (m^3)
Fill		20,667
1A (Sand)		98,506
1B (Sand/Clayey Sand)		123,239
2 (Clay)	ASS	110,020
3 (Clay and weathered rock)		10,992
HM (Harbour Mud/silt)	Contaminated and ASS	52,599
HS (Silty/Clayey Sand)		0
Rock		2,129
Total Volume		**418,152**

The following assumptions are noted relating to dredge volumes and material types:

- Dredge volumes assume all materials above +2.5m PKHD have been removed as part of early enabling works. It is assumed that 50,000m^3 (bulked volume) of these materials (Fill/Unit 1A/Unit 1B) will be transported by road and stockpiled at the Outer Harbour.
- The volumes for Unit 1B and Unit 2 assume a 0.5m buffer zone where the interpreted upper surface of Unit 2 is 'lifted' 0.5m to account for dredging tolerance and natural variability between boreholes and corresponding interpretation.
- The GHD 2018 over-water investigation included seven vibracores to varying depths which typically encountered very soft to soft clayey silt (black-brown, with some fine sand, weak hydrocarbon odour) within the proposed dredge depth. These materials are typical of Harbour Mud (HM). The vibracores did not encounter materials consistent with the description of Harbour Sediments (HS).
- Dredge volumes for each material type have been adjusted to consider existing rock armour at Berth 101 (Approx. 1.5m layer thickness assumed).

5.4 Rock Buttress Materials for Alternate Bund Construction Methodology

SMEC's Temporary Works Design Report, Report PKGT-SMC-OHC-DRE-RPT-0003, Rev00, dated 20 March 2023, provides the design details associated with the construction of a temporary rockfill buttress for the PKOH EC. The main purpose of the buttress is to enhance the global stability of the main bund to the extent required to permit the construction of the containment bund in isolation with the concurrent filling of the cell behind. This is necessary given that dredging has been suspended at Berth 101, and there are large stockpiles of D1 material available at the Outer Harbour.

To summarise, the proposed alternate bund construction methodology will comprise a submerged rockfill buttress founded directly atop the current emplacement cell sea floor (variable, approx. RL -3.0m PKHD) supporting the landward slope of the bund (refer Figure 5-1). The buttress will span the inside of the bund from approximately BND1 Ch 0 (most likely Ch30) to Ch 550. This will lead to the inclusion of approximately 15,000 m^3 of rockfill material. While the function of the proposed buttress is temporary, the rockfill will be left in-situ permanently. The rock material will be local quarry sourced Virgin Excavated Natural Material (VENM).

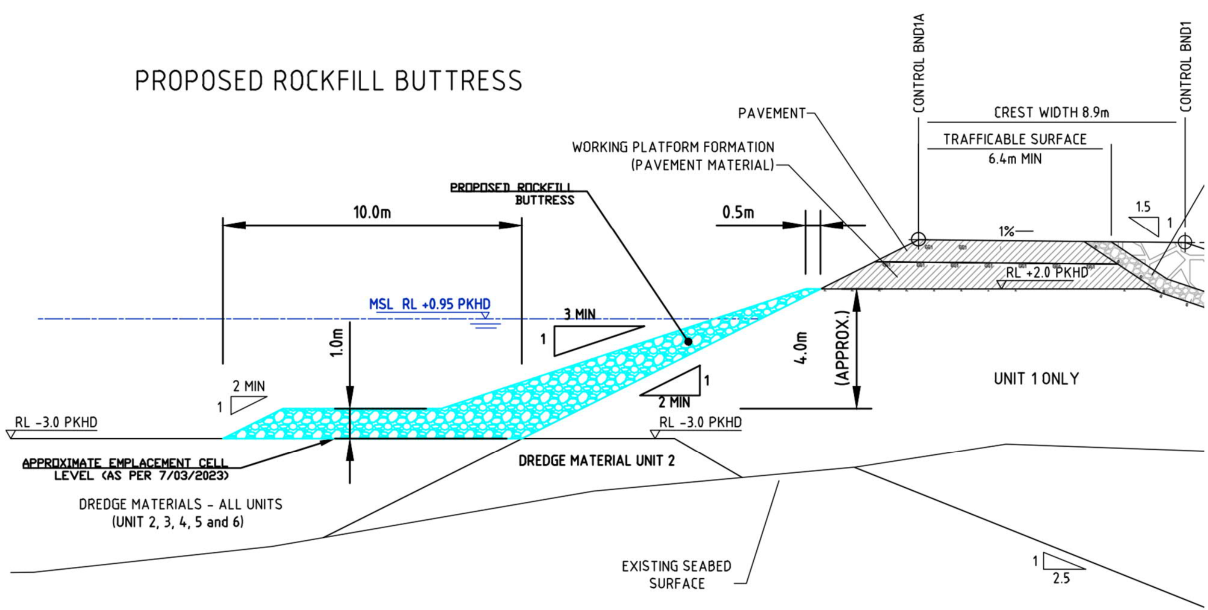


Figure 5-1 Typical Section showing the Rock Buttress (cyan)

5.5 Bulking Factors and Bulked Volumes

The capacity of the proposed emplacement cell is a function of both the dredge volumes and associated bulking factors. A detailed review of bulking factors is provided in Technical Memorandum 30013105-TM-GT-02 (refer Appendix A). It included a review of available technical literature, as well as input from a specialised dredging consultant. SMEC's original design predicted the disturbance to the in-situ material through mechanical dredging would increase the volume of material recovered, effectively "bulking" it up.

Bulking factors were then nominated for each of the geotechnical units from Berth 101, and refer to a 'bank to placed' bulking factor. The bulking factors correspond to underwater placement by direct 'dumping'. Slightly lower bulking factors are applicable for placement above water where there will be some degree of informal compaction due to earthworks plant and equipment. However, these lower factors only apply to Fill/Unit 1A/Unit 1B materials from around mean sea level to +3.55m PKHD. A ± 7.5% sensitivity has been reviewed for each of the bulking factors, as part of the volume balance assessment.

Monitoring of the dredged/placed volume balance has been completed to date. This permitted calculation of observed bulking factors, referred to as "Apparent Bulking Factors" (ABF) as detailed below. As such, going forward the ABF will be used in preference to the originally adopted bulking factors nominated in the previous ECR revision.

In summary, instead of an overall weighted bulking factor of approximately 1.25 for the project, the most recent estimate indicates weighted bulking factor of 0.97. This difference has been significant, leading to a reduction in the emplacement cell footprint. Table 5-4 provides estimated Apparent Bulking Factors for the remainder of the works informed by the analysis of the up-to-date survey of Berth 101 and the emplacement cell.

Table 5-4 Estimated Apparent Bulking Factors

Cases	Fill, 1A and 1B	All other units
Lower Bound	0.95	1.0
Median	1.0	1.1
Upper Bound	1.05	1.15

Dredge volumes are provided in Table 5-5 for the range of bulking factors presented above, and include a 300mm over-dredge allowance. ABF are only applied to the material which remains in-bank at the time of this ECR revision. Volumes for material which has already been dredged and placed is calculated based on survey, including the volumes associated with the excavation of the key trench.

Table 5-5 Dredge Volumes (m^3)

Cases	Dredge Volumes (m^3)	
	Fill, 1A and 1B	All other units[1]
Lower Bound	293,219	232,222
Median	296,012	240,187
Upper Bound	298,805	244,169

Note: (1) Not including volumes for rock buttress or any "additional sources".

5.6 System Losses

Based on advice provided by Heron, losses associated with dredging and placement of materials within the emplacement cell and bund structure are assumed to be sufficiently small to discount from calculations considering the following factors:

- Losses are considered small for backhoe dredging methods (compared to CSD or TSHD) with minimal overflow water in barges, particularly in initial stages of dredging where there is low free water in the bucket.
- Greater volumes of free water may be present during some dredging activities (e.g. during trimming operations), however it is possible to decant water from barges by use of scuppers to minimise losses.
- Relatively benign currents in the Outer Harbour area results in sedimentation remaining within the dredge/placement area. Suspended fines are also retained by silt curtains and are anticipated to settle out.

5.7 Grouped Material Types for Reuse

Volumes for grouped material types (bank to placed) are provided in Table 5-6 for bund material, ASS materials and contaminated materials. Trench materials are assumed to potentially contain ASS materials. Base case and critical case volumes are provided for each group where lower bound bulking factors apply to bund and capping materials, and upper bound bulking factors apply to ASS and contaminated materials.

Table 5-6 Material Groups

Material Group ID	Materials (Units) in Material Group	Base Case Volume (m^3)	Critical Case Volume (m^3)
1	Bund Material and capping materials (Fill, 1A, 1B)	296,012	293,219
2	ASS (Unit 2/3) + Contaminated Material/ASS (HM+HS) + Pre Trench Volume	240,187	244,169

5.8 Emplacement Cell Capacity

The main components of the Emplacement Cell are listed below. Refer to Figure 5-2 for a plan of the emplacement areas and Figure 5-3 for a section showing the pre trench, bund structures and emplacement cell. Refer to the IFC Drawings for further details.

- The bund key trench (completed prior to emplacement cell size reduction)
- Main bund structure– eastern section
- Main bund structure– groyne section
- Stormwater channel bund
- Main emplacement cell (behind bund)

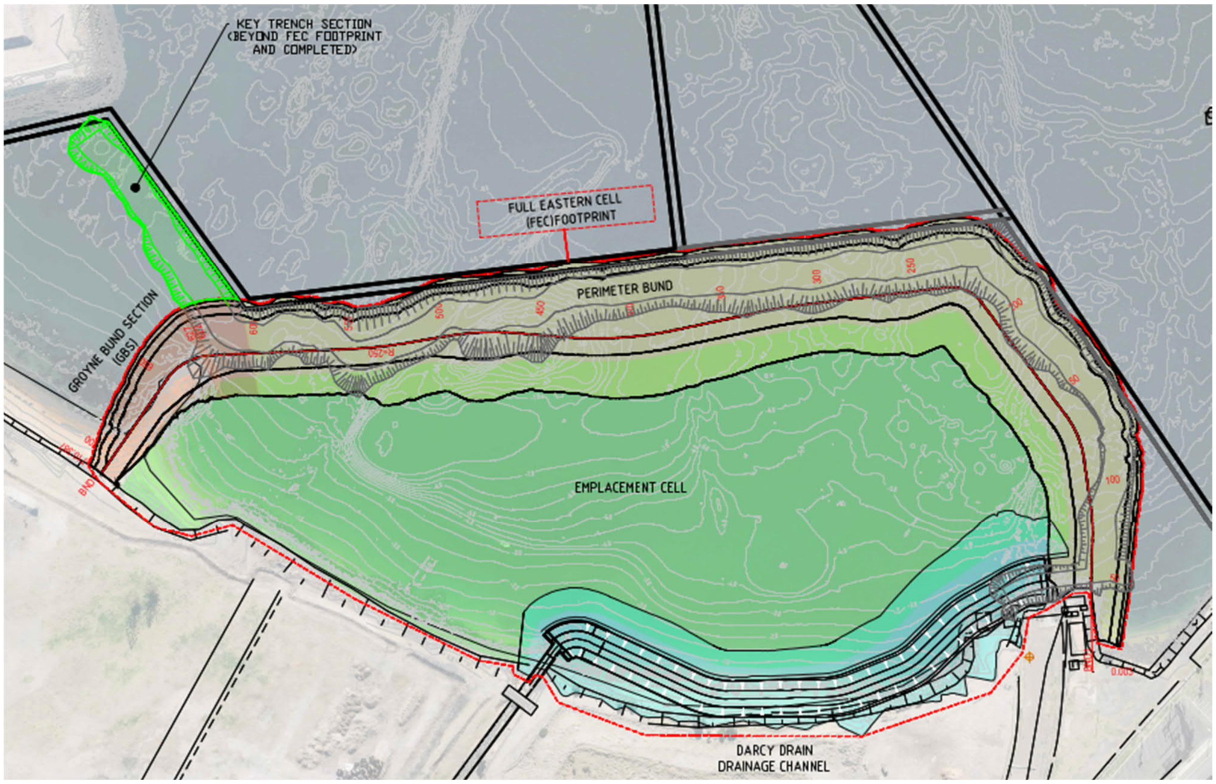


Figure 5-2 Emplacement Areas

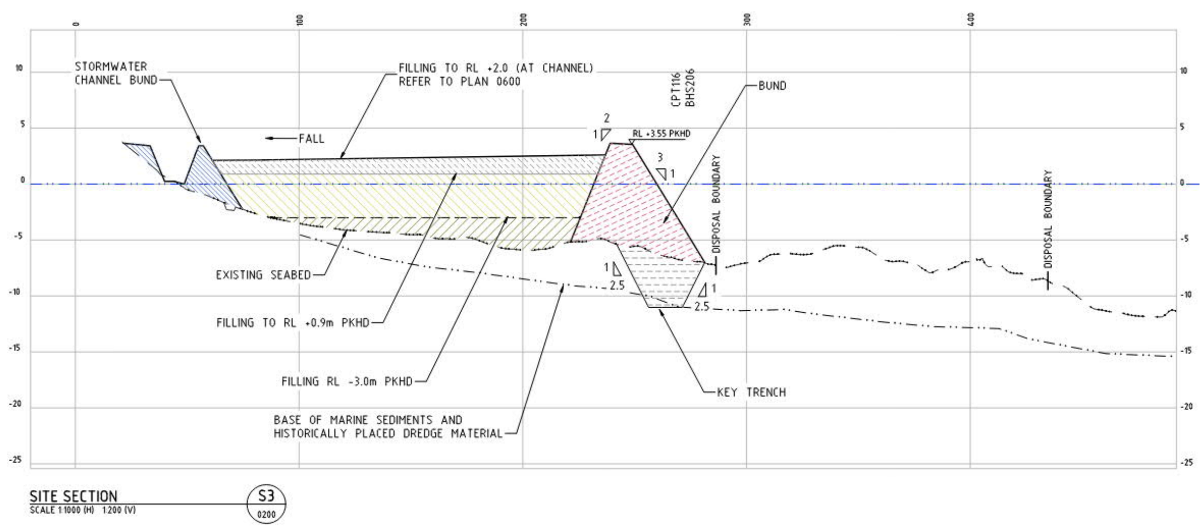


Figure 5-3 Typical Section through Emplacement Cell

The bund volume for the Emplacement Cell is provided in Table 5-7. Bund volumes include filling of the pre-trench and are based on 3H:1V and 2H:1V batter slopes for the seaward and landward sides of the bund respectively.

Table 5-7 Bund Volumes

Bund (m^3)	
Bund fill incl. trench[1]	159,433
Stormwater channel incl. trench[1]	32,436
Total bund volume	191,869

[1]Volumes are for Material Group 1 only

The emplacement cell volume is provided in Table 5-8 below. Volumes have considered the final grading of the cell and are based on 3H:1V and 2H:1V batter slopes for the seaward and landward sides of the bund respectively. The 2H:1V batter slopes on the landward side of the bund have been selected to maximise volume within the cell.

Table 5-8 Emplacement Cell – Available Capacity behind the Bund

Emplacement Cell (m^3)	
Fill Height	Total Volume
Finished Surface Level (FSL) (min. +2.0m)	371,770
+0.90m	293,337

Bund volumes, cell capacity and corresponding material surface levels are summarised in Table 5-9 for the base case and critical case volumes for the materials groups presented in Table 5-6.

Table 5-9 Cell Capacity

		Emplacement Cell	
		Base Case	Critical Case
Bund Volumes	Material Group 1 (m3)	296,012	293,219
	Bund Volume Required (m3) 1	191,522	191,522
	Balance Available for Capping Layer (m3)	104,143	101,350
Cell Storage	Material Group 2 (m3)	240,187	244,169
	Storage Capacity to +0.9mPKHD (m3)	293,337	293,337
	Excess Storage Available (m3)	53,150	49,168
	Percentage Capacity	82%	83%
FSL / Capping Layer Thickness	Final RL of Material Group 2 (m PKHD)	-0.4	-0.3
	Capping depth average (m) 2	1.5	1.4
	Estimate 'average' finish level of cell behind bund (m PKHD) 2 3	1.1	1.1
Estimated volume of additional material required to achieve the design finished level (m^3)		53,150	49,168

[1] Assume stormwater channel and associated filling constructed using Material Group 1

[2] Includes bulking factor adjustment for capping material placed above MSL

[3] This projected finished level provides capacity for bulking factor variance and will be raised to the required Design Average of +2.1m PKHD by the placement of additional materials listed in Section 5.2

Key outcomes of the volumetric assessment are summarised below:

Base Case

- The Emplacement Cell can accommodate all ASS and contaminated materials (Material Group 2) below +0.9m PKHD for the Base Case volumes. The finished RL for Material Group 2 is approximately -0.4m PKHD if the cell is not supplemented with any additional materials.
- A capping layer up to 1.5m thick would be placed over Material Group 2 with an average finished surface level of +1.1m PKHD if the cell is not supplemented with any additional materials.
- Approximately 53,000 m^3 of additional material is required to achieve the design finished surface levels.

Critical Case

- The Emplacement Cell can accommodate all ASS and contaminated materials (Material Group 2) below +0.9m PKHD for the Critical Case volumes.
- If the lower bulking factors are realised for the capping materials, a capping layer up to 1.4m thick can still be achieved above the Unit 2 material, resulting in an average finished surface level of 1.1m PKHD if the cell is not supplemented with any additional materials.
- Approximately 49,000 m^3 of additional material is required to achieve the design finished surface level.

5.8.1 Settlement Estimates

Settlement estimates for the emplacement cell are provided in SMEC's Detailed Design Report for a range of scenarios.

Internal settlement of the bund structures will occur during construction and will result in a minor increase in the above volume requirements for bund construction. The Detailed Design Report provides estimates of post construction settlement along the bund alignment which are generally in the order of 100 to 200mm. The adopted crest level also includes allowance for post-construction settlement of up to 250mm.

Volume estimates have not considered settlement of existing marine sediments and historical dredge materials within the emplacement cell, which would theoretically increase cell capacity. This is discussed further in the Detailed Design Report.

6 Construction Methodology

The following section has been prepared primarily with information supplied by Heron, who has been involved as part of Early Contractor Involvement in the Design process. Refer to the 100% Detailed Design Drawings for Emplacement Cell sequencing Drawings.

Key considerations related to construction methodology and staging are summarised below:

Placement methods will include:

- bottom dumping from split hopper barges (to RL -3.0m PKHD)
- use of unloading Material Handling Barge to unload split bottom barges with conventional land-based earthworks equipment to construct the upper section of the bund
- partial manual unloading of split hopper barges, followed by bottom dumping of remaining load (from reduced draft split hopper barges)
- partial filling and bottom dumping of split hopper barges - where this is more efficient than partial manual unloading

- Dredge materials to be placed in the emplacement as the bund construction progresses. Progressive filling is required behind the landward slope to maintain slope stability with a maximum differential level of 1.5m.
- Pre-trench material cannot be side-cast as it will likely flow back into the trench. It will need to be loaded on barges and moved into areas of shallower water or placed in localised deep areas within the emplacement cell
- Contaminated HM and HS materials will generally be placed below -1.0m PKHD (and not above LAT) and typically be contained by a series of internal bunds to suit construction staging.
- The stormwater channel extension will be required to be constructed prior to when the emplacement cell construction obstructs stormwater discharge from the Darcy Road drain to the Outer Harbour
- The stormwater channel will provide temporary discharge from the cell during filling, where channel construction is completed in advance of filling.
- Bottom dumping from barges is not expected to result in mud-waving or significant displacement of seabed materials given the relatively shallow water depths i.e. dredge materials are not dropping significant distances through the water column
- Stockpiling of materials may be considered within the emplacement to suit dredge staging and final elevation of materials e.g. stockpile surplus Unit 1A/B to permit dredging and placement of the last of the ASS materials from Berth 101
- The bund will include a central open section to provide access to the emplacement, with bund construction being completed/closed as barge access is no longer required/available to the emplacement cell footprint
- With respect to the placement of dredge material on the inside of the cell against the bund, one of two acceptable methodologies will be employed:
  - A temporary submerged rockfill buttress is placed at the toe of the inside of the bund supporting the landward slope of the bund. This removes the need to maintain the maximum differential level of 1.5m. See PKGT-SMC-OHC-DRE-RPT-0003, Rev00, dated 20 March 2023 for design details of the rockfill buttress; OR
  - Dredge materials to be placed in the emplacement as the bund construction progresses. Progressive filling is required behind the landward slope to maintain slope stability with a maximum differential level of 1.5m

Typical over-dredge allowance of 300mm is appropriate for the proposed dredging methods at Berth 101 and in the Outer Harbour.

6.1 Scope of Activities

The scope of works to be undertaken by Heron for the AIE - Port Kembla Gas Terminal involves elements that will require multiple work faces to operate at the same time.

- Installation of silt curtains at the Berth 101 dredge area and around the emplacement cell
- Dredging of a key trench to form the emplacement cell bunds, with an estimated volume of 60,500m^3 and place that material within the emplacement cell boundaries
- Construction of an emplacement cell in the Outer Harbour with a capacity to contain the dredge material using suitable material from the dredge area
- Removal of existing revetment rock and storage for reuse
- Dredging of approximately 450,000m^3 and placing it within the emplacement cell boundaries to the design and specifications of the contract
- Installing revetment around the emplacement cell

We note that there is a requirement for the Designers Site Geotechnical Representative (DSGR) to be onsite during Construction activities. This is considered a key risk control for the project. The requirements for the DSGR including release of Witness and Hold Points are listed in the Technical Specification for the project.

6.2 Anticipated Construction Plant

Plant and equipment associated with the works will be in good working order and have the capacity to safely and efficiently do the work required. All necessary plant inspections and invasive marine species assessments will be undertaken in accordance with the requirements as specified in the Contract to fully comply with the requirements of DPIE prior to being mobilised to site.

The following table outlines the plant and equipment expected for the associated scope. Further risk assessment processes such as the Risk Workshop and the development of the SWMS may identify additional plant or equipment necessary to conduct the work safely.

Table 6-1 Indicative Plant List

Plant and Equipment required for the works:	Type of Works
Backhoe Dredge Machiavelli	Dredge material into barges from Berth 101 and toe trench
Split Hopper Barge – H1201	Transporting material to the Emplacement Cell
Split Hopper Barge – H1202	Transporting material to the Emplacement Cell
Tug – PT May	Pushing barges from dredge to Emplacement Cell
Tug – PT May	Pushing barges from dredge to Emplacement Cell
Survey Vessel- Kaiwea	Hydrographic survey and crew changes
Material handling barge (MHB) fitted with a Liebherr 120t Material Handler and 8m^3 grab	Unloading barges and revetment placement from water side.
Excavator 50 ton - Longreach or similar	Installing revetment, bund trimming
Excavator 40 ton	Loading trucks
Bulldozer - D6 Swampy or similar	Assisting the MHB
ADT 40ton Dump Trucks x 2	Placing fill material

6.3 Dredging Methodology

6.3.1 Turbidity Controls – Dredge Area

SMEC understands that silt curtains will be employed during dredging activities, including revetment rock removal, at Berth 101 or in the Outer Harbour Emplacement Cell.

Silt curtains will typically be Class 3 curtains, suitable for tidal and working harbour conditions, in accordance with performance specifications and custom designed by specialists. Silt curtain can be restrained in a fixed position for the duration of the works, or alternatively comprise a 'moonpool' configuration (known as a Dunlop arrangement) that is tethered to the Backhoe Dredge, thereby delineating the operational area of the excavator whilst also providing turbidity containment local to the dredging face (see Figure 6.1 showing the Dunlop arrangement being mobilised). Anchoring of any silt curtains requires prior approval from the Port Authority of NSW (PANSW) Harbour Master.

As the dredge site is in close proximity of a ship turning circle, a fixed silt curtain around the entire Berth 101 site may not be suitable and input from PANSW will be sought to determine the final position of the curtain. The level of, and requirement for, navigation and special markers to alert vessels operating in the Port area will also be sought from the Harbour Master.

Figure 6-1 Example of Dunlop arrangement being mobilised (photo supplied by AIE)

6.3.2 Dredging

Dredging will be carried out by the BHD Machiavelli and two split hopper barges for the duration of the project. The dredge will be configured to allow for maximum production in the material expected to be encountered at the depths required. Currently it is planned to use the dredge with a 16m boom, 7m stick and a 5.6m^3 GP bucket. This will allow production rates greater than 4,000m^3 per day at the design depths.

6.3.2.1 Dredging Controls

The Machiavelli uses a SeaTools electronic dredging program called DipMate. This program allows the operator to accurately determine the position of the excavator's bucket, boom and dipper. The information the operator receives from the monitor is in real time so the position, angle, depth and reach of the bucket are known at any stage throughout the excavation cycle. In addition to the elevation view, a plan view of the dredge is also provided showing the actual position of the dredge and excavator in relation to the project Coordinate System (refer Figure 6-2).

The dredging monitor receives data from rotation sensors mounted on the excavator's attachments and from RTK GNSS receivers mounted on-board the vessel. Both the rotation sensors and the GNSS receivers supply data to the electronic monitor meaning that any time the x, y, z (northing, easting and reduced level) position of the bucket is known.

A feature of the SeaTools system is the ability to data log or "map" the movement of the bucket in terms x,y,z positions. This information can be downloaded from the dredging computer via a simple ASCII format file. The data can be used to create long sections and cross sections to prove that the bucket has achieved the design dredge profile.

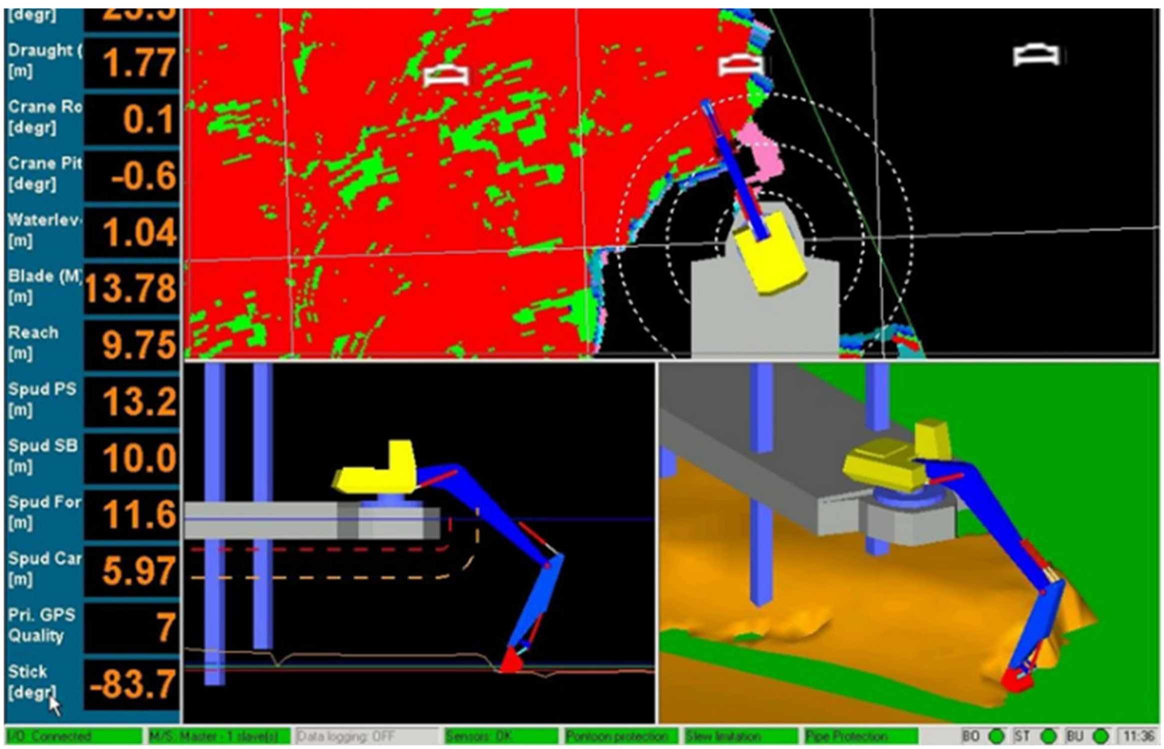


Figure 6-2 Dredge Operators Screen

6.3.2.2 Data Logging

The dredge, tugs and barges continuously record position in an x, y format. Tug and barge activities are monitored, and track plots are recorded during their transition to and from the Emplacement Cell. Real time telemetry logging of the SHB's is undertaken, showing location and times of the barge of movements. Tugs and the dredge are equipped with AIS.

Print screens are recorded the dredge at the beginning and end of each load of position change, Figure 6-3 below is an example of the operators view when dredging in close proximity to a combi wharf structure.

Figure 6-3 Dredge Print Screen

Print screens of the barge opening and placing its load are recorded prior to opening and once they have been closed, they also show the position of all previous placed loads. Figure 6-4 below shows the information provided on each print screen.

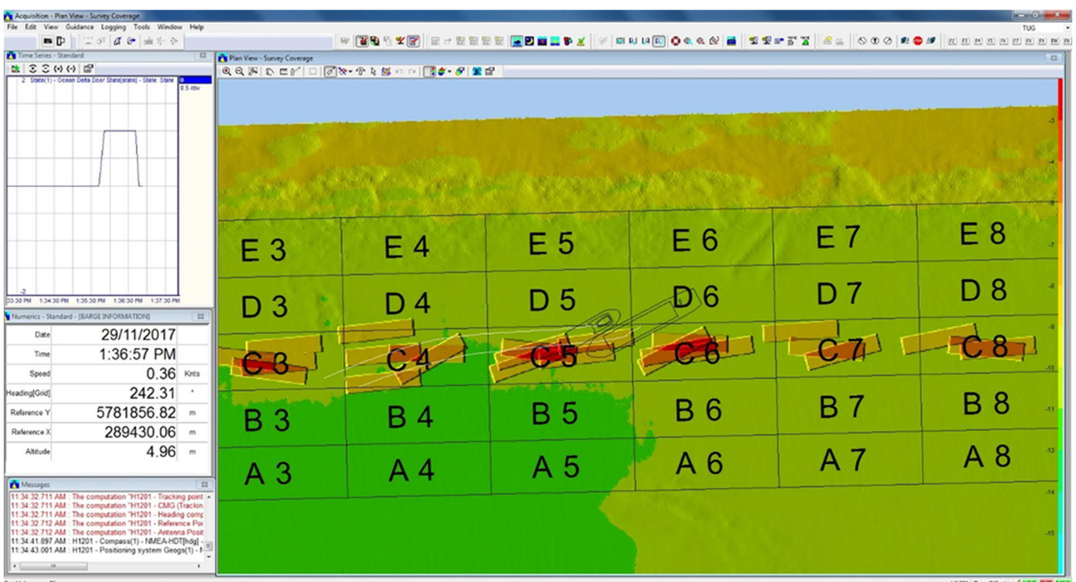


Figure 6-4 Barge Print Screen

Barges track plots are produced to show the exact movements as they transit between the dredge area and disposal area as indicated in Figure 6-5. Each barge has a different colour track.

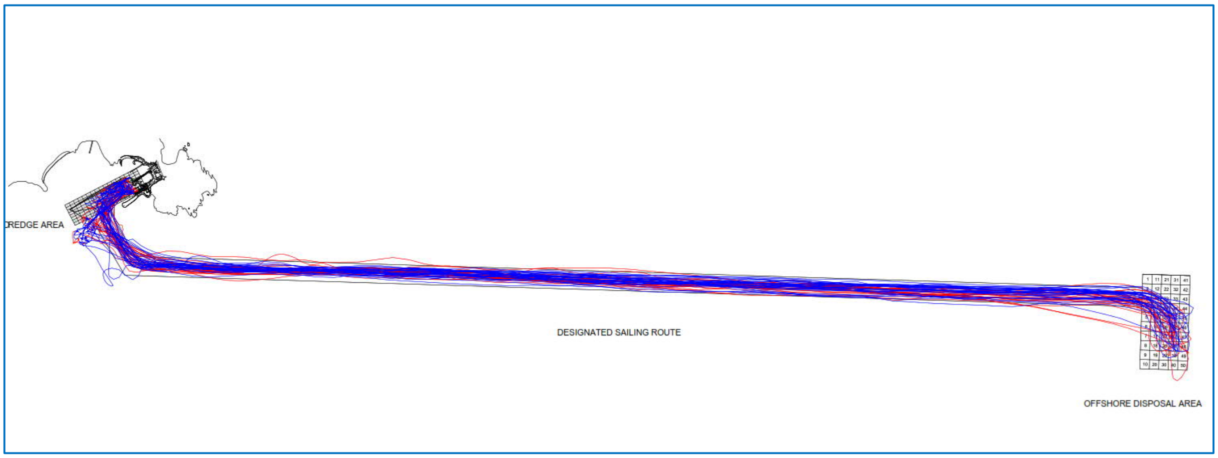


Figure 6-5 Track Plots

When the barge is open it also produces a track that show where it has been while open as shown in Figure 6-6.

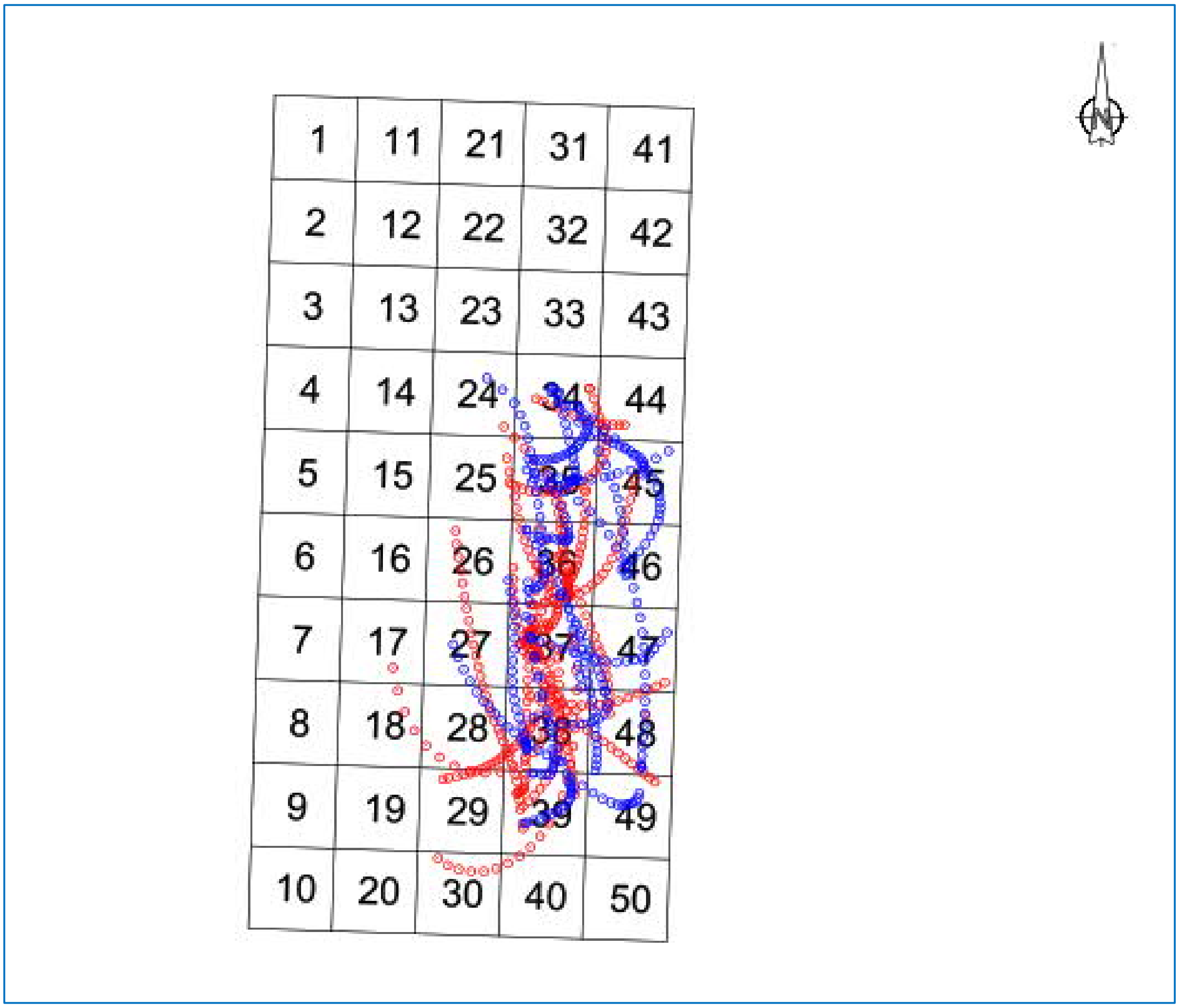


Figure 6-6 Barge Open Tracks

6.4 Emplacement Cell

6.4.1 Emplacement Cell - Indicative Construction Sequence

Dredging activities at Berth 101 will be staged to accommodate the construction sequence of the wharf contactor, this will drive the placement sequence in the Emplacement Cell. A summary of the proposed staging for dredging and reclamation works is provided in Table 6-2 below. Selected construction stages are illustrated in Figure 6-7 to Figure 6-10.

Table 6-2 Indicative dredging and reclamation staging

Stage	Berth 101 (Dredging)	Emplacement Cell (Dredging and reclamation)
1	-	Excavation of bund foundation trench from Ch 075 to nominally Ch 400 and stormwater channel key trench, and placing material within the containment cell; Construct an internal bund from Ch 350 to the shore at RL-1.0m.
2	Removal of Unit 1 material up to the nominated set back from the new wharf down to the Unit 1/Unit 2 interface with nominated buffer depth (clean suitable material for bund construction).	Construct containment bund (first stage) from Ch 0 to Ch 400 and create a landside stockpile. Combination of barges bottom dumping and MHB unloading. Overfill the footprint of the stormwater channel extension with Unit 1 sands up to +0.9m PKHD via MHB unloading.
3	Dredge HM and HS (contaminated) materials.	Place HM and HS materials behind the internal bunded area below -1.0m PKHD.
4	-	Build up bund out of the water and install the revetment. Combination of MHB and land based construction The alternate bund construction method would involve the placement of the buttress rockfill to the rear of the bund, in lieu of the immediate placement of dredge fill behind the bund.
5	Dredge Unit 2 (including ASS/PASS) material from current berth pocket.	Place dredge materials in the containment area below RL+0.9m gradually covering trench materials with HM and HS
6	Dredge Unit 1 and Unit 2 materials (continued)	Excavation of toe trench from Ch 400 to Ch 600 and placing material within the containment cell. Continue placing Unit 2 (including ASS/PASS) followed by Unit 1 Capping
7	Removal of Unit 1 material from Berth 101 wharf Ch 0 to Ch 100 up to the wharf face and down to the Unit 1/Unit 2 interface with nominated buffer depth (subject to wharf construction timing).	Construct bund from Ch 400 to Ch 600 leaving an access channel for barges. Filling will again be a combination of bottom dumping and unloading with MHB.
8	-	Build up bund out of water and install revetment. Combination of MHB and land based construction. The alternate bund construction method would involve the placement of the buttress rockfill to the rear of the

Stage	Berth 101 (Dredging)	Emplacement Cell (Dredging and reclamation)
		bund, in lieu of the immediate placement of dredge fill behind the bund.
9	Dredge Unit 2 material at Berth 101 wharf Ch 0 to Ch 100.	Place dredged materials in the containment area below RL+0.9m
10	Removal of Unit 1 material from Ch 100 to Ch 200 up to the wharf face and down to the Unit 1/Unit 2 interface with nominated buffer depth (subject to wharf construction timing).	Place dredge materials using the MHB to unload barges to a draft of 2m to cap current material in the containment area
11	Dredge Unit 2 material wharf Ch 100 to Ch 200.	Place dredged material in the containment area below RL+0.9m, unloading with the MHB to RL+0.9m.
12	Removal of Unit 1 material from Ch 200 to Ch 300 up to the wharf face and down to the Unit 1/Unit 2 interface with nominated buffer depth (subject to wharf construction timing).	Place dredged material using the MHB to unload barges to cap current material in the containment area; Landside placement of Fill material to cap area at design. Once the cell is sufficiently filled, construct stormwater channel extension by excavating previously placed Unit 1 sands. Excavated sand to be reused as capping material.
13	Removal of Unit 1 material from Ch 000 to end up to the wharf face and down to Unit the Unit 1/Unit 2 interface with nominated buffer depth (subject to wharf construction timing).	Place dredged material using the MHB to unload barges to cap current material in the containment area.

Figure 6-7 Indicative Stage 1 and 2

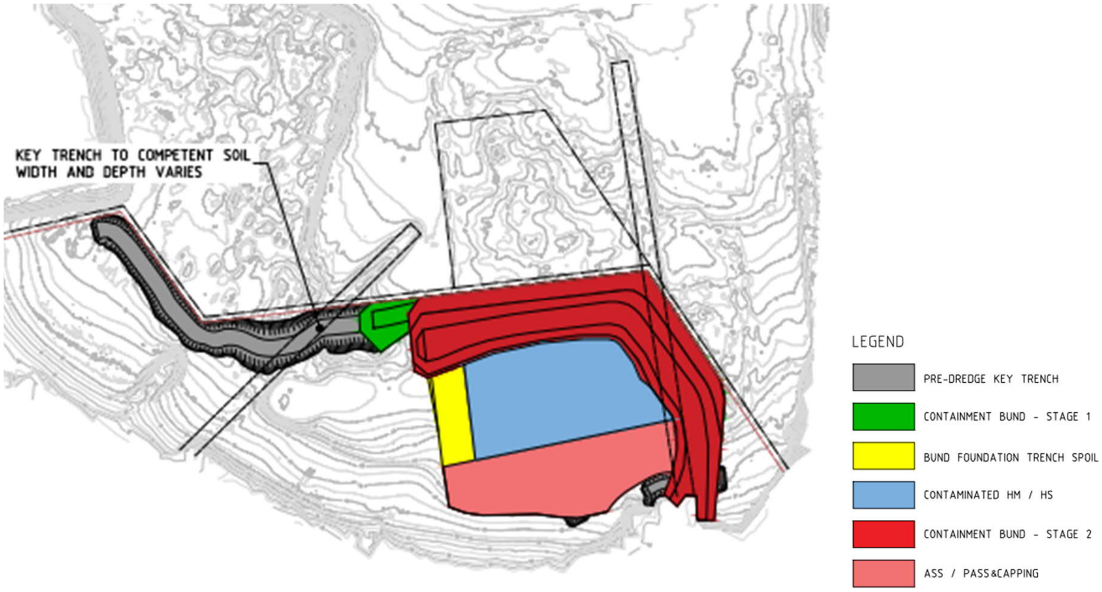


Figure 6-8 Indicative Stages 3,4 and 5

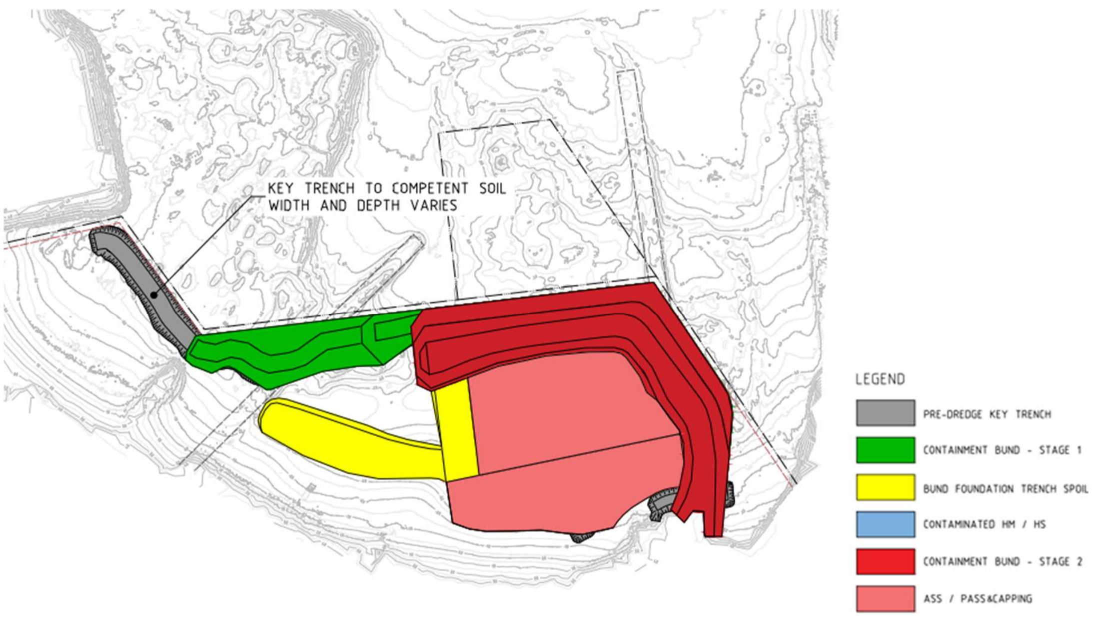


Figure 6-9 Indicative Stage 6 and 7

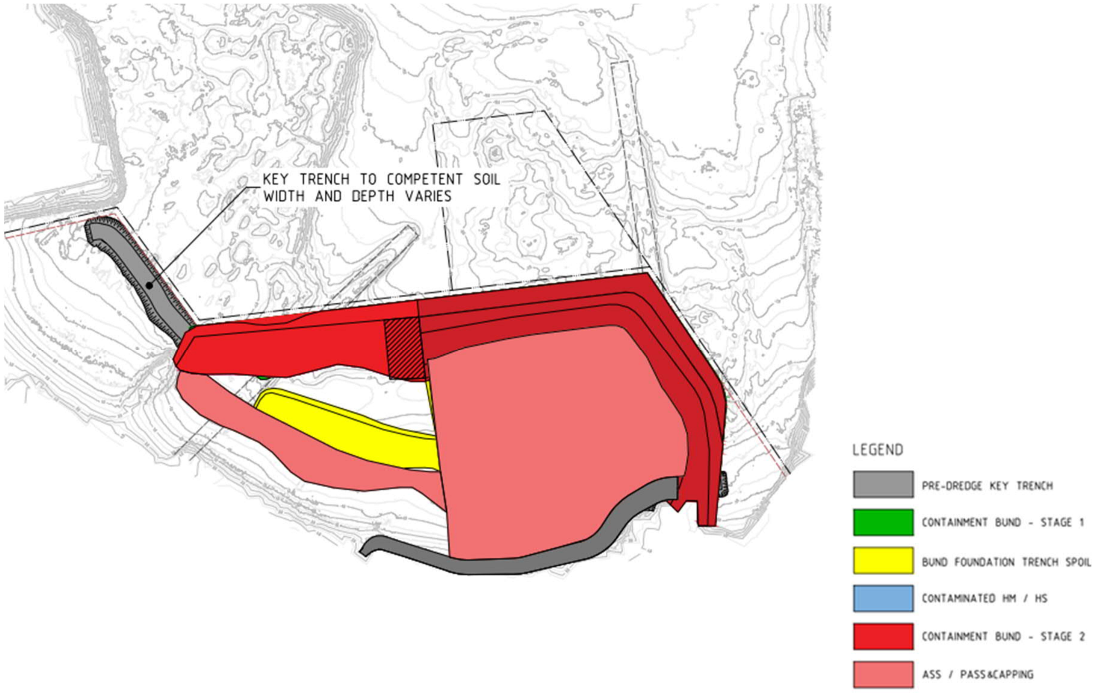


Figure 6-10 Indicative Stage 8 and 9

6.4.2 Turbidity Control – Outer Harbour Emplacement Cell

The installation of silt curtains will be carried out prior to dredging activities at the emplacement cell. Silt curtains will typically be Class 3 curtains, suitable for tidal and working harbour conditions, with details including vertical extent to be determined by design specialists in accordance with the IFC performance specifications. Seastate and water conditions at Port Kembla Outer Harbour varies according to prevailing weather and vessel traffic. However, conditions are generally comparable with 'open water' conditions and the calibre of silt curtain and turbidity controls are to be designed by the Contractor's specialist and manufactured by the Contractor's supplier accordingly to best withstand the conditions.

Alignment and anchoring of the silt curtains may require input from PANSW to determine the level of, and requirement for, navigation and special markers to alert vessels operating in the Port area of the presence of the marine hazard.

Gates through the silt curtain will be required for the passage of marine plant in and out of the emplacement cell construction area. Options for the gates include the use of fixed silt curtain gates, or bubble curtains, which allow equipment movement over the bubble stream while retaining sediment and other suspended matter behind. Exact requirements for the design and supply of the silt curtains will be dependent on the requirements of the EMP manufacturers design requirements.

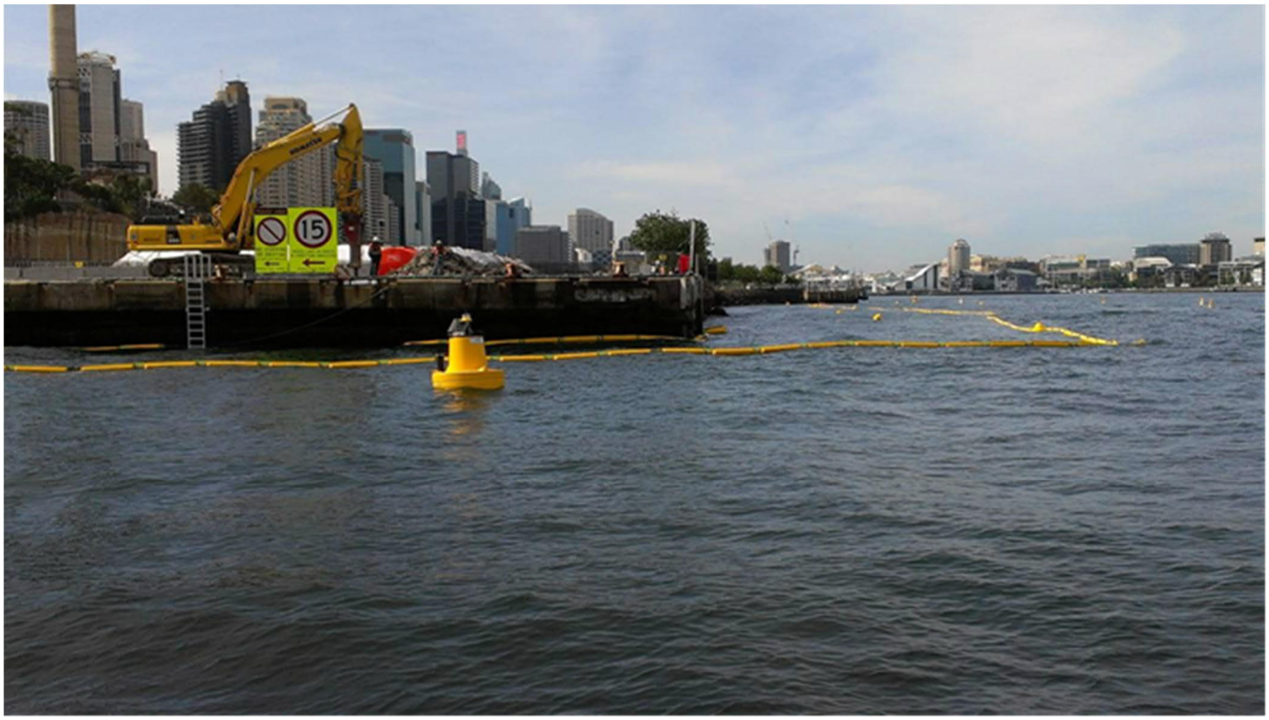


Figure 6-11 Example of the intended silt curtain

6.4.2.1 Silt Curtain Design

Since the purpose of a floating silt curtain is to disrupt the water flow and allow the suspended sediment to settle, the curtain will be deep enough to facilitate the following:

- Provide sufficient disruption to the water flow (current);
- Remain clear from the seabed at low tide; and
- Where required, adhere to EPA or other environmental requirements.

A gap between the bottom of the silt curtain and the seabed at low tide is typical, with the extent of this gap determined by the Contractor's specialist in accordance with performance specifications. Silt curtains are intended to promote the settling of sediment by driving particles closer to the seabed. Water will always find the path of least resistance, therefore the water will pass between the lower edge of the curtain and the sea bed. Sediment must be forced deep enough to improve settlement. The gap between the curtain and seabed provides a significantly more effective pressure release than the porosity of geotextile.

The deeper the curtain, the greater the hydraulic loading which can cause the curtain to flare, resulting in additional horizontal loads. Further, if the curtain penetration is too great, the water that passes beneath the skirt will be squeezed through a small gap resulting in possible further erosion of the seabed and a resuspension of particulate into the upper water column further downstream.

Silt curtain effectiveness is considered as the degree of turbidity reduction achieved within the controlled area relative to the turbidity levels outside of the area. Factors which affect this effectiveness are:

- The quantity and type of material in suspension
- The characteristics, design and construction of the turbidity boom
- The mooring and square metre area of the curtain deployed
- Deployment location and positioning
- The hydrodynamic conditions experienced such as tidal movement, wind velocity and wave height

The silt curtain is not designed to dam the turbid water. Instead, it provides a control for the dispersion of the sediment laden water and allows this suspended silt to settle. It is widely accepted that the interaction between the water column and curtain is a crucial factor in determining the efficiency of the silt curtain. It is integral to the design that the hydrodynamic loads are understood. These loads are the forces applied to the moorings and silt curtain resulting from currents, winds and waves. These forces can affect the buoyancy and ballast ratio, optimal skirt depth and choice of moorings and anchors.

6.4.2.2 Installation

The Outer Harbour silt curtain will be restrained in place by an anchorage system to ensure the silt curtain remains in place. The anchorage system will be designed for the Outer Harbour marine environment based on the parameters provided in the IFC performance specifications.

The installation process involves a combination of vessels, a barge, tug, and low water work punts. Containment curtains are normally constructed in 15m lengths and will be delivered in a container in sections up to a kilometre long ready to be towed out for deployment.

Prior to deployment, end attachment points and tidal compensation systems are fitted at the shore. The roll out should aim to be done in slack tide or calm weather conditions.

Figure 6-12 Silt Curtain Installation Barge

6.4.2.3 Maintenance

The frequency of the inspections is determined by the local conditions. It will initially be done weekly. A storm or heavy rainfall will often trigger an additional inspection.

On completion of the inspection or maintenance visit, an inspection check list and a photographic report is provided to the customer covering:

- Installed navaids and lights
- Anchoring position
- Fatigue and effectiveness

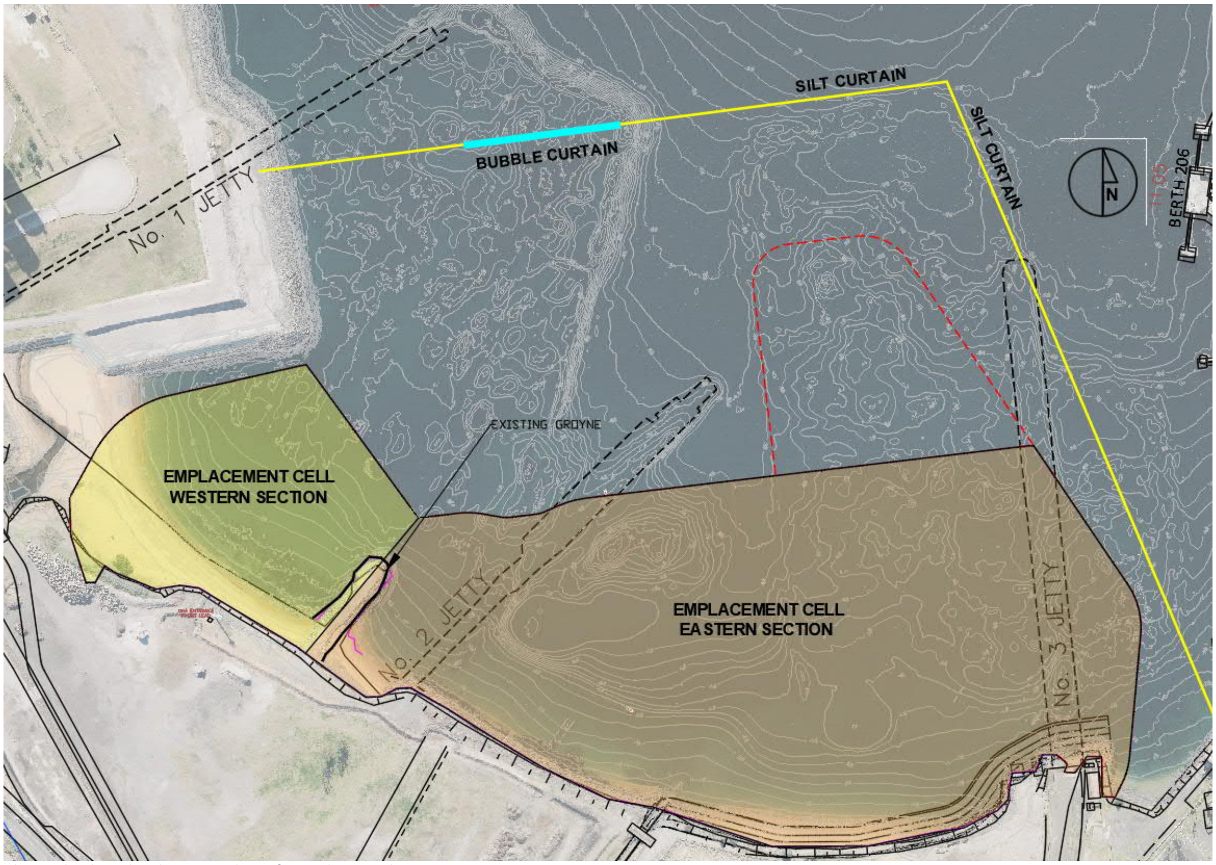


Figure 6-13 Indicative Location of the silt curtain

6.4.3 Placement Methodology

Heron will use a combination of bottom dumping and unloading of barges to place the dredge material in the disposal area. This will maximise the capacity of the Emplacement Cell and provide an economical solution for the project. Where possible barges will place material by bottom dumping but due to the restricted draft this will not be possible for the entire project.

It is intended to mobilise a barge (MHB) with a Liebherr 120t material handling excavator installed on the barge. Barges will be moored alongside the MHB and then be unloaded by the material handler directly to the required storage area at the required elevation. Barges may be completely or partially unloaded by the MHB. Once the required barge draft has been achieved the barge will then be bottom dumped and returned to the dredge.

When unloading to final design of RL+3.55m landside equipment will be required to trim and place some material.

Using this combination of unloading methods it will be possible to place at least 90% of the dredged material from the marine side virtually eliminating the need for road trucks on public roads.

Construction of the bunds begins with excavation of the toe trench using the dredging equipment and placing the excavated material within the emplacement cell. Nominally 350m of trench will initially be excavated.

Once the dredge area at Berth 101 is prepared, removal of revetment rock, fill and Unit 1 material will be dredged, with the fill and Unit 1 bottom dumped into the toe trench, progressively raising the level to RL-3m PKHD. When barges become draft restricted the bund construction will continue from the material handling barge, unloading barges and placing it directly over the bund. At this stage it will become possible for land-based equipment to progressively work out from the shore on the bunds, this will enable the use of stockpiled Fill to be used to construct the bunds.

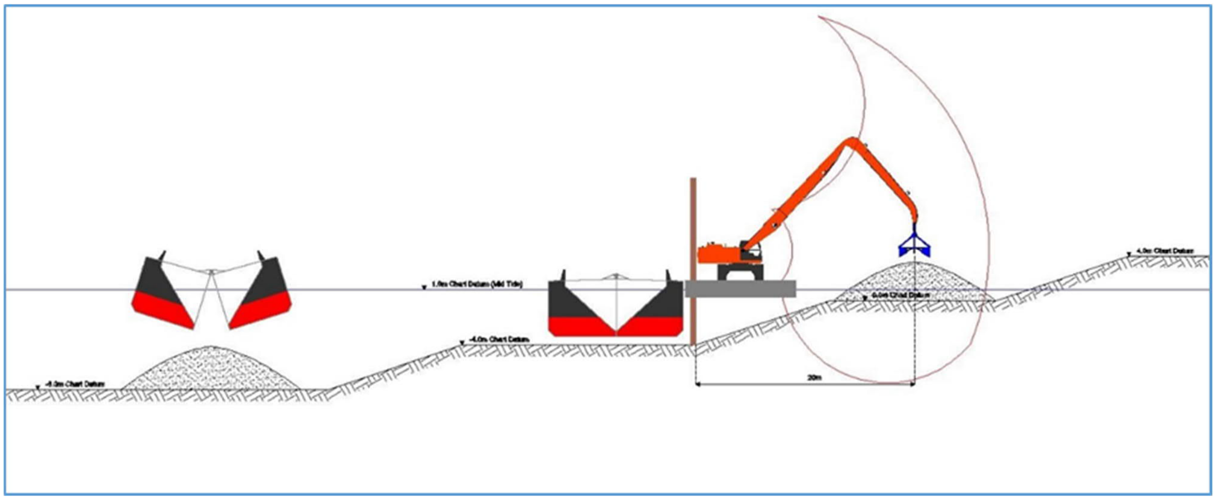


Figure 6-14 Placement Methods

Controls for ASS management are described in Section 8.4.

The rate of placement of bund and cell emplacement materials will be kept below a maximum weekly cumulative thickness of 4.0m. Placement of materials will also comply with the following height differentials:

- 1.5m height differential between cell emplacement and bund crest throughout construction stages
- Maximum cell emplacement material grade of 10H:1V in any direction
- Lateral/leading edge maximum bund gradient of 4H:1V

To facilitate an alternate bund construction approach, there is provision for a stabilising rockfill buttress to be constructed along the landward side of the bund, as described in Section 5.4. This removes the 1.5m height differential limit between the bund and the emplacement cell.

6.4.4 Bund Protection

Heron shall construct the bund revetment to the final design in accordance with the specifications, incorporating the armour rock that is recovered from the existing Berth 101. The works shall include the placement of geotextile extending from bund crest level to the toe of the revetment, underlayer rock, and riprap armour all in accordance with the drawings.

6.4.4.1 Rock Placement

Rock will be transported to the work area from the stockpile area using 40t ADTs. Smaller armour rock and bedding materials will be tipped near the required placement area. Larger armour rock will be unloaded individually with a grab. All grades of rock will be placed using either a bucket or grab fitted to a GPS controlled 50t excavator or the MHB. This will allow for very accurate placement to ensure that the requirements of the Technical Specifications are met.

A grid system will be set up over the extent of the bund wall showing the operator of the excavator where rock is required and how many dumps are required to achieve the profile. This model will be updated following hydrographic survey of the revetment. Figure 10 shows the grid system used to place rock, numbers indicate the number of rock required to fill the area.

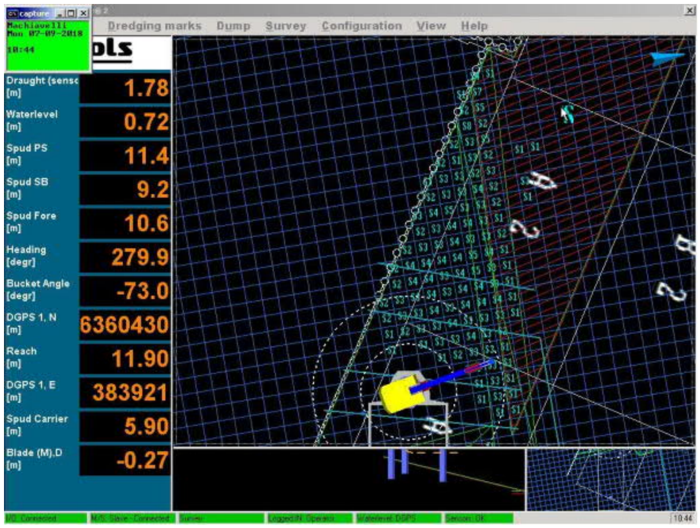


Figure 6-15 Excavator Operators View of placement plan

6.5 Port Activities and Restrictions

A port navigation plan will need to be developed by the Contractor to detail how marine activities are managed and communicated with Port Authority of NSW during the course of the works.

7 Contingency Measures

The following section provides details of the proposed contingency measures in the event of a failure or deficiency during or after construction. This has been prepared primarily by Heron as part of the Early Contractor Involvement process.

7.1 During Construction

7.1.1 Silt Curtain or Bubble Curtain Failure

Silt curtains will be installed around the dredge area and the Emplacement Cell totalling in approximately 2km of curtain. Heron will have a robust maintenance program and a substantial inventory of replacement curtain and fittings. Dredging will be suspended if the silt curtain becomes unserviceable until either temporary or permanent repairs have been approved by the Project Manager.

Bubble curtains and fixed gates in the curtain will be subject to the same stringent process.

7.1.2 Equipment Failure

If there is a catastrophic failure of the dredge or barges during the project, Heron will mobilise a replacement dredge or barge from New Zealand. For all normal breakdowns each of the vessels has a large inventory of spare parts including engines, hydraulic pumps and cylinders and wear parts.

7.1.3 Loss of Dredge Material Outside the Emplacement Cell

Split hopper barges will be used for all material transport. Barges will have overflow vents sealed. Barges are to be in good order and regular inspections completed. All barges will be fitted with low pressure flashing strobe lights to alert dredge operators if the barge is not properly closed. In addition, barges are fitted with DGPS and data logger systems, this will provide track plots for the hopper barges and record the position, elevation, and time that the hopper barge opened and closed. This system is backed up to the cloud.

Heron have in place a number of engineering and administrative controls to prevent the accidental discharge of a barge as outlined in their Standard Operating Procedures. In the unlikely event that there is an accidental discharge from the barge an incident report will be submitted detailing the quantity and location of the material. In consultation with AIE and PANSW Harbour Master the material would be removed using the dredge.

7.1.4 Contaminated and ASS material placed in the Perimeter Bund

Positive identification of the areas of contamination at Berth 101 has been carried out, allowing the dredging contractor to only target these areas when the perimeter bund construction has progressed to the extent there is sufficient capacity to start receiving those materials.

Tracking of all material types from dredge area to the Emplacement Cell will be completed for every load. Contaminated material will only be placed in a pre-determined cell inside the perimeter bund. Daily reports will provide evidence of the placed material including track plots, print screens, tug reports and all backed by daily hydrographic survey.

In the event that any material is placed incorrectly (eg. contaminated material in the perimeter bund), that part of the works will be remediated to the satisfaction of AIE and the Construction Auditor (in accordance with the Infrastructure Approval).

7.1.5 Placement of ASS Inside the Emplacement Cell

No ASS material will be placed above +0.9m PKHD for the duration of the project. Equipment used to place all dredge material will be fitted with a GPS controlled management system giving the operator exact information as where they are placing the material, including the levels. If material is above the required level the operator should remove it as part of the operation.

All levels achieved within the emplacement cell will be verified by survey prior to capping layers being placed as per the Stage 2A/B Management Plans.

7.1.6 Hydrocarbon Release to the Environment

The dredging spread proposed for project utilises several measures to firstly prevent Hydrocarbons and/or other environmentally hazardous substances from entering the water or impacting on the marine environment. Controls for chemical and hydrocarbon spills are described in Section 8.3.6.

In the event of a hydrocarbon spill into the water all personnel will be familiar with the procedures and reporting process as outlined in Heron's Stage 2A/B Management Plans that will cover emergencies such as a hydrocarbon spill. All vessels engaged in the PKGT project will have onboard sorbent materials, oil spill booms, pads and suitable PPE to assist any spill on the project.

7.1.7 Vessel Collision or Grounding

Project vessels are required to follow a strict communication process prior to moving around in Port Kembla Harbour requiring approval from VTS. All masters of vessels will have the appropriate ticket and experience to operate the vessel, a local knowledge certificate for Port Kembla Harbour. The Stage 2A/B Management Plans will set out the communication processes for operations in a Port including interaction with recreational vessels.

Sailing speeds for tugs towing split hopper barges, auxiliary equipment and small support equipment will be as directed by the Harbour Master and be in line with good seamanship. At all times adherence to notice to mariners, navigational aids and direction will be followed.

In the event of a near miss or incident it is a legal requirement to report incidents to AMSA under Section 268 of the Navigational Act. Emergency procedures for each must be followed as per their SMS.

7.1.8 Adverse Seastate and Weather Conditions

The ability of a BHD to operate requires that weather and sea state are within the capabilities of the dredge. Generally, this can be limited by a combination of wave height, swell direction and current. The Machiavelli can operate in sea conditions of between Hs<1.0m to 1.5m, without a barge alongside. These parameters may increase if the bow of the dredge can be positioned into the prevailing swell/wind direction.

If the BHD pontoon has reached its limitations, the Superintendent or delegate will decide when dredging will be terminated as per the De Donge operational manual requirements.

Daily weather information and forecasts will be made available to each of the project vessels, so the Masters can make their decisions relevant to the conditions. If required to cease works, project vessels will be made fast alongside the dredge, or at a suitable wharf, as directed by the Harbour Master. Barges and tugs may also be placed on anchor, subject at the Harbour Masters approval.

7.1.9 Earthquake

Following a recorded earthquake, works will be stopped to access the stability of the dredge works and the Emplacement Cell. Dredging may be required to stop until repairs have been completed. Damage to the emplacement cell due to earthquakes during the construction period will be surveyed, redesigned and remediated to the satisfaction of the engineer.

7.1.10 Surplus ASS

The Emplacement Cell design has been based on detailed geotechnical investigation and interpretation; prepared by suitability qualified and experienced engineering practitioners; and includes a number of assumptions on inputs such as bulking factors. The design demonstrates that there should be sufficient capacity for ASS within the cell below +0.9m PKHD. In the event that some materials perform differently to expected, there is the potential for a surplus ASS volume that cannot be accommodated within the Emplacement Cell. At the time of this report AIE is investigating offshore and onshore disposal options, which would be subject to approval by the relevant authorities including DPIE, with neutralization/treatment being disregarded due to difficulties of this approach for stiff clays.

7.2 Post Construction

As part of the detailed design the following potential modes of failure have been identified:

- Excessive crest subsidence / settlement. A maximum of 250mm settlement has been allowed for during the life of the emplacement cell. Should more than 250mm of settlement occur, the bund crest would have to be lifted to be at a minimum RL +3.30 m PKHD.
- Riprap armour damage - the design approach allows for initial damage of up to 5% of riprap armour units being displaced during the 50-year ARI storm event, or intermediate damage during a 100-year ARI storm event. Therefore maintenance of the revetment is expected during its design life (Refer to Section 9.2 for further details of post construction monitoring and maintenance).
- Revetment damage - revetment damage/failure would likely be caused either by a storm event exceeding the design storm event or associated with failure of the bund structure. It is expected that revetment damage would be identified and rectified early where the Inspection and Maintenance Plan is followed.
- Bund instability – failure of the bund structure either towards the Harbour or into the emplacement cell. This type of failure could result where there is of substantial damage/loss of the revetment which has not been repaired, a loading situation outside of the design specifications.

It is not expected that the failure modes listed above will result in collapse of the structure or a sudden loss of function. It is also noted that even in the event of bund failure, material identified as ASS and/or contaminated will still be maintained below +0.9m PKHD, reducing any potential consequences.

The risk of these failure modes occurring has been managed in design through the following:

- Consideration for different material strength parameters
- Analysis of multiple design cases for each failure mode
- Analysis at various cross sections/locations along the proposed perimeter bund/emplacement cell
- Adoption of engineering reduction factors and factors of safety
- Calculation of various settlement and consolidation cases including adoption of an estimated PCS range.

For the purposes of post construction contingency measures, it has been assumed that the perimeter bund and emplacement cell have been built according to approved and accepted design specifications, and construction supervision requirements include Designers Site Geotechnical Representation by SMEC to verify that works have been completed in accordance with the design intent. In the unlikely event there is a loading event which causes significant damage to the revetment and bund core, the normal approach would be to isolate the area, perform an engineering assessment of the type and extent of damage and then design, plan and execute the required repairs.

8 Environmental Controls

The following sections utilise information provided by the dredging contractor Heron.

8.1 Environmental Risk Assessment, Identification and Control

The Dredging contractor Heron has completed a draft Environmental Risk Assessment (ERA) to identify potential risk and controls to be implemented during the dredging of contaminated materials and their subsequent placement in the Emplacement Cell. It is recommended that the draft ERA will be used as a basis to undertake an environmental risk assessment workshop, prior to dredging.

This workshop will be attended by all stakeholders and by an interdisciplinary team. Each risk will be discussed, and controls proposed and agreed to ensure that residual risk is brought down to an acceptable level.

8.2 System Management Procedures

Heron has an ISO 14001 Environmental Management Systems and ISO 9001 Quality Management System. Telarc will audit Heron during the PKGT project. In support of the ISO accreditation Heron has produced, and will implement, a number of Stage 2A/B Management Plans for the overall management of the project.

8.3 Environmental Management & Monitoring

An Environmental Management Strategy (EMS) will be prepared as part of the project Stage 2A/B Management Plans (SMP). The Stage 2A/B Management Plans will address Spoil Management, Dredging and Excavation, Water Quality Monitoring, and Contaminated Spoil as required in the approval conditions. The Management Plans for the spoil, dredging, excavation, water quality, contaminated spoil will herein be referred to as the Environmental Management Plans (EMPs). The EMPs will be reviewed and approved by the reviewed in consultation by the EPA accredited Site Auditor, as per the Infrastructure Approval. Environmental management will be in accordance with the Project Approval conditions, approved EMPs and the Environmental Protection Licence (EPL 21529). The EMPs will include an environmental monitoring program that includes the requirements of the EPL and Approval conditions as well as the mitigation measures.

8.3.1 Sensitive Receptors

The EIS identifies the sensitive receptors in relation to the project site and activities. Figure 17-1 of the EIS depicts the representative sensitive receivers noise monitoring and land use locations map, Figure 18-1 of the EIS depicts the site and sensitive receptor locations for air quality.

Sensitive receptors also include the ground water, the surface water and marine environment, the marine species, the community and the workforce. All sensitive receptors will be considered in the Risk Workshop and Risk Assessment in Section 8.1 above. The management measures listed in the EIS will be implemented as required by the MCOA 1 and the implementation will be detailed in the EMPs that will be reviewed in consultation by the EPA accredited Site Auditor, as per the Infrastructure Approval.

8.3.2 Water Quality

The EIS discusses water quality extensively. Water quality in the Inner Harbour and Outer Harbour of Port Kembla has been historically impacted by urban and industrial discharges as well as port activities. The EIS states:

- Potential impacts during the construction phase are primarily associated with water quality impacts generated during the removal, handling and placement of dredged sediments. In particular, dredging and reclamation activities may generate turbid plumes, mobilise contaminants, disturb dinoflagellate cysts within the Outer Harbour and increase rates of sedimentation.

The Stage 2A/B Management Plans will be developed to manage water quality impacts on the project. The Plans will incorporate and address the following:

- The marine water quality objective,
- the EPL monitoring requirements and limits for the water quality monitoring locations,
- the EPL requirement to implement the approved Ecological health monitoring plan,
- the management measures in EIS particularly but not limited to Table 12-3 for water resources.
- the Plans will also include all relevant conditions from Schedule 3, Condition 3 of the Infrastructure Approval
- the risks and control measure discussed at the Risk Workshop and Risk Assessment.

The Plan shall detail how water quality will be part of the Induction and training on the project for all staff throughout the project.

8.3.3 Introduced Marine Species (IMS)

All vessels mobilised to Port Kembla for the dredging and cell construction will be inspected by a suitably qualified marine biologist to ensure that marine pest species in particular are not introduced.

The BHD Machiavelli and two Split Hopper Barges (SHBs) will be towed from Newcastle to the Port Kembla by tugs. The Material handling barge will be towed from Sydney to Port Kembla. All vessels are located within New South Wales waters and therefore present as low risk. In preparation for mobilising to the site Heron will have an IMS assessment of all vessels to be used on the project completed by a Marine Biologist. Prior to floating plant arriving at Port Kembla, the IMS assessment will be provided to the AIE for review in accordance with the EMPs.

The BHD Machiavelli (BHD) was slipped in April 2019 and had her hull cleaned and antifouled as part of survey requirements. The two split hopper barges were slipped in April/May and then again in October 2019 and remained in Yamba since that slipping. Reports on the works and antifoul certification will be provided to AIE.

Each of the vessels proposed for the project has an approved Heron Biofouling Management Plan (HBMP) that is specific to that vessel. The plan follows the outline given in the International Maritime Organisation (IMO) Guidelines for the control and management of ship's biofouling to minimise the transfer of invasive aquatic species, as adopted under Resolution MEPC.207 (62) on 15 July 2011.

In addition, a survey report will be provided for each vessel to demonstrate they have in place a current certificate of classification, insurances and are in good working order.

The vessel inspections will include the Department of Primary Industries (DPI) marine pest species including, but not limited to Caulerpa Taxafolia, Japanese seaweed (wakeme) and Asian green mussel etc. If pest species are identified these will be reported to DPI Aquatic Biosecurity Unit hotline on (02) 4916 3877 as required and the vessels will be cleaned and reinspected to confirm cleanliness prior to mobilisation. International vessels (should they be required) will empty ballast water in accordance with the latest version of the Australian Ballast Water Management Requirements (DAWR, 2017).

It is also a condition of the EPL that all dredgers and associated vessels must have their ballast & bilge water pumped out prior to arriving in Port Kembla Harbour.

8.3.4 Cultural Heritage

Cultural heritage will be addressed in the project EMPs and in Heritage Unexpected Finds Protocol developed for the construction phase of the project.

8.3.5 Solid & Liquid Waste

The EPL provides the following conditions of waste:

- Condition O5.1 Excavated material and/or dredged spoil must not stockpiled in Outer Harbour unless it will be re-used within the proposed Outer Harbour emplacement cell.

- Condition O5.2 Stockpiles of material stored at the premises must either be used as on-site backfill or emplacement cell construction, or disposed offsite to a facility licensed to accept the material, within 12months following stockpile creation.

The management and minimisation of solid and liquid waste will be detailed in the EMPs to be reviewed and approved by the AIE Environmental Site Representative. All relevant conditions from the Infrastructure Approval and mitigation measures in the EIS will be incorporated and addressed.

Solid waste from vessels and land construction activities will be classified in accordance with the NSW EPA Waste Classification Guidelines and disposed of to a suitably license facility. Waste disposal bins will be secured and fitted with lids to prevent litter being blown onto waters and to prevent birds and pests scattering waste. Where practical waste will be compacted and collected and emptied at regular intervals.

Liquid waste and sewage generated on vessels will be appropriately treated and managed in accordance with NSW legislation and regulation. Heron intends to implement the following strategies during marine operations:

- Sewage generated on-board is to be directed to the on-board treatment system. The system must be designed to meet the NSW legislative standard for Grade A treated sewage.
- Effluent from the treatment system is only to be discharged in appropriate locations to ensure compliance with the NSW Transport Operation (Marine Pollution) Act and Regulations (refer s.48 of the Act; Sch. 4 of the Regulations).
- Effluent is to be diverted to holding tanks when operating in nil discharge areas.
- The holding tank is to be pumped out either in accordance with untreated sewage requirements under New South Wales legislation or otherwise by appropriate licensed contractors while the dredge is in port.

The liquid waste management systems will be regularly monitored and records kept. If untreated sewage is released in a nil discharge zone, the breach must be reported to TfNSW (formerly RMS) as soon as possible including estimates of the likely volume of sewage discharged and the location of the release. Depending on the volume of material discharged and the sensitivity of the location of the discharge, the dredge contractor may be directed to undertake water quality monitoring and/or clean up at its cost.

8.3.6 Chemicals & Hydrocarbons (including spill prevention)

Heron has developed procedures to prevent the marine environment from being harmed or contaminated during the dredging activities by chemicals or hydrocarbon release. No hazardous or contaminated substances are to be released to waters from construction equipment and no ballast water or sediments from ballast tanks will be discharged into waterways. The strategies implemented to achieve this include, but not limited to:

- Quick deployed marine grade absorbent of boom and recovery equipment in the unlikely event of a hose failure.
- Preventative Maintenance Schedule in place which includes 6 hourly visual checks of high-risk hydraulic hoses. This process is documented by the Mechanical Attendant.
- Sealed Barges to be utilised to eliminate sediment release during loading and transport.
- All dredging activities will be conducted using equipment in good working order that has a stringent preventative maintenance program in place.
- Heron will be familiar with, and adhere to, the PANSW Emergency Spill Response requirements.
- Any fuels or chemicals stored at the Emplacement Cell or on barges, will be stored in a bunded area to prevent any chemical leaks or spills entering the water.
- Heron shall ensure vessel pollution drills are carried out as per the vessel SMS and legislative requirements. Any pollution drills will be coordinated with the Harbour Master and VTS prior to commencement. A Marine Pollution drill shall be conducted during the first week of the project and as per the drill schedule. Drills shall be recorded on the Heron Emergency Drill Record Form and shall be utilised to ensure drills are documented and any actions from the drills recorded.
- Excavators fitted with burst control valves on hydraulic system.
- Biodegradable Panolin Hydraulic Oil utilised on BHD and SHBs.

- Appropriate spill kits will be available on-board the BHD and tugs actively involved in the construction works as per survey requirements.
- In the event of a spill, incident or emergency, construction activities in the immediate area will cease immediately.
- Heron will carry out regular inspections of its work areas and complete daily inspection forms and the site inspections to check for leaks and equipment damage.
- Any spills will be immediately reported, and incident reporting requirements followed. Reporting:
  - Any spill, whether it occurs in water, or on land and subsequently entered the water, must be immediately reported to Vessel Traffic Service (VTS). Aquatic spill kits are to be kept on site during construction.
  - Australian Maritime Safety Authority (AMSA) Incident Reporting requirements to be followed.
  - PANSW Incident Reporting requirements to be followed.
  - As appropriate, the NSW EPA will also be notified. Written details of the incident will be recorded, investigated, and addressed as per an Incident Procedure and the EPL. Written details of the incident will be prepared within seven days of the date on which the incident occurred.
  - A written Report will be prepared if required by the EPA as per the EPL.

A marine refuelling procedure will be developed and approved to ensure safe handling and refuelling of vessels on the project and minimises the risk of spills and leaks as much as reasonable and feasible.

8.3.7 Benthic Primary Producer Habitat

The EIS records (13.3.1 Marine habitat) that the seabed within the Inner Harbour has previously been described as consisting of unconsolidated silt expanses. Furthermore, no seagrass was recorded in the Outer Harbour reclamation area during the conduct of the geochemical assessment in 2018. There are no known mapped seagrass communities adjacent to the project.

The EIS also records macroalgae have been known in the Inner and Outer harbour but none are present within the proposed dredging footprint.

The Dredging and spoil relocation methodology has been developed to ensure that the benthic and primary producer habitat around the project are not adversely impacted. This will be achieved by the installation of approved dredging controls around the dredging area including silt curtains that ensure maximum retention of turbidity and fines within the dredging area and do not disturb the bottom at low tide. Dredging will only take place in the approved dredging zone and tracking and recording of vessel movements will take place. Also dredging spoil will be retained fully within the split hopper barge used to relocate spoil to the bunded spoil emplacement cell to ensure no leaks and that the spoil is placed in the pre-determined part of the cell and at the correct depth.

Management measures ME1 (EIS table 13-6) is proposed to be implemented during construction in accordance with Condition 1 of the Infrastructure Approval.

Please refer to Section 6for more details on the emplacement methodology and the sequencing of dredging.

8.3.8 Marine Fauna

The EIS Table 13-1 Potential for species listed under the EPBC Act 1999 to occur at the project site includes: Black rock cod, Southern right whales, humpback whales and Grey nurse shark. Also Listed marine species (not previously listed including: Long-nosed fur seals, Australian fur seals, Indian Ocean bottlenose Dolphins and Bottlenose dolphins and sydgnathids (i.e. seahorses, seadragons, pipefish and pipehorses).

The EIS proposed management measures for marine ecology in Table 13-6 of the EIS shall be implemented. These are proposed to be implemented as part of the EMPs and dredge and vessel management procedures. Training and monitoring to look-out for marine species on all vessels will be undertaken and the measures will be implemented including to address artificial light emissions that may affect marine fauna.

The interaction of all vessels with cetaceans and pinnipeds will be compliant with Part 8 of the Environment Protection and Biodiversity Conservation (EPBC) Regulations (2000). The Australian Guidelines for Whale and Dolphin Watching (DoEE, 2017) for sea-faring activities will be implemented across the entire project. This includes the implementation of the following guidelines:

- Caution zone (300 m either side of whales and 150 m either side of dolphins) –vessels must operate at no wake speed in this zone.
- Caution zone must not be entered when calf (whale or dolphin) is present
- No approach zone (100 m either side of whales and 50 m either side of dolphins)
- Vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod, or follow directly behind
- If there is a need to stop, reduce speed gradually
- Do not encourage bow riding
- If animals are bow riding, do not change course or speed suddenly.

8.3.9 Compliance Monitoring and Reporting

The EMPs will detail a compliance tracking program for the Conditions of the Infrastructure Approval and an internal and external schedule of audits and review on the EMPs. The Conditions of the Infrastructure Approval requirements for updating and staging of strategies, plans or programs and the revision of strategies plans and programs will be complied with.

All statutory reporting requirements and time frames in the POEO Act, the EPL and the compliance reporting requirements of the Conditions of the Infrastructure Approval will be strictly adhered to.

Heron states that a Principal an Environmental Management Weekly Report, signed by the Heron's Authorised Person and including the information specified below, as evidence of implementation of the EMPs will be submitted:

- Contract details – the names of the Contract, Contractor and Heron representative, the report date and the period covered.
- Implementation of environmental management – details of:
  - The environmental risks and opportunities, and significant environmental impacts associated with the work.
  - Environmental objectives, targets and measures of performance (where practical).
  - Management actions, including environmental controls, training, inspections and testing.
- Implementation of incident management, including emergency response – details of all environmental incidents or emergencies, including non-compliance with environmental procedures and near misses, implementation of incident and emergency response management, and implementation of corrective action.
- Implementation of review – details of internal reviews, audits and inspections undertaken to verify that on-site environmental processes and practices conform with this ECR including:
  - Monitoring measurement, evaluation and review of activities.
  - The consequences of non-conformances.
  - Investigation, analysis, evaluation and follow-up verification.
  - Corrective and preventative action taken.

8.3.10 Environmental Compliance and Auditing

Environmental Compliance will be tracked as part of the compliance tracking program described and approved as part of the EMPs. The EMPs will be audited internally and externally as per the schedule therein.

Heron states that throughout the project period, weekly Environmental Compliance Audits of activities will be undertaken. Heron Weekly Environmental Compliance Audits are targeted to demonstrate compliance with this ECR with a requirement to immediately rectify any identified issues.

A Project Completion Environmental Audit by the AIE will also be conducted to demonstrate compliance with the EMPs and this ECR. This audit will document all the outcomes of the routine Environmental Compliance Audits and also address how regulator conditions have been met.

8.3.10.1 Internal Audits

The HSE Manager will undertake periodic internal audits of high-risk activities and selected sub-contractors or on the Stage 2A/B Management Plans to ensure that project activities are in accordance with this ECR and EMPs. These audits will include:

- Dredging operations and disposal of dredge material;
- Water quality testing and calibration records, confirming compliance with approvals and regulatory guidelines;
- Waste Management; and
- Noise Management.

Vessels arriving to site, to ensure all floating plant meets legislative requirements which includes:

- Vessel certification;
- Navigational equipment;
- The International Convention for the Prevention of Pollution from Ships (MARPOL);
- Hull, decks and superstructure;
- Lifesaving equipment/capability (Regulation 8 of Chapter I of SOLAS);
- Watertight integrity;
- Fire safety;
- Safety management (dedicated suitable transfer station, hazard marking, winch guarding, deck cranes and lifting equipment etc.)
- Mooring capability;
- Sewage containment or treatment;
- Marine pest check (if mobilising from outside of Port Kembla).

8.3.10.2 External Audits

External audits and inspections of the Project may be conducted by regulators to ensure compliance with the SSI Instrument of Approval, permits and licences. For such audits and inspections, the Heron Environmental Representative and an AIE representative will accompany the auditors.

The findings and recommendations arising from external audits will be recorded in the Heron Improvement Register to be prepared for action and close out. Improvement Register will detail the source of the action (i.e., audit, inspection or other), the action required, target close out date, actual close out date and the person responsible for the action item.

Certification surveillance audits conducted by Telarc shall also form part of the Heron IMS ongoing proactive management.

8.4 Acid Sulfate Soil Management

The Stage 2A/B Management Plans will document procedures to manage acid sulfate soil risk in line with the work methodologies being employed by Heron. The Stage 2A/B Management Plans will be developed in accordance with Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998) and other national guidelines. The emplacement cell has been designed to contain ASS below +0.9mPKHD as per the Minimum Design Requirements. This level has been assessed to have a low likelihood of acid generation.

The design includes a minimum 1m capping layer of non-ASS material to further reduce potential for oxidation. Heron will utilise split hopper barges that can transport material to the emplacement cell in typically less than 30 minutes and be unloaded in a short timeframe reducing potential oxidation. Contingency measures will be developed in the event of breakdown such as maintaining material moisture/wetting of loaded materials to prevent drying.

8.5 Emergency Response and Preparedness

As part of the Stage 2A/B Management Plans, Heron will prepare the Emergency Response Management Plan (ERMP) for the Project in liaison with the Port Authority of NSW. The following factors will be taken into account:

- The parts of the site or adjoining properties likely to be affected;
- The degree of predictability of the emergency;
- The likely speed of onset;
- The likely effect of the emergency
- The risk workshop and risk assessment.

The ERMP will include:

- Description of the potential emergency;
- The person responsible for actioning the ERMP;
- The equipment required to deal with the emergency including rescue and containment equipment;
- Emergency contact numbers;
- Direction to site workers and other affected persons on what they are required to do;
- The methods used to deal with the emergency (for example how to use specific equipment).

As necessary, emergency services such as Police, Fire Brigade, Ambulance, and Port Authority are to be contacted and invited to visit the site to become aware of site access and other emergency considerations.

The ERMP will also incorporate:

- Emergency contact list (for the above);
- Emergency reporting instructions;
- Emergency muster point location
- Emergency Response Coordinator Action Plan;
- Emergency personnel and equipment.

The Emergency Response Management Plan will be made available to all project stakeholders and included in the site Induction. All relevant Project personnel, subcontractors and emergency agencies will be instructed and rehearsed.

The procedure for responding to a pollution incident in accordance with the EPL shall form part of the overarching ERMP.

9 Monitoring and Maintenance

To compare with design predictions, monitoring instrumentation is proposed for implementation across the project. The basis for implementing a robust monitoring scheme is to have a mechanism that allows for the measurement and recording of actual effects resulting from constructed works for comparison against the predicted effects.

Monitoring allows for:

- Verification of design intent
- Appropriate contingency and remedial measures to be implemented in a timely and efficient manner, where these will be required

In addition to monitoring, periodic maintenance of the bund structure, revetment and stormwater infrastructure will be required for the design life of these structures.

9.1 Construction Phase Monitoring

The construction of the Emplacement Cell with be undertaken in accordance with 'Issued for Construction' (IFC) documentation. The IFC documentation comprises design drawings and technical specification, which collectively outline the QA checks and QC documentation to be provided by the Contractor throughout the construction works.

Prior to the commencement of the works, the Contractor is required to prepare Inspection & Test Plans (ITPs) which collate the required steps in the QA process in compliance with the IFC documentation. These checklists facilitate the tracking of the supply of QA documentation during the works, by AIE and its representatives.

During the works, AIE and its Geotechnical Site Representative will undertake site inspections and observations of the works, as well as review the Contractor's QA/QC documentation. The QA/QC documentation is required to be supplied progressively to AIE and its representatives. The Geotechnical Site Representative is engaged to perform dual roles:

1. as auditor of the construction of the Emplacement Cell and the placement of the dredged sediments, in accordance with the Infrastructure Approval (specifically Schedule 3 Specific Environmental Conditions – Condition 10);
2. as certifier that the construction of the Emplacement Cell is in accordance with the Issued for Construction documentation, the Agreement for Lease, applicable law and good design and construction practice.

Some of the typical QA and QC records that are stipulated within the IFC documentation include:

- Hydrographic surveys at different stages of the dredging and construction to assess areas/volumes dredged, and bund founding levels achieved;
- Tracking of each barge, material type, dumping/unloading locations and placement methods;
- Hydrographic survey of placed materials (referred to as 'dump box areas') and below water construction of the containment bund and revetments;
- Topographic survey of materials placed above water, to verify revetment layers and slopes;
- Supporting quality documentation for imported materials.

As each stage of the Emplacement Cell construction is completed, the Geotechnical Site Representative will prepare an audit report in accordance with the requirements stipulated in the Infrastructure Approval. Then once the Emplacement Cell construction reaches Practical Completion, the Geotechnical Site Representative will certify that the works have been completed in accordance with the design.

The final geotechnical testing for the containment bund comprises Cone Penetrometer Testing (CPT) at discrete locations along the completed bund crest. These post construction CPT locations are detailed in the IFC documentation and are required to be undertaken in accordance with the Minimum Design Requirements (MDRs), and form part of the handover documentation to NSW Ports.

The above documents, along with the Contractors as-built documentation (stipulated in the Issued for Construction documentation), form the full set of construction records for the Emplacement Cell.

9.2 Post Construction Monitoring and Maintenance

The emplacement cell has been designed in accordance with the Minimum Design Requirements for a 15 year design life. The bund structure and revetment has been designed to accommodate sea level rise, storm surge and wave loading, and to provide access to maintenance plant and equipment. It is assumed that ongoing maintenance of the Emplacement Cell will be required for the design life of the structure, particularly for the revetment and main bund.

Ongoing maintenance of revetment structures during their design life is typical and the bund structure includes provision of an access track suitable for a 110t long reach excavator and loaded semi-trailer to facilitate this future maintenance. The bund is expected to settle during its design life, with the majority of settlement predicted to be completed within the first two years of the design life. The revetment, which protects the integrity of the bund, has also been designed to accommodate this settlement.

There are no performance requirements or proposed operational uses specified for the Emplacement Cell. While the finished surface of the Emplacement Cell is to be graded towards the stormwater channel, there is expected to be a notable amount of post construction settlement which is likely to impact on the final surface level and lead to potential drainage issues and ponding. It is expected that periodic maintenance will be required for the finished surface of the cell to maintain drainage and avoid ponding.

Periodic maintenance of the Emplacement Cell will be undertaken by NSW Ports during its design life. It is considered that the proposed post construction inspection and maintenance regime will be a suitable approach to identify revetment damage and subsequent maintenance requirements, in order to avoid further deterioration and damage to the bund core (within the bounds of the design events). This inspection regime will include 'event inspections' following storm events where the significant wave height within the Outer Harbour exceeds 0.8m, which should therefore identify any substantial resulting damage to the revetment.

For the bund alignment, a maximum 250mm settlement has been allowed for during the life of the emplacement cell. As such, should more than 250mm of settlement occur, the bund crest would have to be lifted to be at a minimum RL +3.30 m PKHD.

Additionally, along the stormwater channel and culvert alignment, should settlement along the alignment cause significant differential settlement such that water does not flow at a minimum design downstream grade of 0.25%, the channel/culvert will need to be realigned.

The recommended post construction monitoring, in terms of locations and frequency, will be outlined in an Inspection & Maintenance Plan as part of the handover documentation. The monitoring infrastructure is proposed to comprise:

- Survey monuments installed at 50m intervals along the outer crest of the perimeter bund structure and the stormwater channel;
- Survey targets installed at each of the headwalls on either end of the culvert.

Design details for this monitoring infrastructure are provided in the IFC documentation for the project.

10 Safety in Design

Safety in Design (SID) for constructability have been carried out throughout the stages of the design of the project using a systematic risk based approach that includes the identification of hazards within hazard workshops.

The operational and maintenance safety issues will be addressed and mitigation measures developed in parallel to the design.

Each element of the design has been examined and the risk, cause and consequence throughout the project life cycle identified.

A SiD Workshop was held on 20 July 2021 with project stakeholders contributing to the Project SiD register. This SiD Register was reviewed through the design process to see that the issues are addressed and correctly assigned to the stakeholder that is the in the appropriate position to own or address the risk. At the 100% Detailed Design stage an additional workshop was undertaken to review and update the SiD Register. The Safety in Design Register developed from this workshop is presented in below Appendix B.

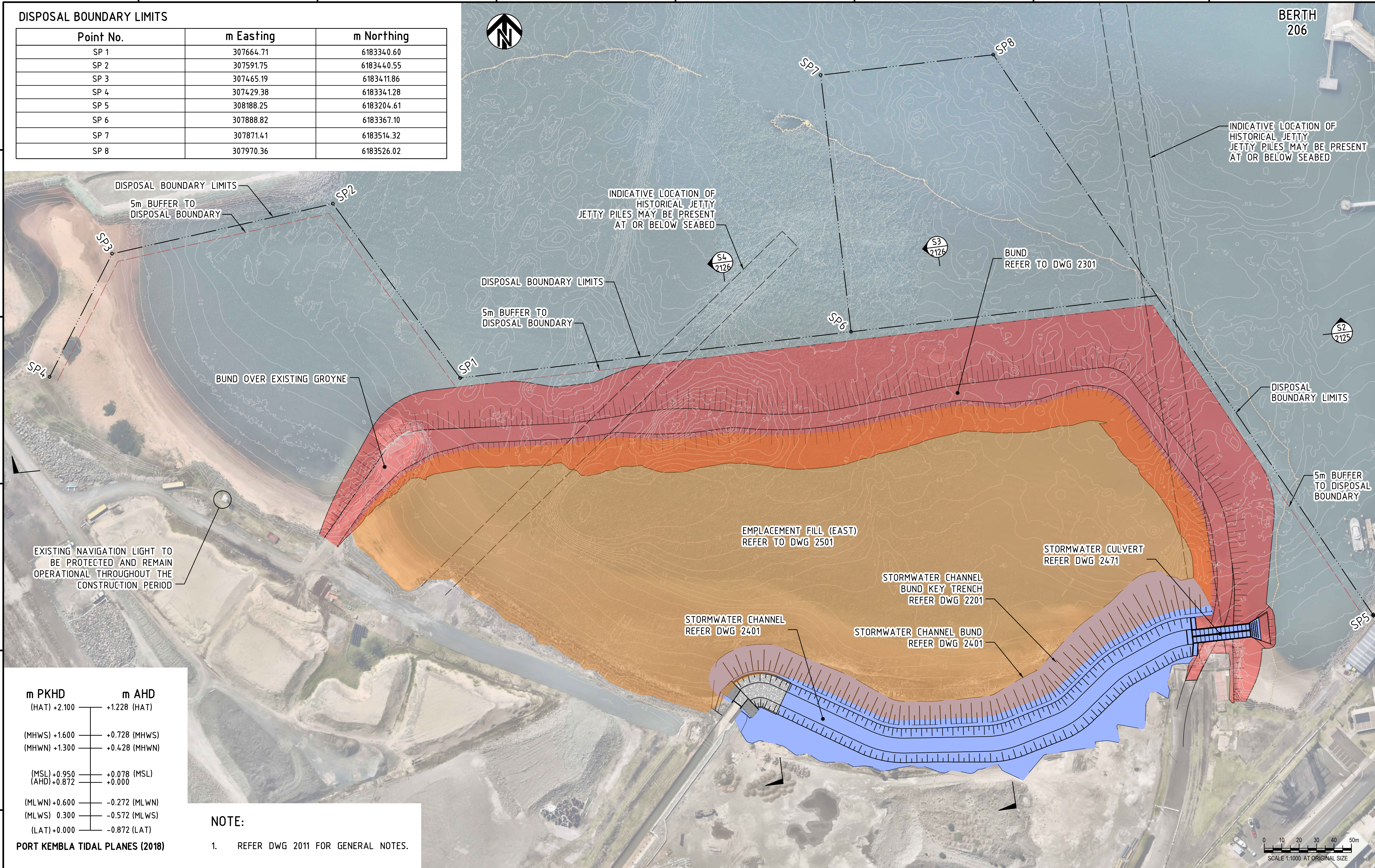
11 Project Risk Register

SMEC has also developed a Project Specific Risk Register which is presented in Appendix C.

12 Drawings

DISPOSAL BOUNDARY LIMITS

Point No.	m Easting	m Northing
SP 1	307664.71	6183340.60
SP 2	307591.75	6183440.55
SP 3	307465.19	6183411.86
SP 4	307429.38	6183341.28
SP 5	308188.25	6183204.61
SP 6	307888.82	6183367.10
SP 7	307871.41	6183514.32
SP 8	307970.36	6183526.02



m PKHD	m AHD
(HAT) +2.100	+1.228 (HAT)
(MHWS) +1.600	+0.728 (MHWS)
(MHWN) +1.300	+0.428 (MHWN)
(MSL) +0.950	+0.078 (MSL)
(AHD) +0.872	+0.000
(MLWN) +0.600	-0.272 (MLWN)
(MLWS) 0.300	-0.572 (MLWS)
(LAT) +0.000	-0.872 (LAT)

PORT KEMBLA TIDAL PLANES (2018)

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
		04	ISSUE FOR REVIEW	KB	CL	HP	PM	16.05.23
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	25.11.21

PLOT DATE: 21 May 2023 TIME: 15:09:01

CLIENT: AIE Powering Australian Industry

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2121.dwg

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MMJ BUILDING, 6-8 REGENT STREET
WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

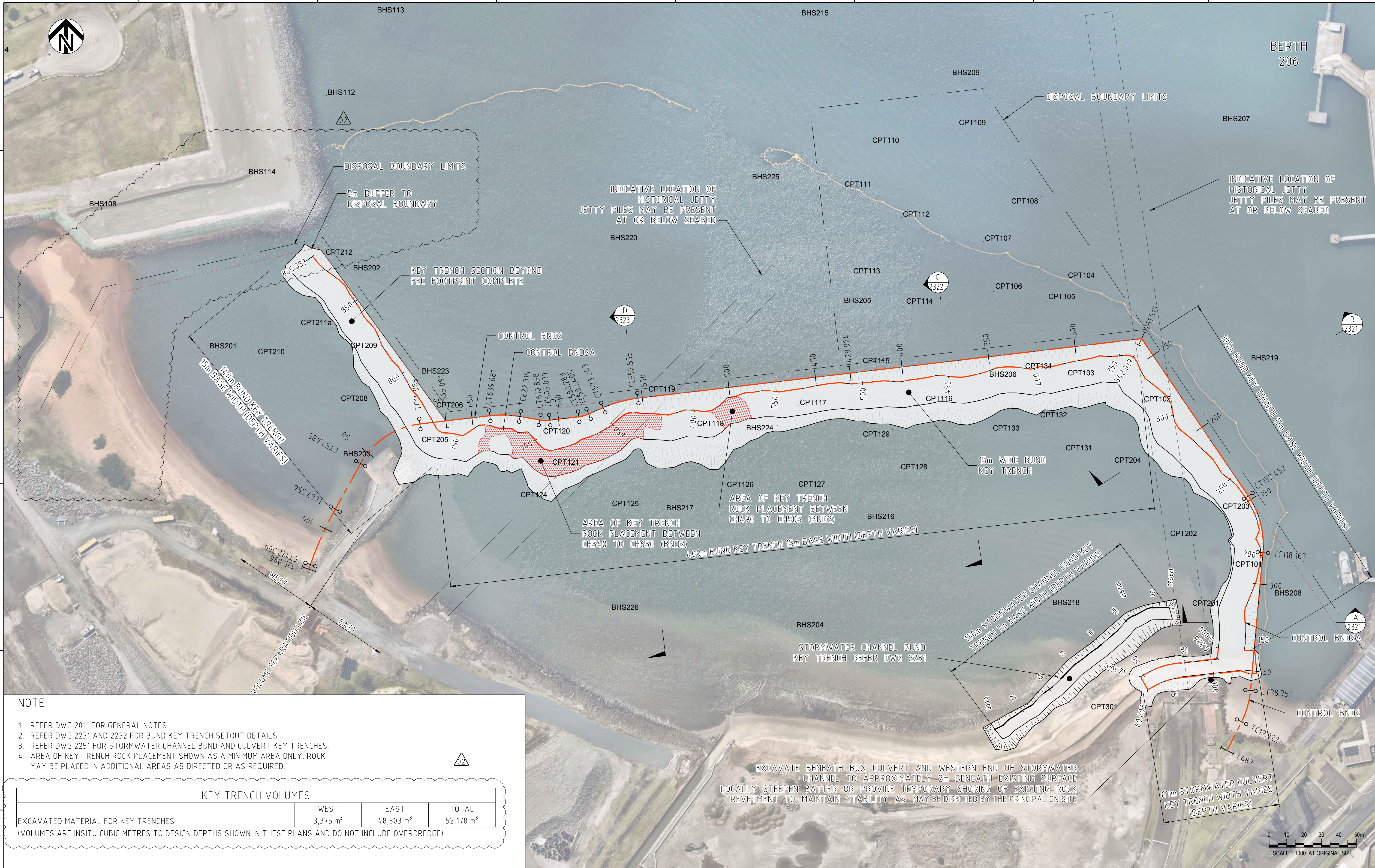
SCALE	1:1000
DRN	M. COLLINGS
CHK	D. LEE
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

MASTER PLAN

PKGT-SMC-OHC-CIV-DWG-2121 04

A1 150 mm ON ORIGINAL



NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.
2. REFER DWG 2231 AND 2232 FOR BUND KEY TRENCH SETOUT DETAILS.
3. REFER DWG 2251 FOR STORMWATER CHANNEL BUND AND CULVERT KEY TRENCHES.
4. AREA OF KEY TRENCH ROCK PLACEMENT SHOWN AS A MINIMUM AREA ONLY. ROCK MAY BE PLACED IN ADDITIONAL AREAS AS DIRECTED OR AS REQUIRED.

KEY TRENCH VOLUMES

	WEST	EAST	TOTAL
EXCAVATED MATERIAL FOR KEY TRENCHES	3,375 m^3	48,803 m^3	52,178 m^3

(VOLUMES ARE INSITU CUBIC METRES TO DESIGN DEPTHS SHOWN IN THESE PLANS AND DO NOT INCLUDE OVERDREDGE)

REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
01	ISSUE FOR REVIEW	KB	DL	HP	PM	16.05.23

CERTIFIER NO. | CERTIFYING ENGINEER NAME

PLOT DATE: 23 May 2023 TIME: 16:04:02

CLIENT: AIE

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DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2202.dwg

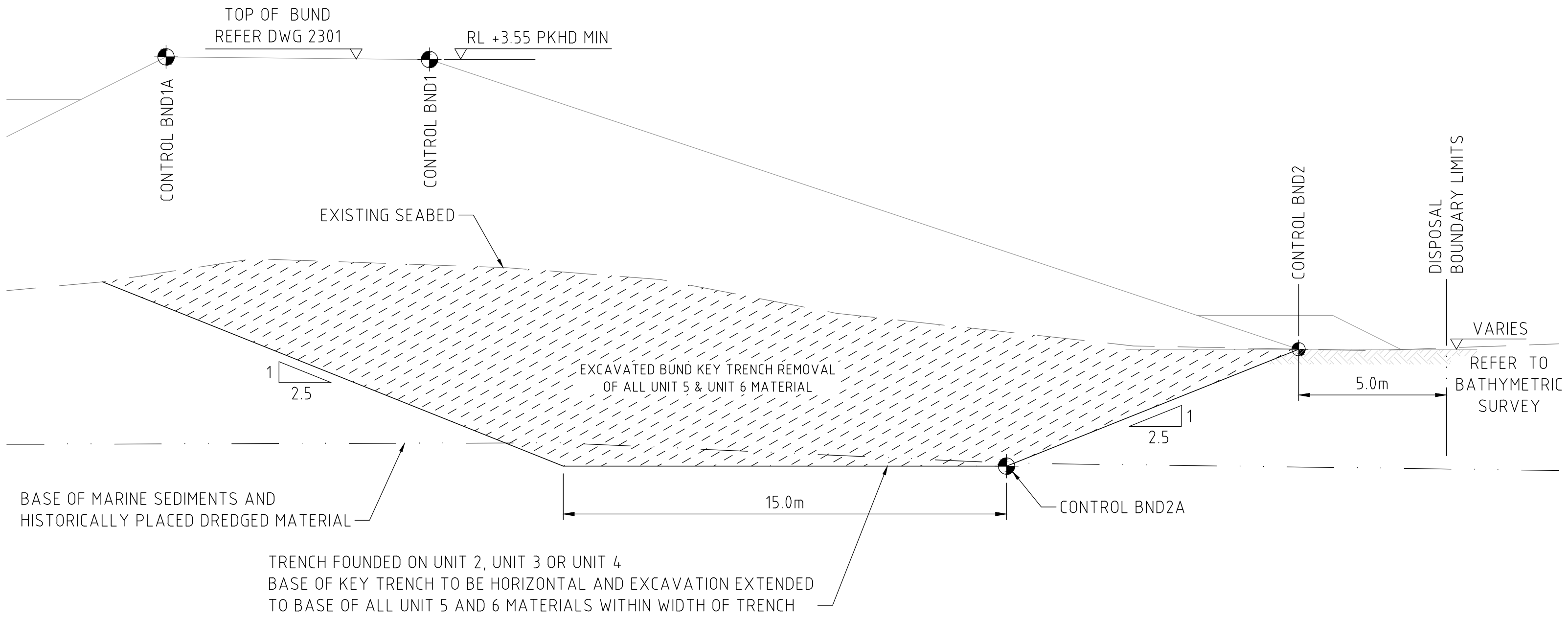
SCALE	1:1000
DRN	K. BOOTH
CHK	D. LEE
DES	H. PANCHALINGAM
APR	P. MOYES
PM	H. PANCHALINGAM
PD	P. MOYES

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

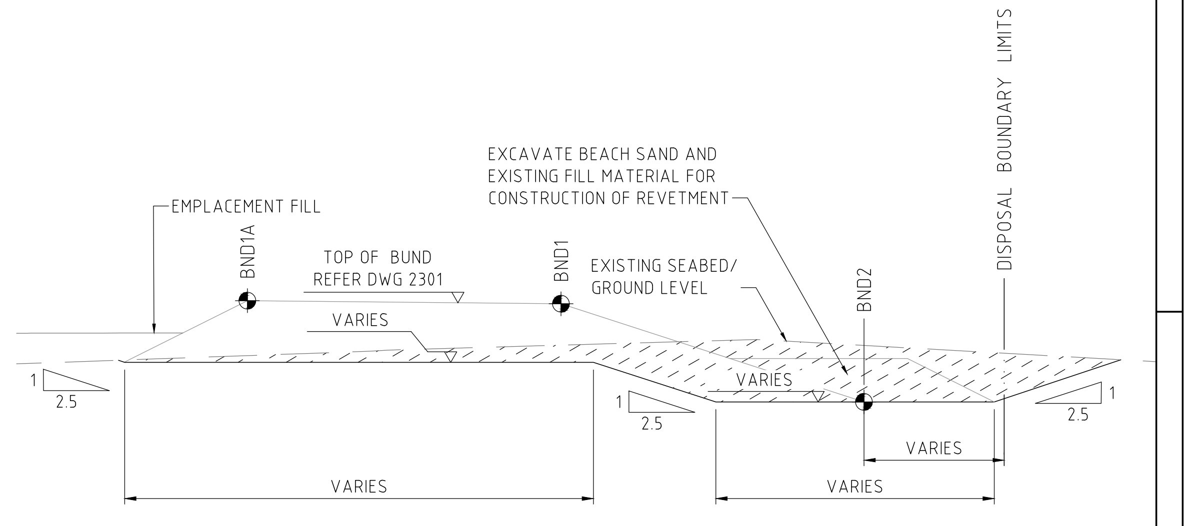
KEY TRENCH
GENERAL ARRANGMENT
PLAN - FEC

PKGT-SMC-OHC-CIV-DWG-2202 | 01

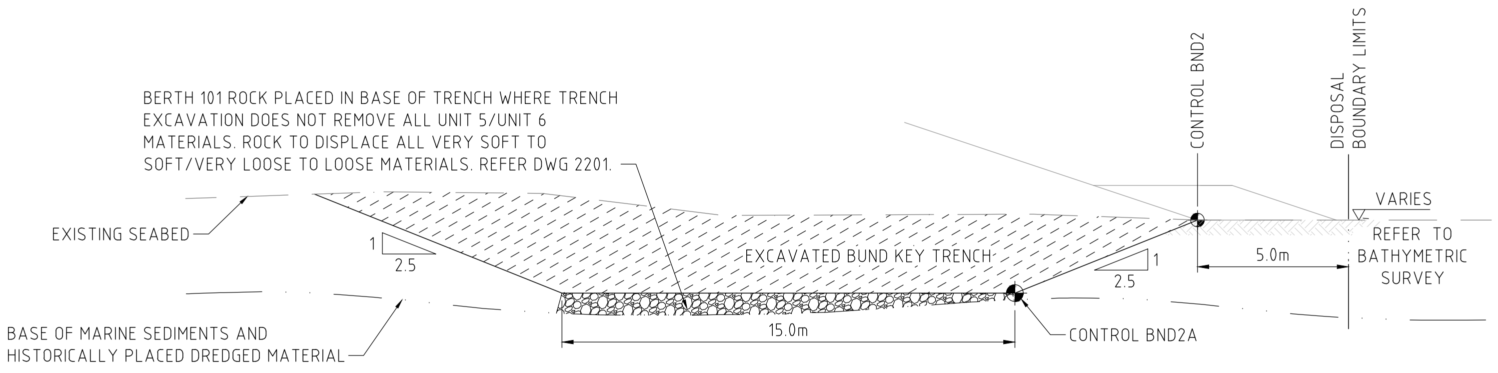
150 mm ON ORIGINAL | A1



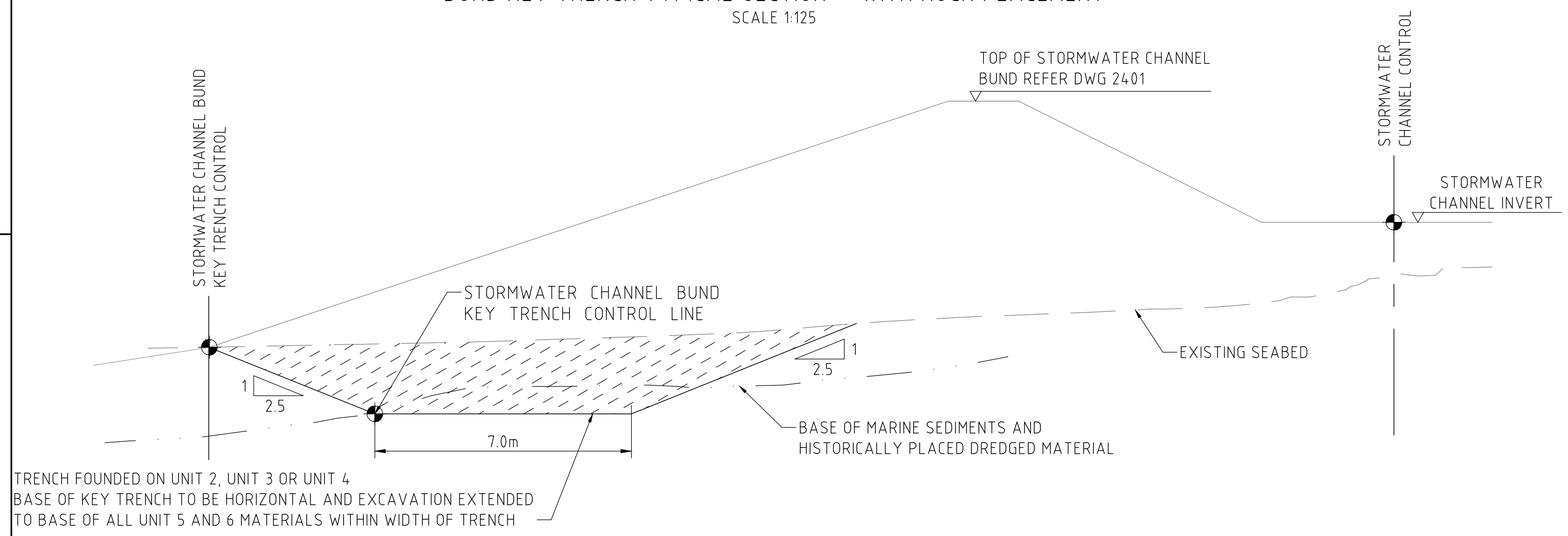
BUND KEY TRENCH TYPICAL SECTION - NO ROCK PLACEMENT
SCALE 1:125



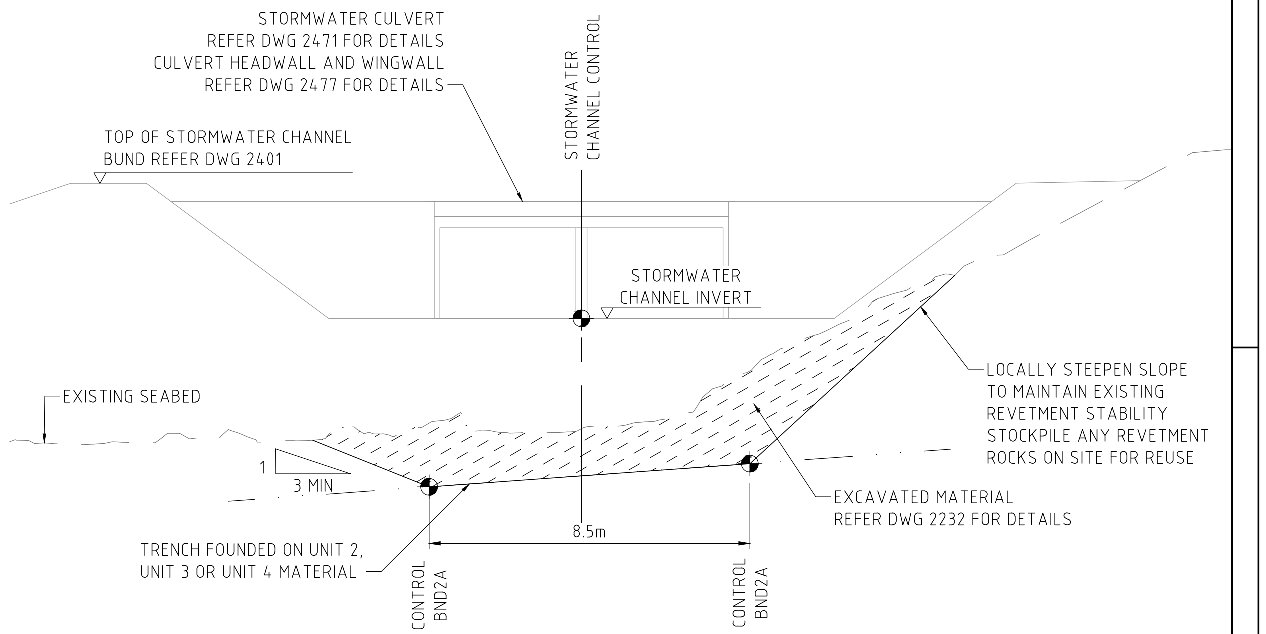
GBS REVETMENT TRENCH TYPICAL SECTION
SCALE 1:100
04



BUND KEY TRENCH TYPICAL SECTION - WITH ROCK PLACEMENT
SCALE 1:125



STORMWATER CHANNEL BUND KEY TRENCH TYPICAL SECTION
SCALE 1:100



STORMWATER CULVERT KEY TRENCH TYPICAL SECTION
SCALE 1:100

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
		04	ISSUE FOR REVIEW	DL	PB	HP	PM	22.02.23
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	25.11.21

PLOT DATE: 23 May 2023 TIME: 14:05:31

CLIENT: AIE Powering Australian Industry

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SMEC PROJECT No 30013105

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2211.dwg

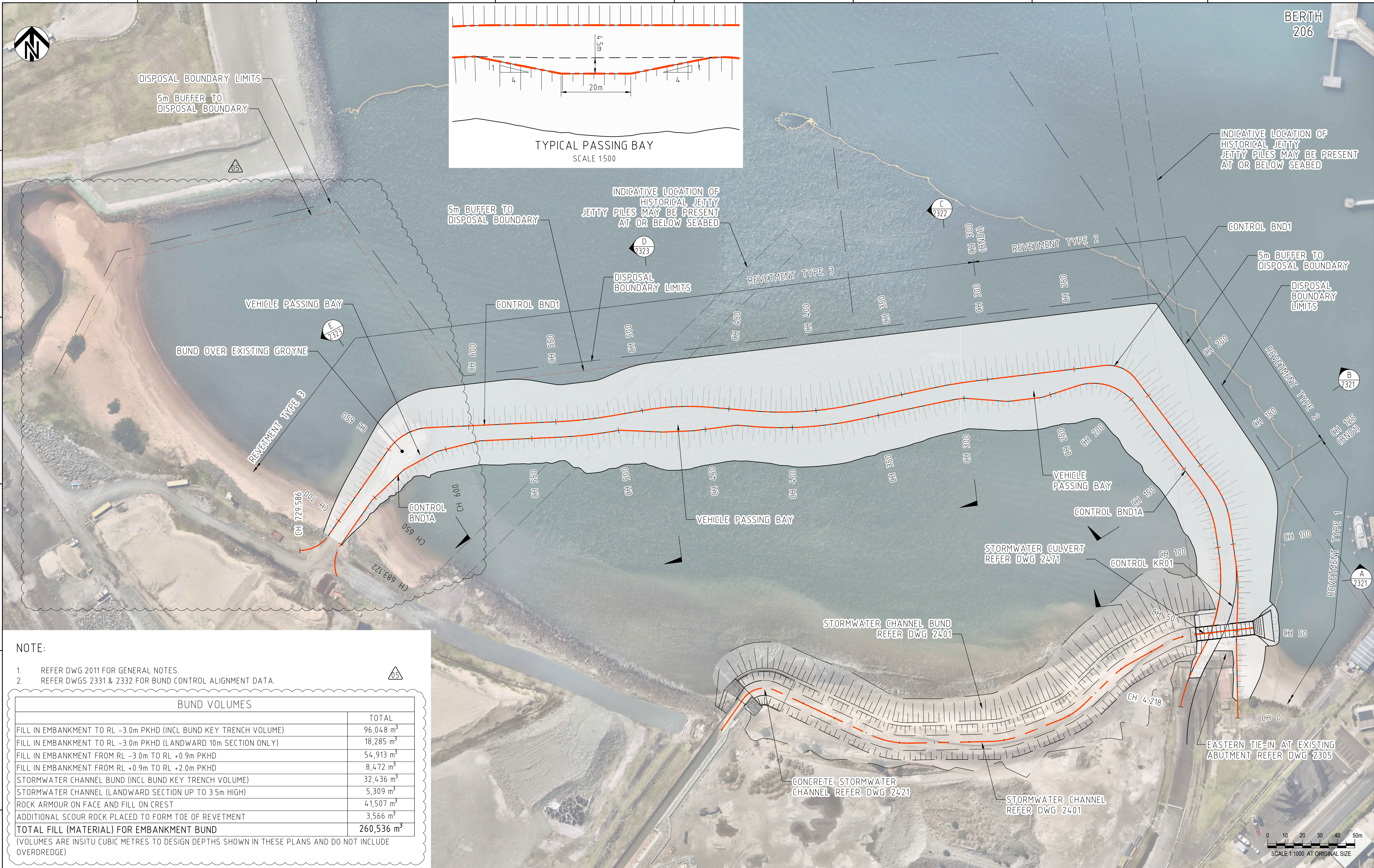
SCALE	1:100
DRN	D. LEE
CHK	P. BROWN
DES	M. COLLINGS
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
KEY TRENCH
TYPICAL SECTIONS

PKGT-SMC-OHC-CIV-DWG-2211 | 04

150 mm ON ORIGINAL
A1



NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.
2. REFER DWGS 2331 & 2332 FOR BUND CONTROL ALIGNMENT DATA.

BUND VOLUMES

	TOTAL
FILL IN EMBANKMENT TO RL -3.0m PKHD (INCL BUND KEY TRENCH VOLUME)	96,048 m^3
FILL IN EMBANKMENT TO RL -3.0m PKHD (LANDWARD 10m SECTION ONLY)	18,285 m^3
FILL IN EMBANKMENT FROM RL -3.0m TO RL +0.9m PKHD	54,913 m^3
FILL IN EMBANKMENT FROM RL +0.9m TO RL +2.0m PKHD	8,472 m^3
STORMWATER CHANNEL BUND (INCL BUND KEY TRENCH VOLUME)	32,436 m^3
STORMWATER CHANNEL (LANDWARD SECTION UP TO 3.5m HIGH)	5,309 m^3
ROCK ARMOUR ON FACE AND FILL ON CREST	41,507 m^3
ADDITIONAL SCOUR ROCK PLACED TO FORM TOE OF REVETMENT	3,566 m^3
TOTAL FILL (MATERIAL) FOR EMBANKMENT BUND	260,536 m^3

(VOLUMES ARE INSITU CUBIC METRES TO DESIGN DEPTHS SHOWN IN THESE PLANS AND DO NOT INCLUDE OVERDREDGE)

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
		05	ISSUE FOR REVIEW	KB	DL	HP	PM	16.05.23
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	21.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	25.11.21

PLOT DATE: 23 May 2023 TIME: 16:09:44

CLIENT: AIE

DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013105\110__CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2301.dwg

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SMEC PROJECT No 30013105

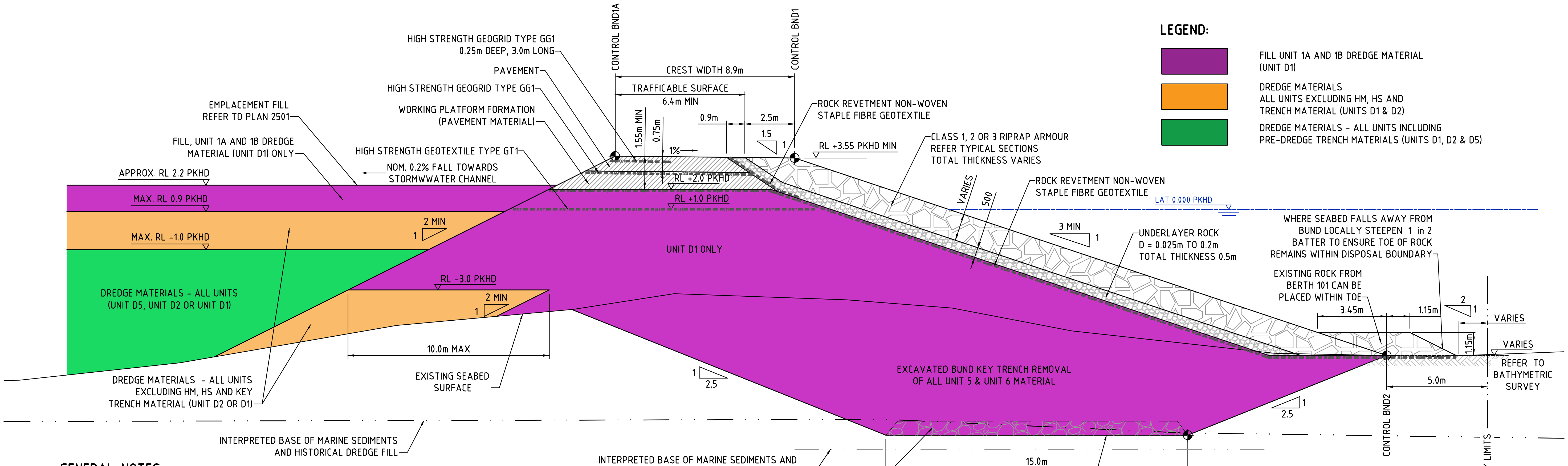
SCALE	1:1000
DRN	M. COLLINGS
CHK	D. LEE
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

BUND
GENERAL ARRANGMENT
PLAN

PKGT-SMC-OHC-CIV-DWG-2301 | 05

150 mm ON ORIGINAL
A1



TYPICAL SECTION
SCALE 1:100

GENERAL NOTES:

1. REFER DWG 2011 FOR GENERAL NOTES.
2. RIP RAP ARMOUR CRUSHED OR SPLIT DUE TO TRAFFIC DURING CONSTRUCTION TO BE REMOVED AND REPLACED.
3. STABILITY OF COMPARTMENT FACE OF BUND SUBJECT TO REVIEW OF CONTRACTOR'S PROPOSED CONSTRUCTION SEQUENCING AND METHODOLOGY.
4. AT THE INTERFACE BETWEEN REVETMENT TYPES, THE TRANSITION IN RIP RAP ARMOUR LAYER THICKNESS MUST BE ACHIEVED THROUGH A SMOOTH INCREASE IN LAYER THICKNESS OVER A MINIMUM DISTANCE OF 10 METERS.
5. MINIMUM 2.6 TONNES/m^3 ROCK DENSITY ADOPTED FOR REVETMENT. ROCK REVETMENT SUBJECT TO DESIGNER REVIEW AND POTENTIAL DESIGN UPDATE IF ROCK DENSITY DEVIATES FROM 2.6 t/m^3.
6. THE SPECIFIED UNDERLAY ROCK DIAMETERS (D) ARE THE REQUIRED REPRESENTATIVE SIEVE SIZE. EQUIVALENT NOMINAL DIAMETERS (D_n) CAN BE CALCULATED AS D x 0.84.
7. PAVEMENT MATERIAL TO BE DGS40 IN ACCORDANCE WITH TfNSW QA SPECIFICATION 3051 OR APPROVED EQUIVALENT.
8. PAVEMENT TO BE COMPACTED IN MAX. 300MM LAYERS TO MIN. 98% STANDARD COMPACTION AT 60-90% OF OMC.

NON-WOVEN STAPLE FIBRE GEOTEXTILE (TYPE G) NOTES:

1. NON-WOVEN STAPLE FIBRE GEOTEXTILE PRODUCT IS PROVISIONAL, SUBJECT TO ON SITE DRY TRIALS TO THE SATISFACTION OF THE DESIGNER, BASED ON CONTRACTOR ROCK PLACEMENT AND GROOMING TECHNIQUES, TO CONFIRM NON-WOVEN STAPLE FIBRE GEOTEXTILE STRENGTH AND ELONGATION PROPERTIES.
2. NON-WOVEN STAPLE FIBRE GEOTEXTILE MUST NOT BE SUBJECT TO CONSTRUCTION TRAFFIC OR MACHINERY LOADING. CONTRACTOR MUST UNDERTAKE DRY TRIALS TO THE SATISFACTION OF THE DESIGNER PRIOR TO ANY CONSTRUCTION TRAFFIC OR MACHINERY LOADING.
3. NON-WOVEN STAPLE FIBRE GEOTEXTILE SHEETS MUST BE PLACED VERTICALLY DOWN THE SLOPE.
4. EACH END OF NON-WOVEN STAPLE FIBRE GEOTEXTILE MUST BE RESTRAINED WITH ROCK. NO SIDE OF A PLACED GEOTEXTILE SHEET IS TO BE UNRESTRAINED ONCE GEOTEXTILE SHEETS ARE PLACED UNLESS AN ALTERNATIVE APPROACH PROVIDED BY THE CONTRACTOR IS APPROVED BY THE DESIGNER.
5. CONTRACTOR IS RESPONSIBLE FOR STABILITY OF THE GEOTEXTILE AT ALL TIMES. ADDITIONAL ROCK MAY BE REQUIRED DURING CONSTRUCTION TO ENSURE GEOTEXTILE REMAINS STABLE.
6. DROP HEIGHT OF ROCK AGAINST THE GEOTEXTILE MUST BE NO GREATER THAN 0.5m.
7. NON-WOVEN STAPLE FIBRE GEOTEXTILE MUST BE COVERED FROM UV EXPOSURE AT ALL TIMES PRIOR TO GEOTEXTILE PLACEMENT.
8. IN ADDITION TO THE ABOVE, HANDLING AND INSTALLATION OF NON-WOVEN STAPLE FIBRE GEOTEXTILE MUST BE IN ACCORDANCE WITH MANUFACTURER'S REQUIREMENTS.

HIGH STRENGTH GEOSYNTHETIC REINFORCEMENT (GEOGRID/GEOTEXTILE) NOTES:

1. HIGH STRENGTH GEOSYNTHETICS ARE TO BE SUPPLIED IN ACCORDANCE WITH TfNSW QA SPECIFICATION R67. HANDLING AND INSTALLATION MUST ALSO BE IN ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS.
2. THE DESIGN STRENGTH SPECIFIED IS THE LONG TERM DESIGN STRENGTH (TD) IN ACCORDANCE WITH TfNSW R67.
3. THE PRODUCT STRENGTH FOR HIGH STRENGTH GEOSYNTHETIC REINFORCEMENT SHALL BE DETERMINED BASED ON BS8006 (1995) BY THE REINFORCEMENT SUPPLIER. THE ULTIMATE TENSILE STRENGTH OF THE REINFORCEMENT (T_U) SHALL BE OBTAINED BY MULTIPLYING THE DESIGN TENSILE STRENGTH (TD) WITH APPROPRIATE PARTIAL MATERIAL FACTORS AS PER BS8006 AND CONSIDERING A STRAIN LEVEL OF 5% AND A DESIGN LIFE OF 15 YEARS.
4. GEOSYNTHETIC REINFORCEMENT SHALL HAVE A MINIMUM LONG TERM DESIGN STRENGTH AS SPECIFIED IN TABLE 1
5. GEOSYNTHETICS SHALL BE OVERLAPPED BY A WIDTH OF AT LEAST 300 mm OR AS PER MANUFACTURER'S GUIDELINES, WHICHEVER IS GREATER
6. SLIGHTLY TENSION ANY GEOSYNTHETIC BEFORE PLACING FILL MATERIAL. THE METHOD OF FILL PLACEMENT AND COMPACTION MUST ENSURE THAT SLACK IS NOT INTRODUCED INTO THE LAYER AS FILL IS PLACED. USE PINS AND STAKES AS REQUIRED.
7. THE CONTRACTOR MUST ENSURE THAT GEOSYNTHETICS ARE PLACED IN ACCORDANCE WITH THE MANUFACTURERS MAXIMUM RECOMMENDED APERTURE SIZE. IF THIS IS EXCEEDED, A SUITABLE LAYER OF SELECT MATERIAL SHOULD BE INSTALLED (AS PER MANUFACTURERS RECOMMENDATIONS) PRIOR TO PLACEMENT OF GEOSYNTHETIC.

* GEOTEXTILE REINFORCEMENT REQUIRED FOR SUPPORT OF TEMPORARY CONSTRUCTION LOADING (MAX 100kPa TRACK PRESSURE). REINFORCEMENT DETAILS ARE INDICATIVE ONLY - TO BE CONFIRMED UPON CONFIRMATION OF PLANT AND EQUIPMENT LOADING AND SUBJECT TO SUBGRADE INSPECTION BY THE DESIGNERS SITE GEOTECHNICAL REPRESENTATIVE (DSGR).

TABLE 1

HIGH STRENGTH GEOTEXTILE/GEOGRID	LONG TERM DESIGN STRENGTH (TD) (kN/m)
GEOTEXTILE - TYPE GT1*	100
GEOGRID - TYPE GG1	100

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	21.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	25.11.21

PLOT DATE: 21 Jun 2022 TIME: 11:18:14

CLIENT: AIE Powering Australian Industry

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SMEC PROJECT No 30013105

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110__CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2311.dwg

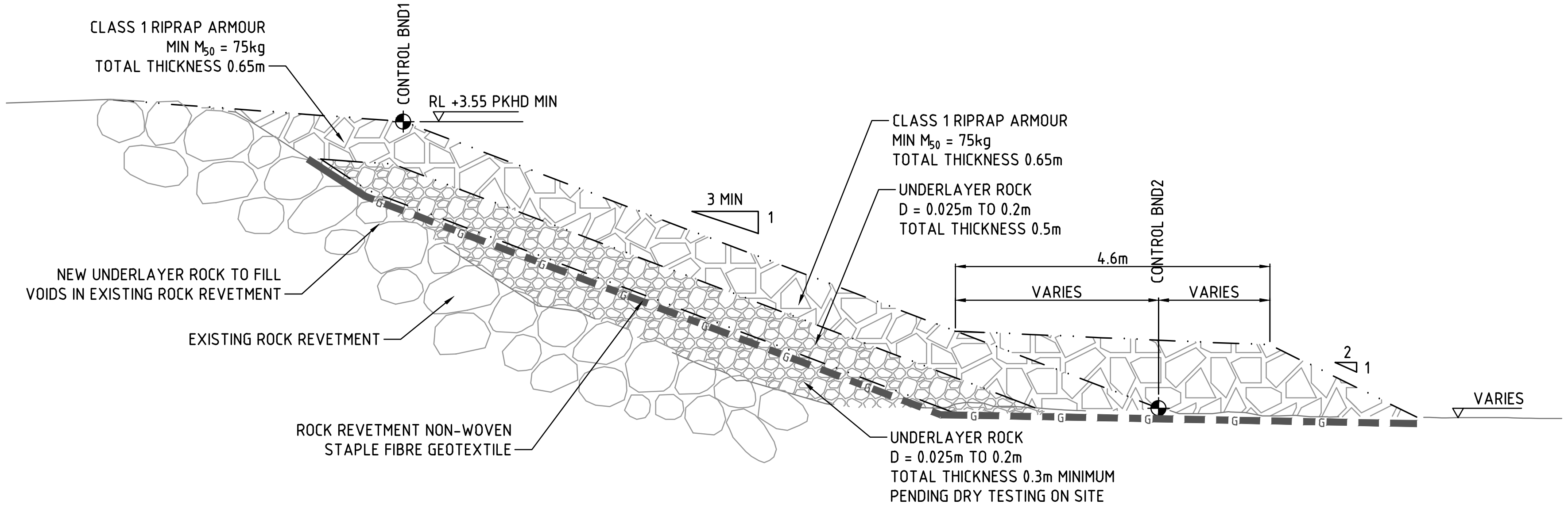
SCALE	1:50
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

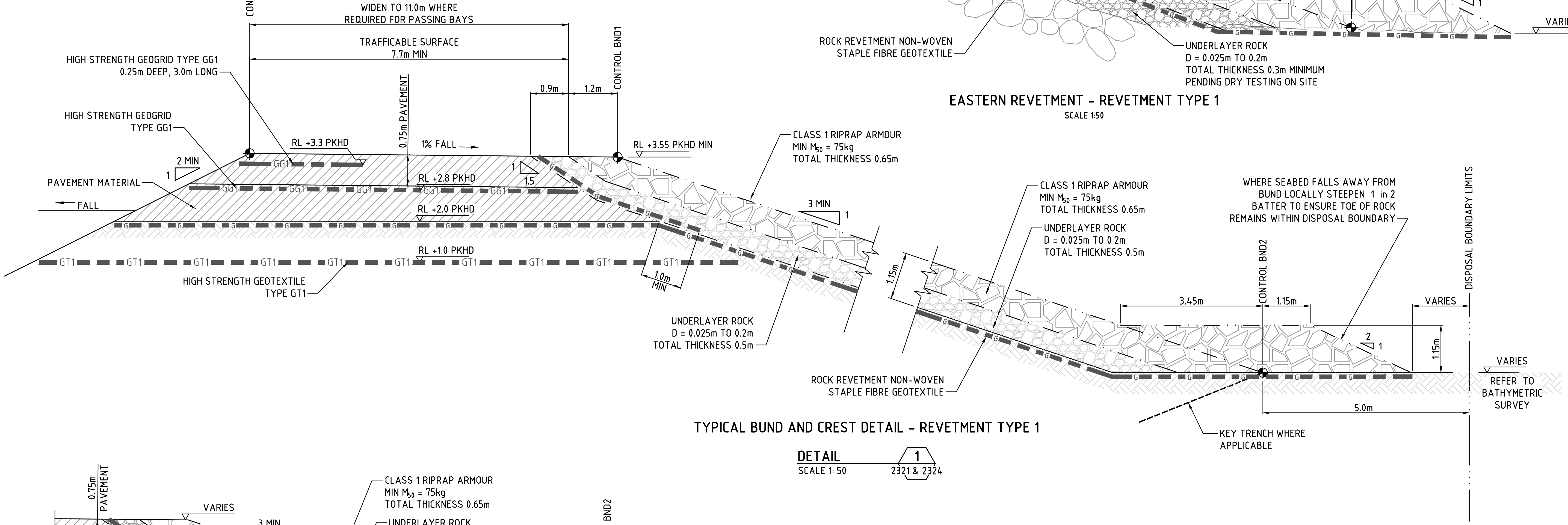
PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
BUND
TYPICAL SECTION
SHEET 1

PKGT-SMC-OHC-CIV-DWG-2311 04

150 mm ON ORIGINAL
A1

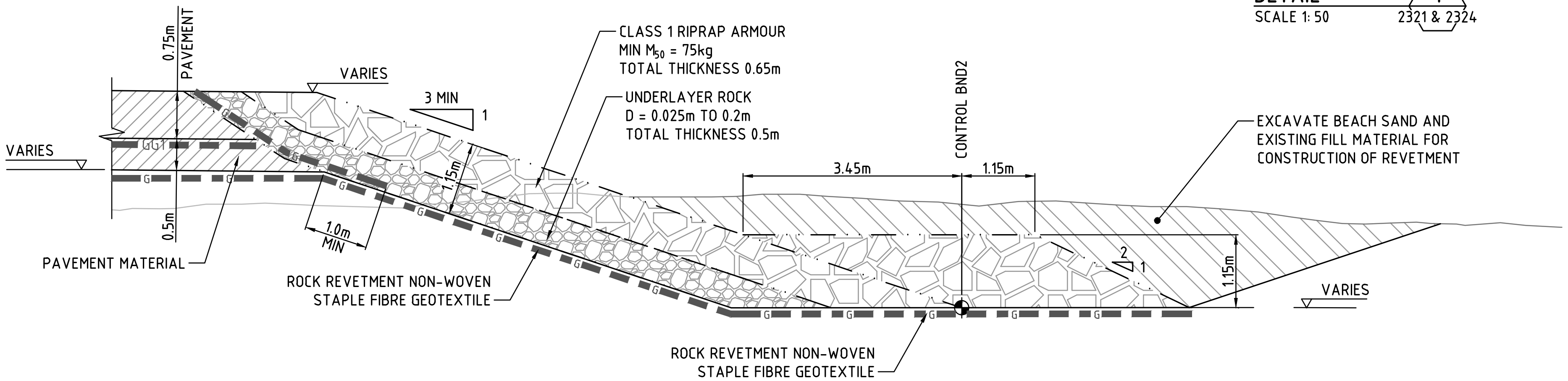


EASTERN REVETMENT - REVETMENT TYPE 1
SCALE 1:50



TYPICAL BUND AND CREST DETAIL - REVETMENT TYPE 1

DETAIL 1
SCALE 1: 50
2321 & 2324



WESTERN REVETMENT - REVETMENT TYPE 1
SCALE 1:50

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

0 0.5 1.0 1.5 2.0 2.5m
SCALE 1:50 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	22.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	25.11.21

PLOT DATE: 22 Jun 2022 TIME: 14:17:04

CLIENT

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2312.dwg

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WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

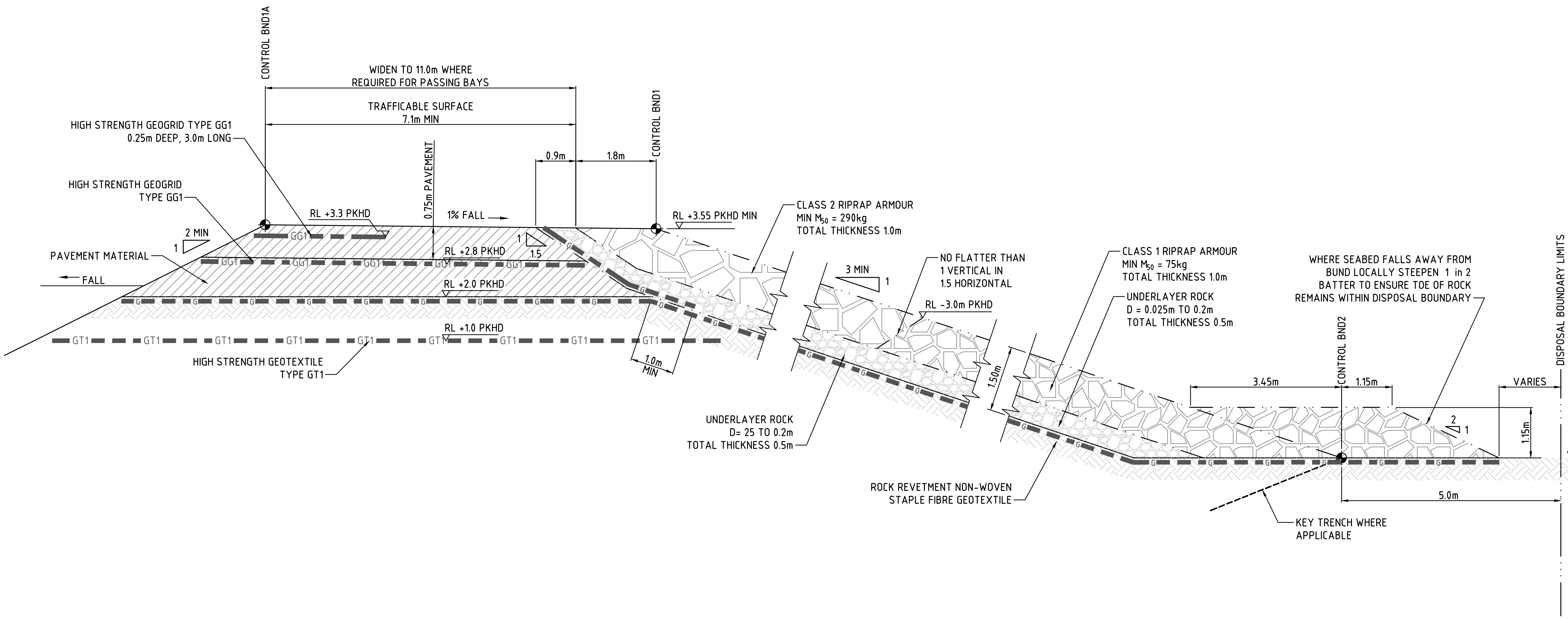
SCALE	1:50
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
BUND
TYPICAL SECTION
SHEET 2

PKGT-SMC-OHC-CIV-DWG-2312 | 04

150 mm ON ORIGINAL
A1



TYPICAL BUND AND CREST DETAIL - REVETMENT TYPE 2

DETAIL 2 / 2321
SCALE 1: 50

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

FOR CONSTRUCTION

0 0.5 1.0 1.5 2.0 2.5m
SCALE 1:50 AT ORIGINAL SIZE

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	22.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	25.11.21

PLOT DATE: 22 Jun 2022 TIME: 14:17:23

CLIENT: AIE Powering Australian Industry

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2313.dwg

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WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

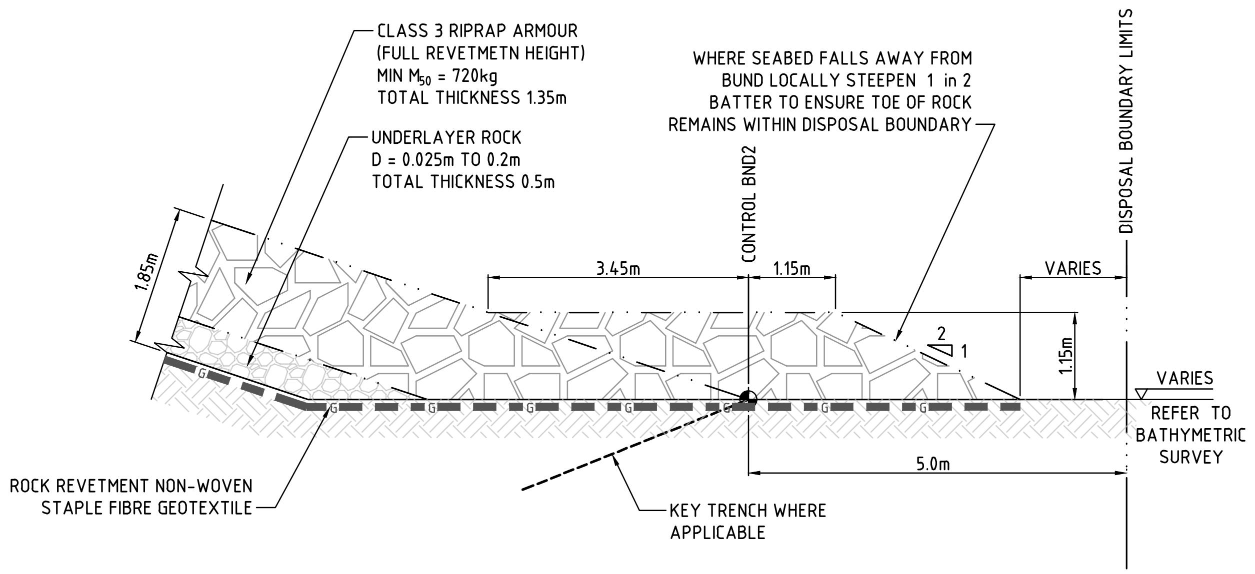
SCALE	1:50
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

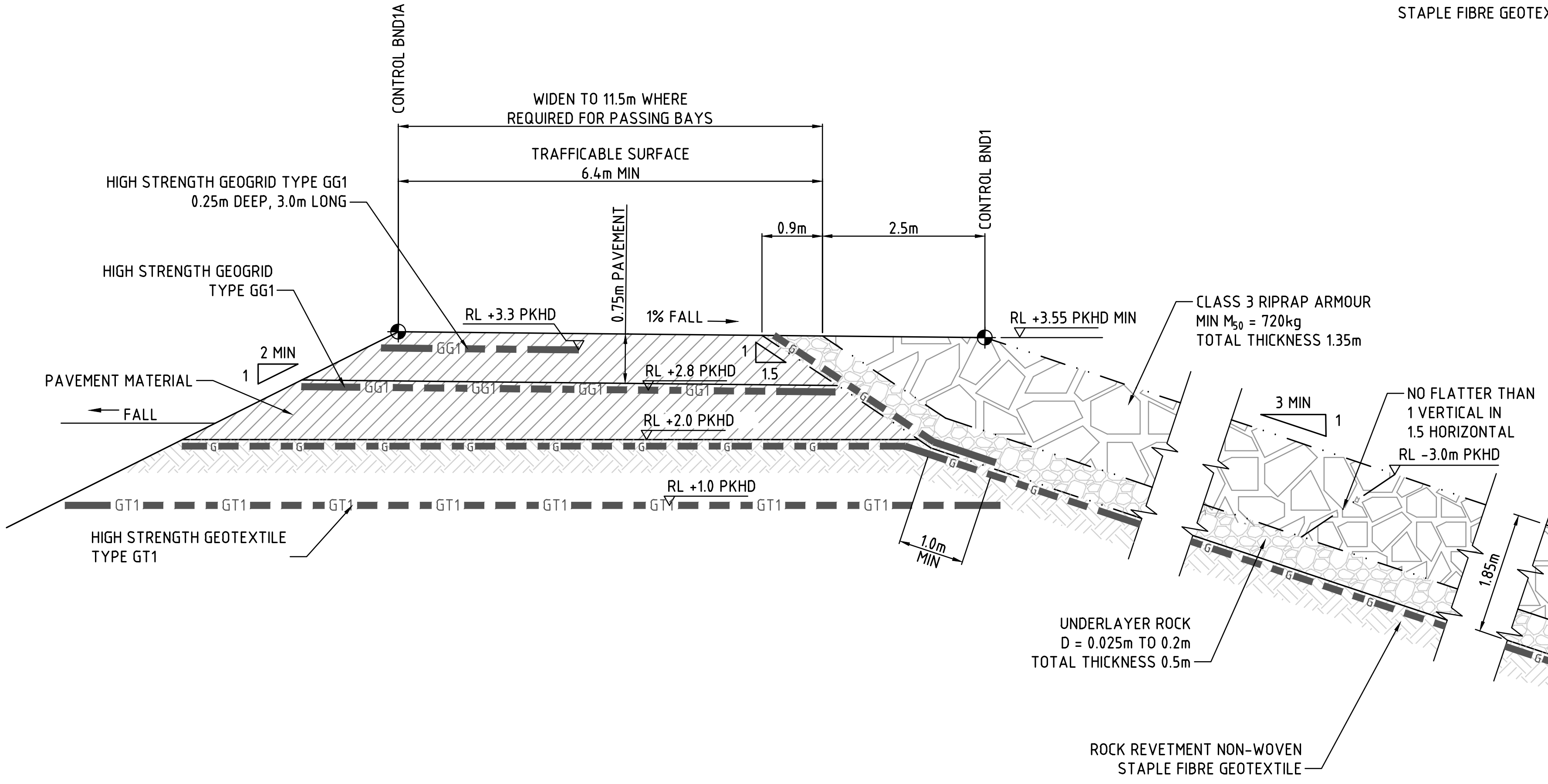
PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
BUND
TYPICAL SECTION
SHEET 3

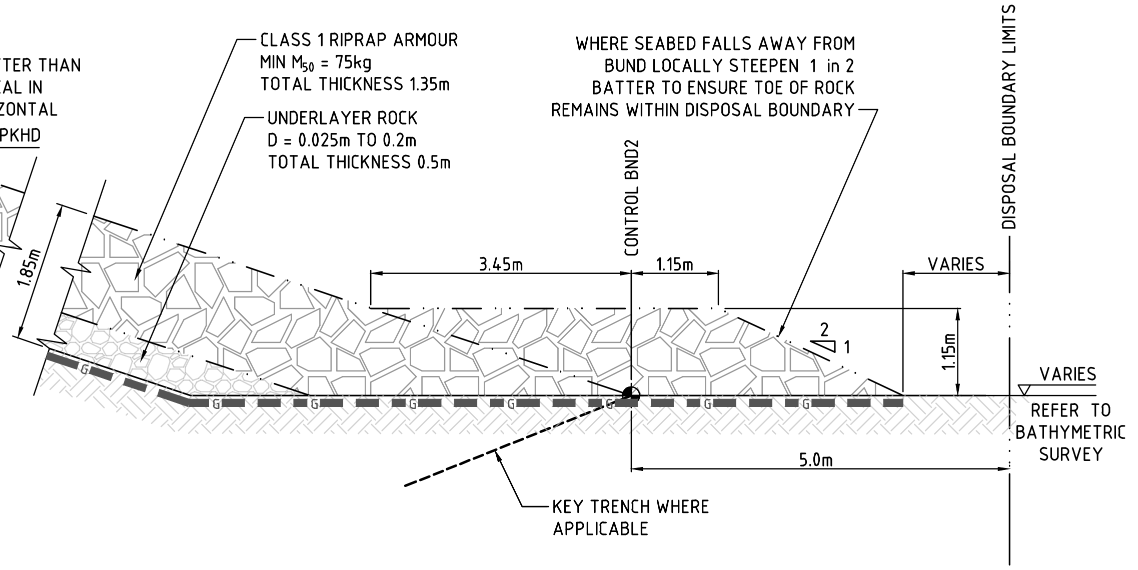
PKGT-SMC-OHC-CIV-DWG-2313 | 04

150 mm ON ORIGINAL
A1



TYPICAL TOE DETAIL
FOR SEABED ABOVE -4.15m PKHD





TYPICAL TOE DETAIL
FOR SEABED AT OR BELOW -4.15m PKHD

TYPICAL BUND AND CREST DETAIL - REVETMENT TYPE 3

DETAIL 3
SCALE 1: 50 2322 & 2323

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

0 0.5 1.0 1.5 2.0 2.5m
SCALE 1:50 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	22.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	25.11.21

PLOT DATE: 22 Jun 2022 TIME: 14:52:51

CLIENT

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2314.dwg

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MMJ BUILDING, 6-8 REGENT STREET
WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

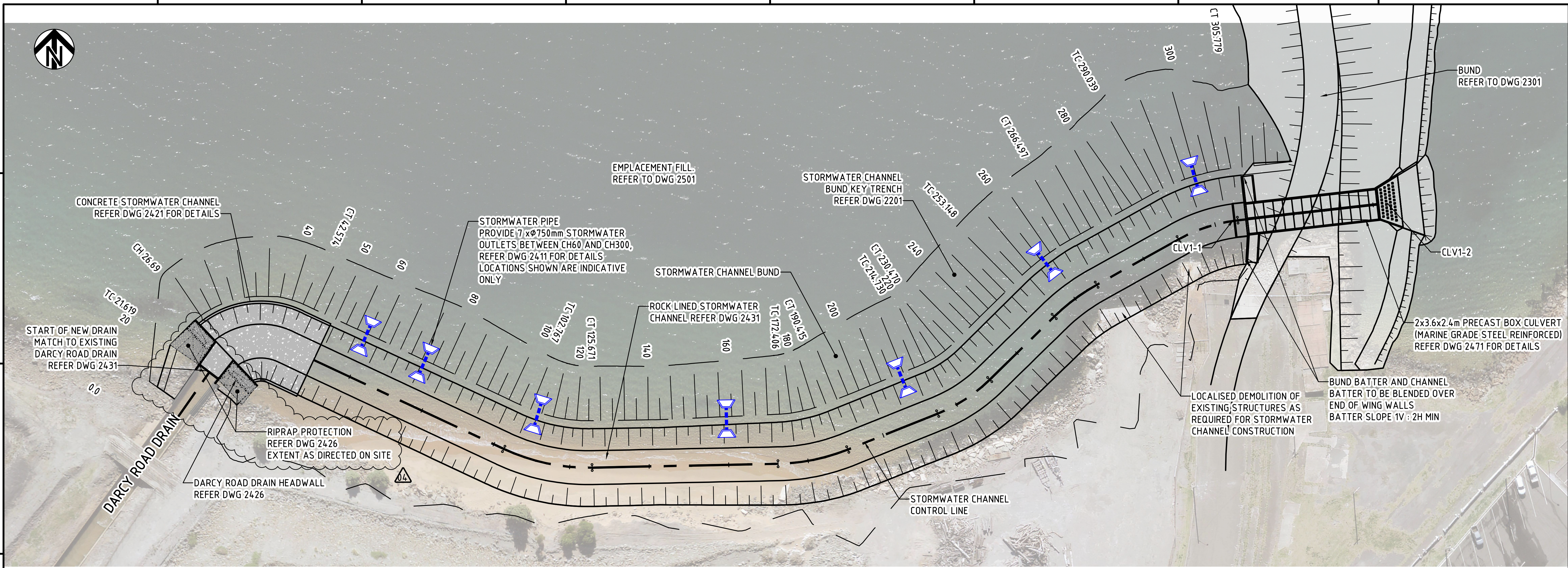
SCALE	1:100
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
BUND
TYPICAL SECTION
SHEET 4

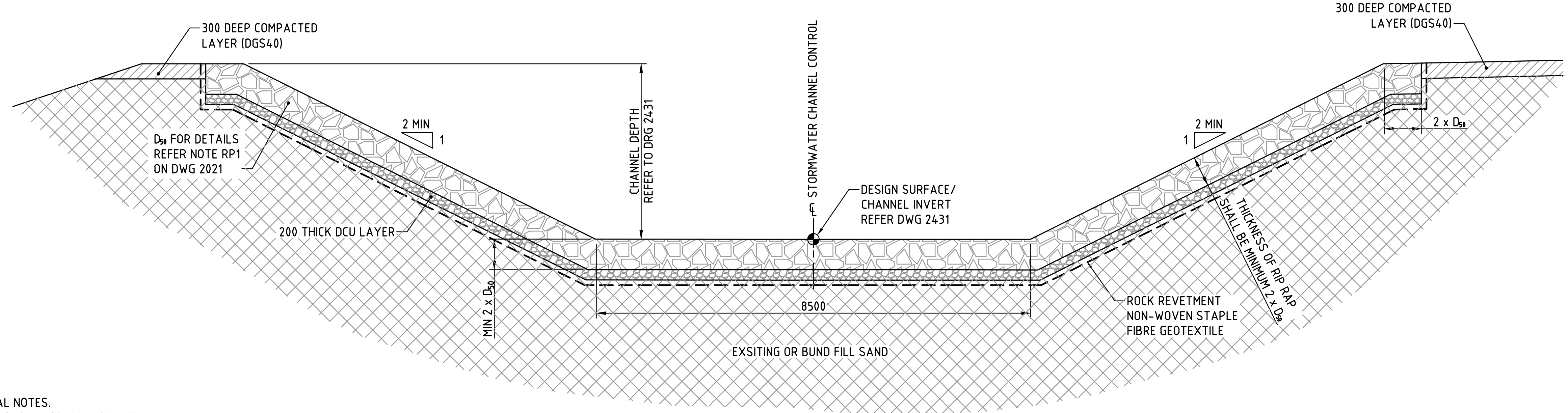
PKGT-SMC-OHC-CIV-DWG-2314 | 04

150 mm ON ORIGINAL
A1



STORMWATER CHANNEL GENERAL ARRANGEMENT

SCALE 1:500



TYPICAL CROSS SECTION OF ROCK LINED CHANNEL

SCALE 1:50

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.
2. COMPACTED LAYER TO BE DGS40 IN ACCORDANCE WITH TfNSW QA SPECIFICATION 3051 OR APPROVED EQUIVALENT
3. DGS40 TO BE COMPACTED IN MAX. 300 LAYERS TO MIN. 98% STANDARD COMPACTION AT 60-90% OMC

0 0.5 1.0 1.5 2.0 2.5m
SCALE 1:50 AT ORIGINAL SIZE
0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
589150	S. SRITHARAN	04	ISSUE FOR CONSTRUCTION	DL	PB	SS	HP	05.04.23
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	SM	PM	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	25.11.21

PLOT DATE: 04 Apr 2023 TIME: 15:09:51

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WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2401.dwg

SCALE	1:500
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

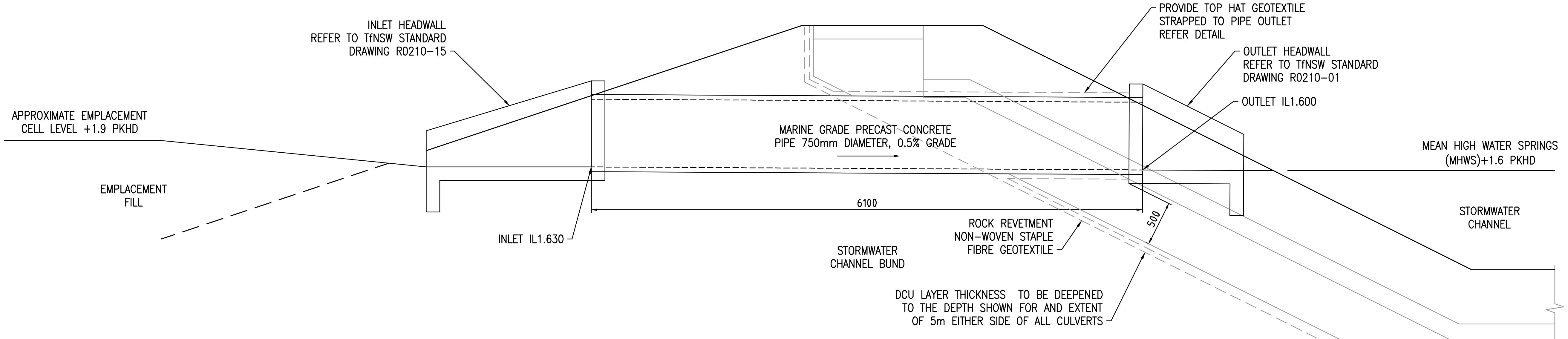
PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

STORMWATER CHANNEL
GENERAL ARRANGEMENT
PLAN

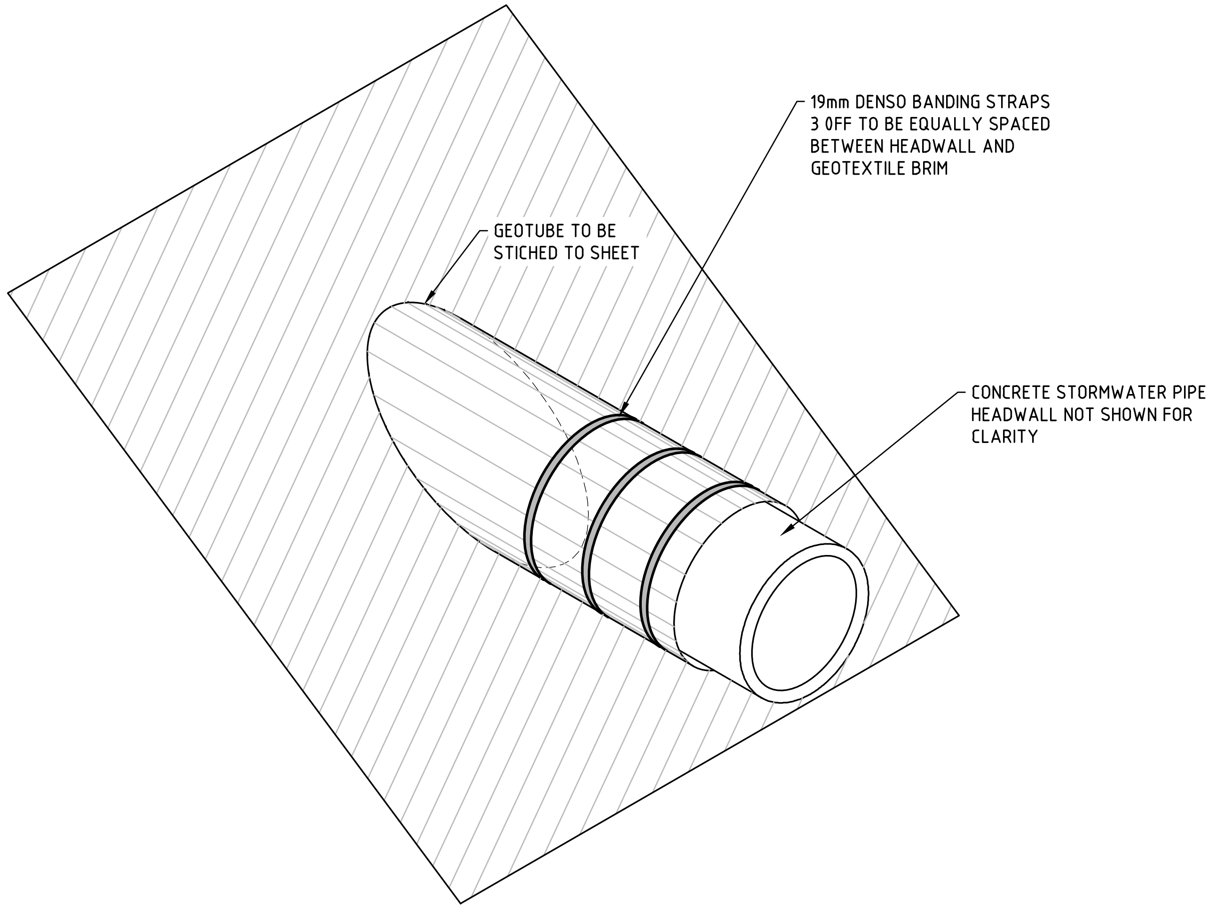
PKGT-SMC-OHC-CIV-DWG-2401 | 04

150 mm ON ORIGINAL

A1



TYPICAL STORMWATER PIPE



GEOTEXTILE TOP HAT
FABRICATED VIEW
SCALE 1:25

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.
2. ALL PRECAST PIPES TO BE MARINE GRADE GLASS REINFORCED PRECAST CONCRETE (EXPOSURE CLASSIFICATION C2).
3. ALL PRECAST HEADWALLS TO BE MARINE GRADE STEEL REINFORCED PRECAST CONCRETE (EXPOSURE CLASSIFICATION C2)
4. GEOTEXTILE 'TOP HAT' DETAIL TO BE FABRICATED FROM 1200R TEXCEL PRODUCT BY GEOFABRICS AUSTRALIA.
5. ALL GEOTEXTILE TOP HAT SEWN SEAMS ARE TO BE DOUBLE LOCK STITCH UTILIZING HEAVY DUTY M5/M6 POLYESTER SEWING YARN ABLE TO DEMONSTRATE SEAM STRENGTH OF 25kN/m MINIMUM.

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	22.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	SM	PM	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	25.11.21

PLOT DATE: 22 Jun 2022 TIME: 07:48:16

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WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2411.dwg

SCALE	TBC
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
STORMWATER CHANNEL
TYPICAL STORMWATER CHANNEL DETAILS

PKGT-SMC-OHC-CIV-DWG-2411 | 04

A1 150 mm ON ORIGINAL

GENERAL NOTES:

1. REFER DWG 2011 FOR GENERAL NOTES.
2. COMPACTED LAYER TO BE DGS40 IN ACCORDANCE WITH TfNSW QA SPECIFICATION 3051 OR APPROVED EQUIVALENT.
3. DGS40 TO BE COMPACTED IN MAX. 300 LAYERS TO MIN. 98% STANDARD COMPACTION AT 60-90% OMC.

HIGH STRENGTH GEOSYNTHETIC REINFORCEMENT (GEOGRID/GEOTEXTILE) NOTES:

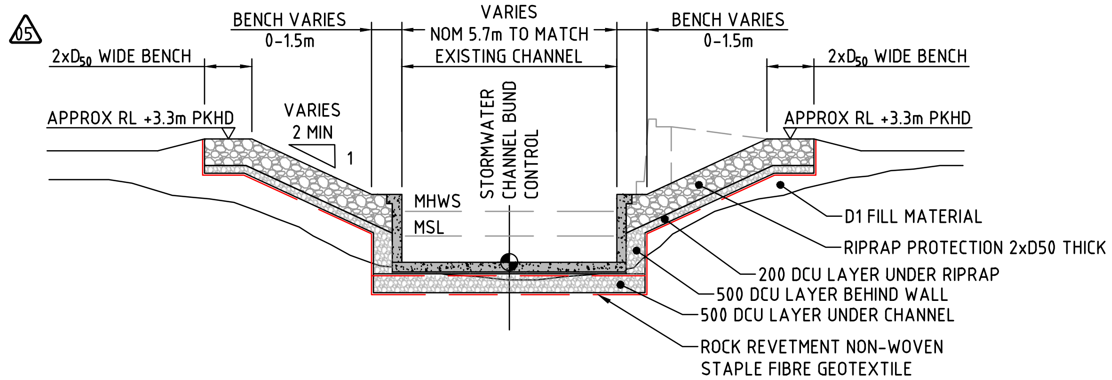
1. HIGH STRENGTH GEOSYNTHETICS ARE TO BE SUPPLIED IN ACCORDANCE WITH TfNSW QA SPECIFICATION R67. HANDLING AND INSTALLATION MUST ALSO BE IN ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS.
2. THE DESIGN STRENGTH SPECIFIED IS THE LONG TERM DESIGN STRENGTH (TD) IN ACCORDANCE WITH TfNSW R67.
3. THE PRODUCT STRENGTH FOR HIGH STRENGTH GEOSYNTHETIC REINFORCEMENT SHALL BE DETERMINED BASED ON BS8006 (1995) BY THE REINFORCEMENT SUPPLIER. THE ULTIMATE TENSILE STRENGTH OF THE REINFORCEMENT (Tu) SHALL BE OBTAINED BY MULTIPLYING THE DESIGN TENSILE STRENGTH (TD) WITH APPROPRIATE PARTIAL MATERIAL FACTORS AS PER BS8006 AND CONSIDERING A STRAIN LEVEL OF 5% AND A DESIGN LIFE OF 15 YEARS.
4. GEOSYNTHETIC REINFORCEMENT SHALL HAVE A MINIMUM LONG TERM DESIGN STRENGTH AS SPECIFIED IN TABLE 1.
5. GEOSYNTHETICS SHALL BE OVERLAPPED BY A WIDTH OF AT LEAST 0.3m OR AS PER MANUFACTURER'S GUIDELINES, WHICHEVER IS GREATER.
6. SLIGHTLY TENSION ANY GEOSYNTHETIC BEFORE PLACING FILL MATERIAL. THE METHOD OF FILL PLACEMENT AND COMPACTION MUST ENSURE THAT SLACK IS NOT INTRODUCED INTO THE LAYER AS FILL IS PLACED. USE PINS AND STAKES AS REQUIRED.
7. THE CONTRACTOR MUST ENSURE THAT GEOSYNTHETICS ARE PLACED IN ACCORDANCE WITH THE MANUFACTURERS MAXIMUM RECOMMENDED APERTURE SIZE. IF THIS IS EXCEEDED, A SUITABLE LAYER OF SELECT MATERIAL SHOULD BE INSTALLED (AS PER MANUFACTURERS RECOMMENDATIONS) PRIOR TO PLACEMENT OF GEOSYNTHETIC.

TABLE 1

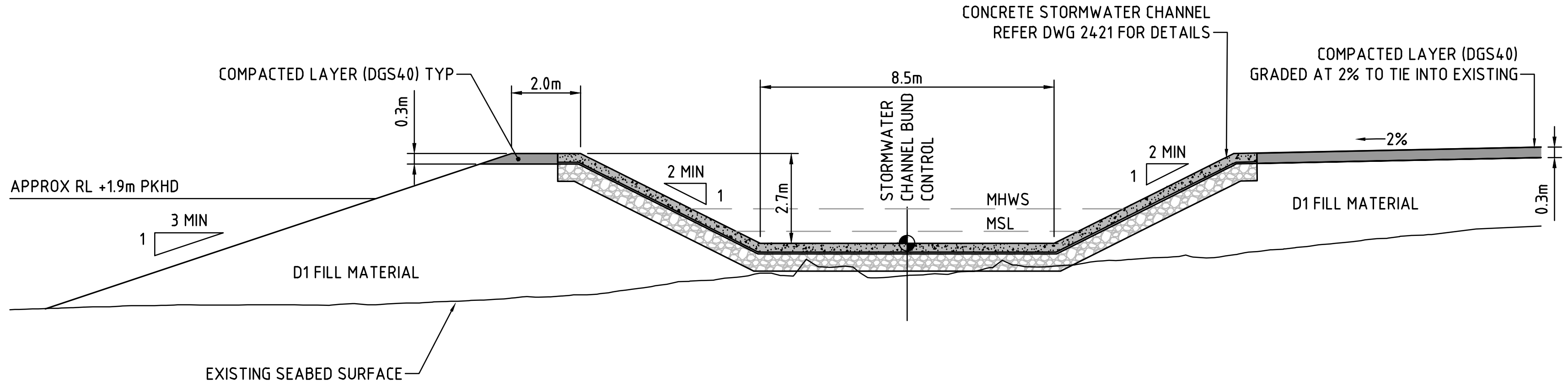
HIGH STRENGTH GEOTEXTILE/GEOGRID	LONG TERM DESIGN STRENGTH (TD) (kN/m)
GEOTEXTILE - TYPE GT1	100
GEOGRID - TYPE GG1	100

FOR ROCK RIPRAP REFER
TABLE 21 - TECHNICAL SPECIFICATION

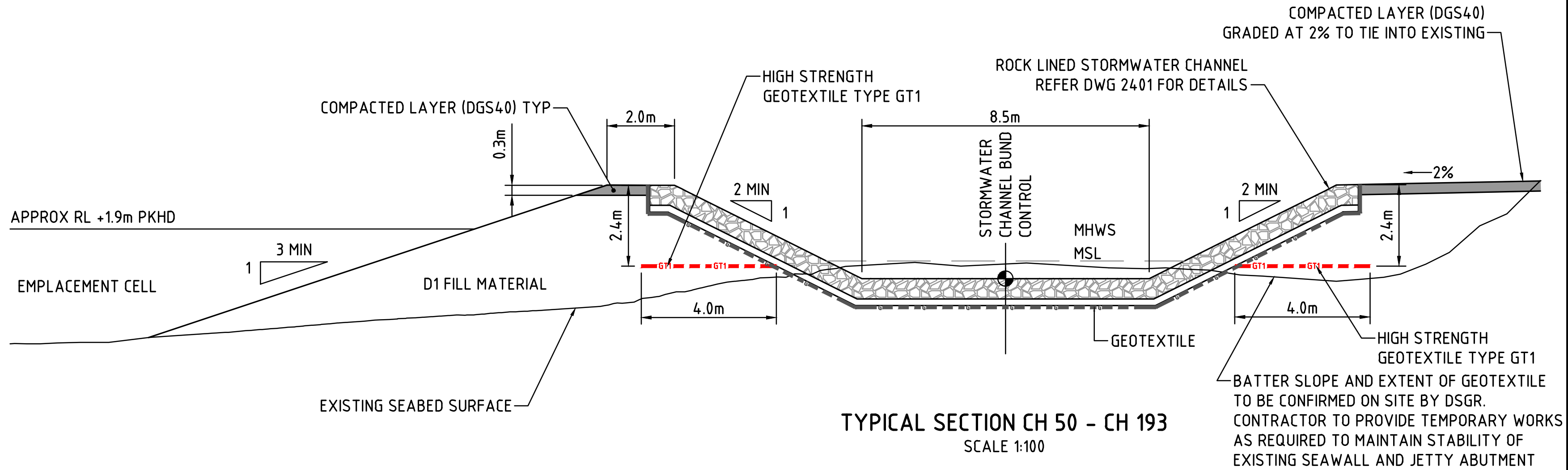
FOR DRAINAGE CHANNEL UNDER LAYER REFER
TABLE 22 - TECHNICAL SPECIFICATION



TYPICAL DARCY ROAD DRAIN EXTENSION SECTION CH 0 - CH 22.69
SCALE 1:100



TYPICAL SECTION AT CONCRETE CHANNEL CH 22.69 - CH 50
SCALE 1:100



TYPICAL SECTION CH 50 - CH 193
SCALE 1:100

0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

0 0.5 1.0 1.5 2.0 2.5m
SCALE 1:50 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
589150	S. SRITHARAN	05	ISSUE FOR CONSTRUCTION	DL	PB	SS	HP	05.04.23
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	15.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	SM	PM	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	25.11.21

PLOT DATE: 04 Apr 2023 TIME: 15:10:16

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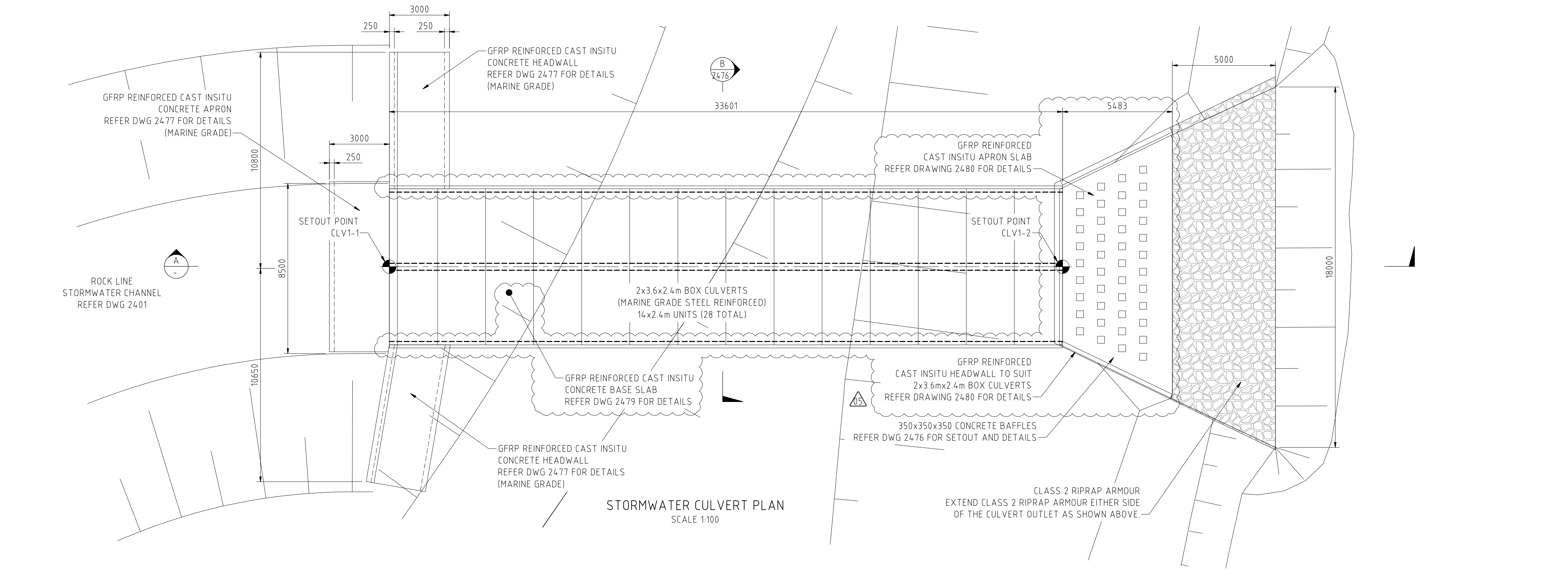
SCALE	1:100
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

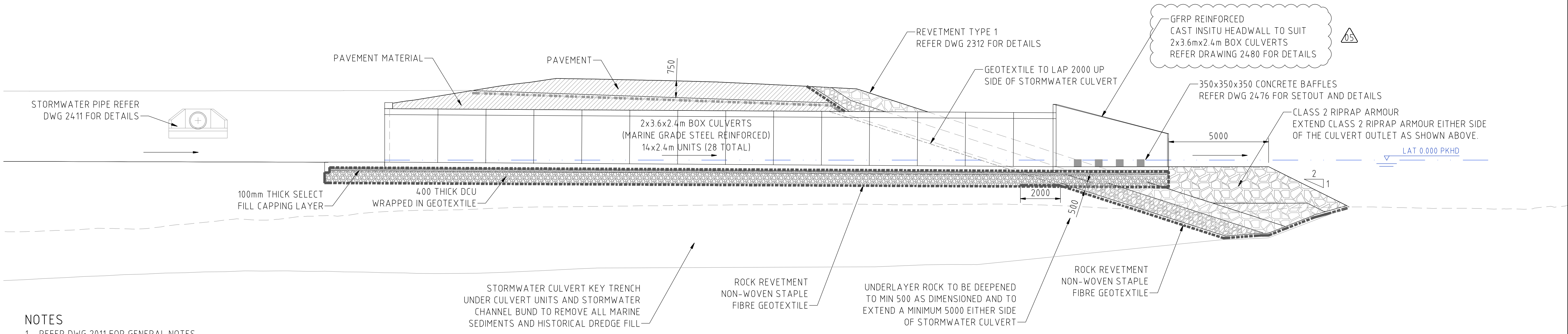
PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
STORMWATER CHANNEL
TYPICAL CHANNEL BUND SECTIONS
SHEET 1

PKGT-SMC-OHC-CIV-DWG-2415 | 05

A1 — 150 mm ON ORIGINAL



STORMWATER CULVERT PLAN
SCALE 1:100



TYPICAL CULVERT SECTION

SECTION A
SCALE 1: 100

NOTES

1. REFER DWG 2011 FOR GENERAL NOTES.
2. PAVEMENT TO BE DGS40 IN ACCORDANCE WITH TfNSW QA SPECIFICATION 3051 OR APPROVED EQUIVALENT.
3. PAVEMENT TO BE COMPACTED IN MAX. 300 LAYERS TO MIN. 98% STANDARD COMPACTION AT 60-90% OMC.

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
589150	S. SRITHARAN	06	ISSUE FOR CONSTRUCTION	DL	PB	SS	HP	22.12.22
589150	S. SRITHARAN	05	ISSUE FOR REVIEW	DL	PB	SS	HP	14.12.22
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	22.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	NP	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	NP	PM	25.11.21

PLOT DATE: 23 Dec 2022 TIME: 08:37:58

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DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2475.dwg

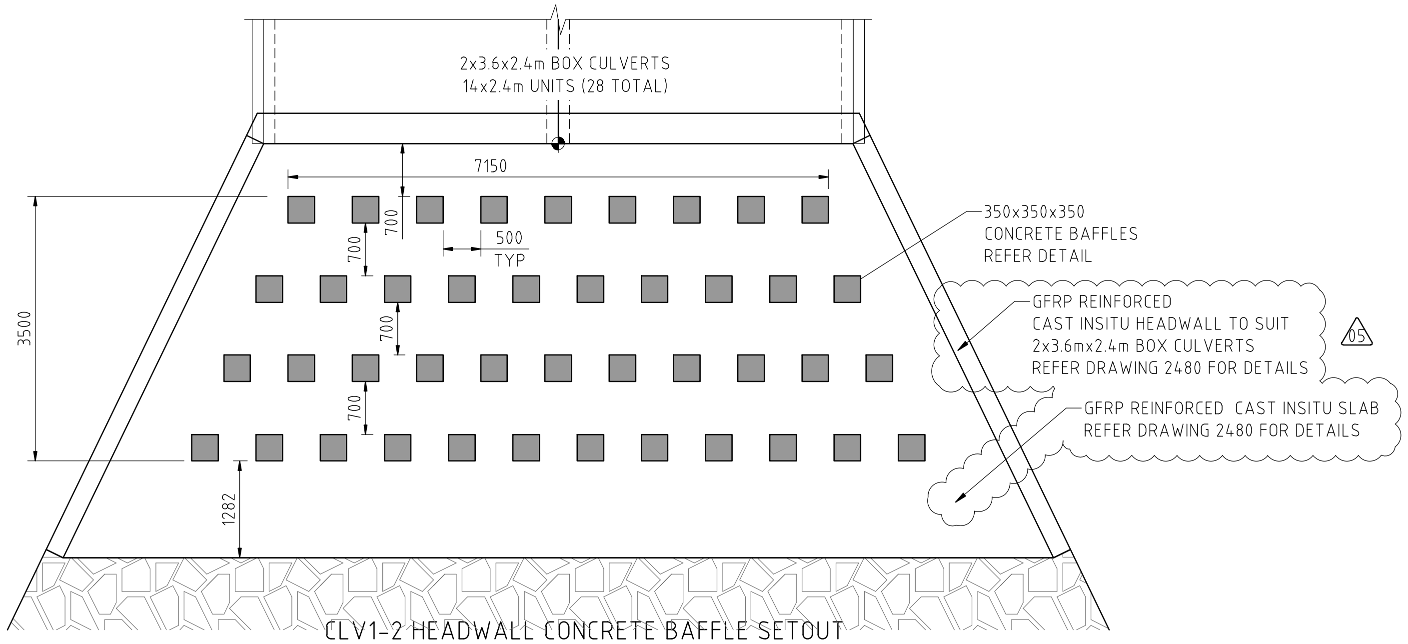
SCALE	1:100
DRN	D. LEE
CHK	N. PANNIPITIYA
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

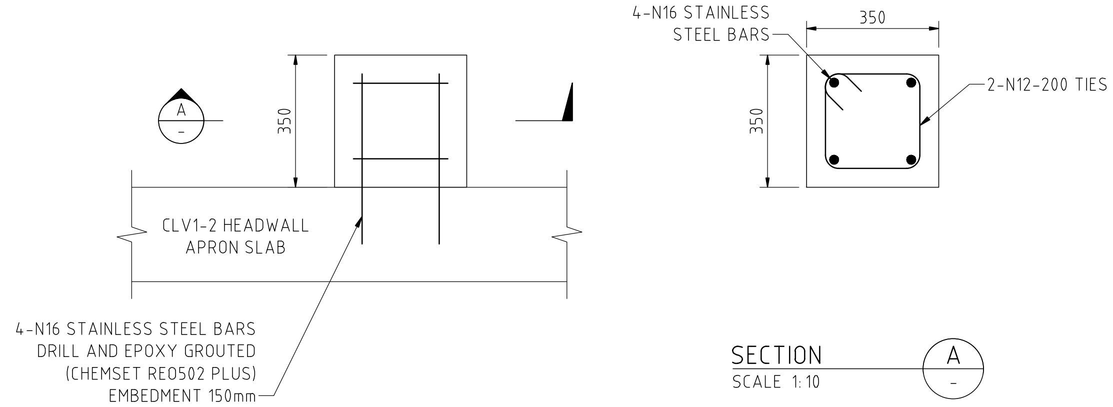
PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
STORMWATER CULVERT
DETAILS
SHEET 1

PKGT-SMC-OHC-CIV-DWG-2475 | 06

150 mm ON ORIGINAL
A1

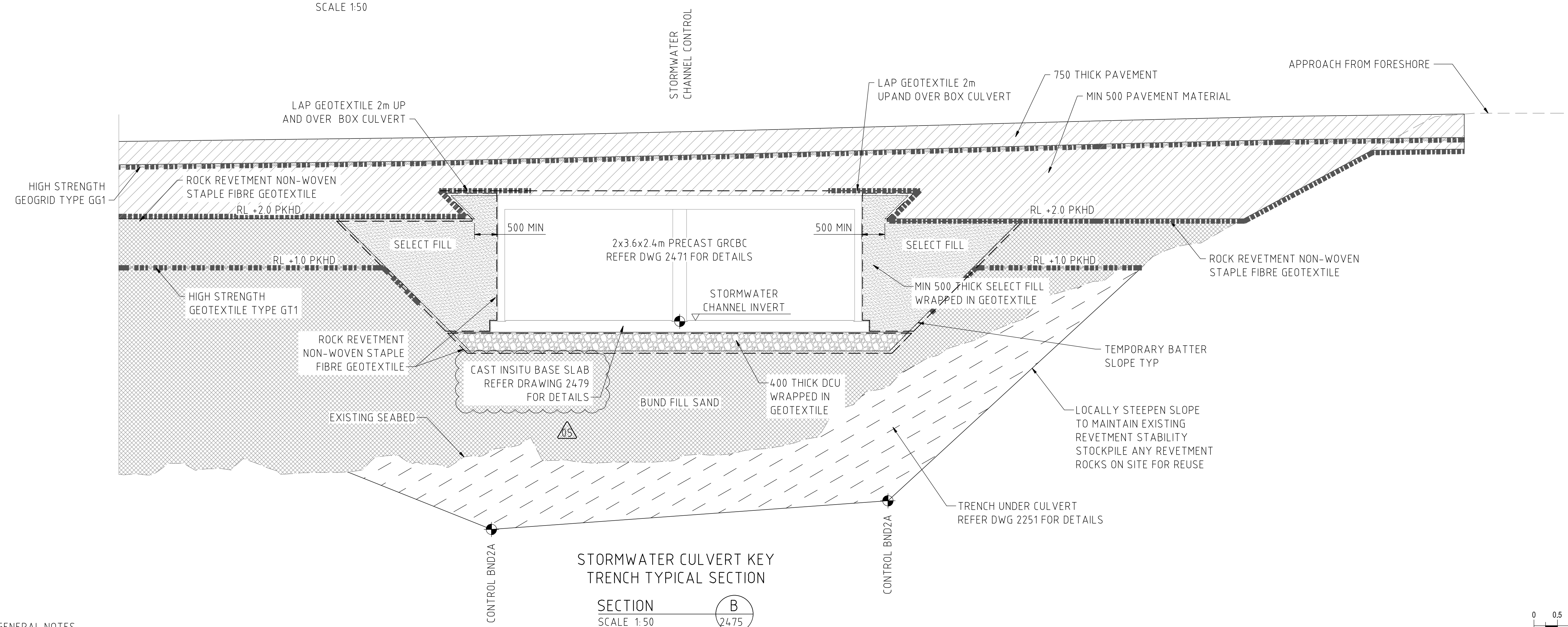


CLV1-2 HEADWALL CONCRETE BAFFLE SETOUT
SCALE 1:50



SECTION A
SCALE 1:10

CLV1-2 HEADWALL - CONCRETE BAFFLE DETAILS
SCALE 1:10



STORMWATER CULVERT KEY
TRENCH TYPICAL SECTION

SECTION B
SCALE 1:50
2475

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

FOR CONSTRUCTION

0 0.5 1.0 1.5 2.0 2.5m
SCALE 1:50 AT ORIGINAL SIZE

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
589150	S. SRITHARAN	06	ISSUE FOR CONSTRUCTION	DL	PB	SS	HP	22.12.22
589150	S. SRITHARAN	05	ISSUE FOR REVIEW	DL	PB	SS	HP	14.12.22
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	22.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	DL	PB	NP	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	DL	PB	NP	PM	25.11.21

PLOT DATE: 22 Dec 2022 TIME: 12:39:54

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DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2476.dwg

SCALE	1:50
DRN	D. LEE
CHK	N. PANNIPITIYA
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

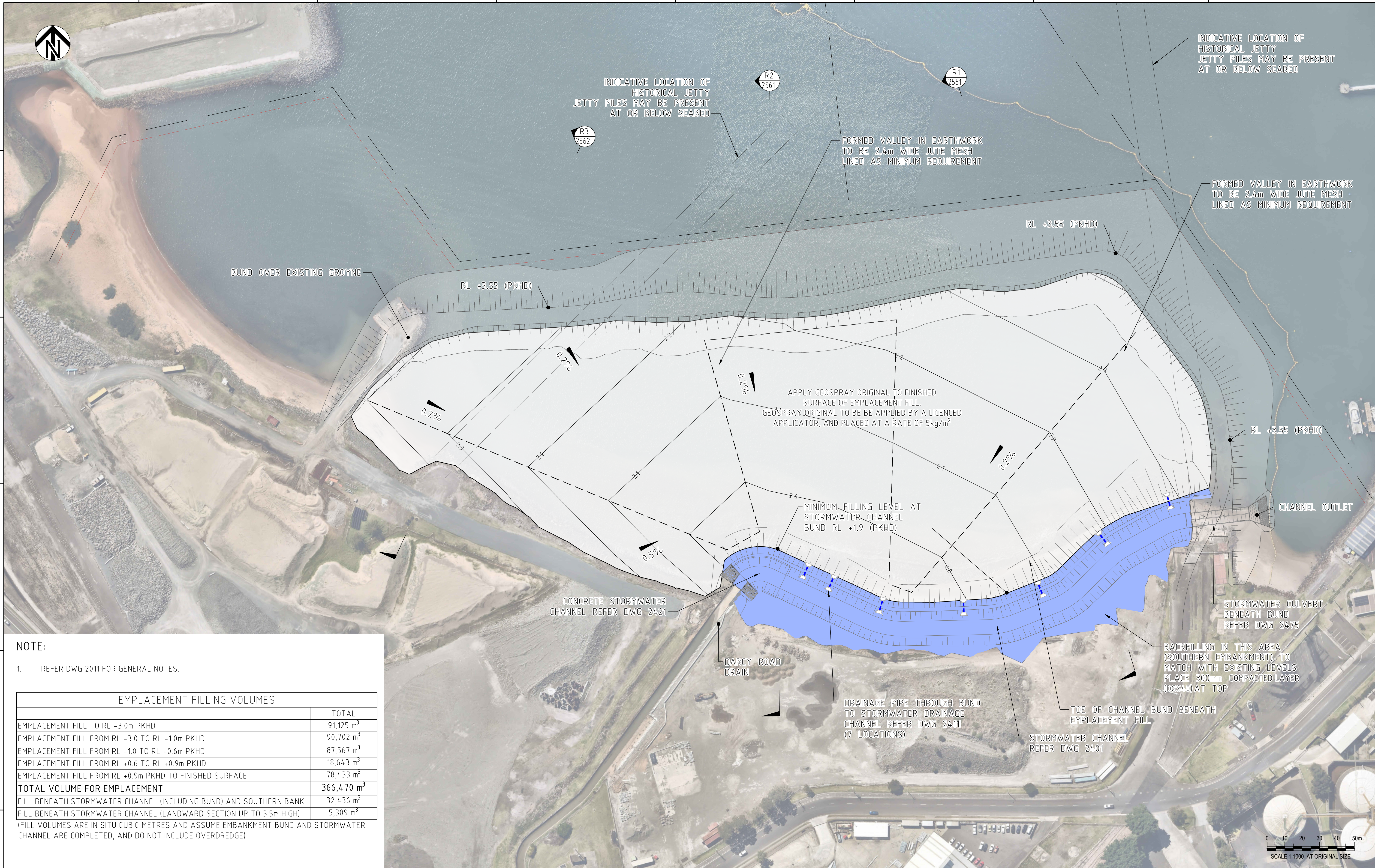
CONSTRUCTION

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

STORMWATER CULVERT
DETAILS
SHEET 2

PKGT-SMC-OHC-CIV-DWG-2476 | 06

150 mm ON ORIGINAL
A1



NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

EMPLACEMENT FILLING VOLUMES

	TOTAL
EMPLACEMENT FILL TO RL -3.0m PKHD	91,125 m^3
EMPLACEMENT FILL FROM RL -3.0 TO RL -1.0m PKHD	90,702 m^3
EMPLACEMENT FILL FROM RL -1.0 TO RL +0.6m PKHD	87,567 m^3
EMPLACEMENT FILL FROM RL +0.6 TO RL +0.9m PKHD	18,643 m^3
EMPLACEMENT FILL FROM RL +0.9m PKHD TO FINISHED SURFACE	78,433 m^3
TOTAL VOLUME FOR EMPLACEMENT	366,470 m^3
FILL BENEATH STORMWATER CHANNEL (INCLUDING BUND) AND SOUTHERN BANK	32,436 m^3
FILL BENEATH STORMWATER CHANNEL (LANDWARD SECTION UP TO 3.5m HIGH)	5,309 m^3

(FILL VOLUMES ARE IN SITU CUBIC METRES AND ASSUME EMBANKMENT BUND AND STORMWATER CHANNEL ARE COMPLETED, AND DO NOT INCLUDE OVERDREDGE)

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
		05	ISSUE FOR REVIEW	KB	CL	HP	PM	16.05.23
1289790	P. MOYES	04	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	22.06.22
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	25.11.21

PLOT DATE: 23 May 2023 TIME: 16:35:38

AIE Powering Australian Industry

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DRAWING FILE LOCATION / NAME V:__Vault\Projects\3001\30013105\110__CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2501.dwg

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WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

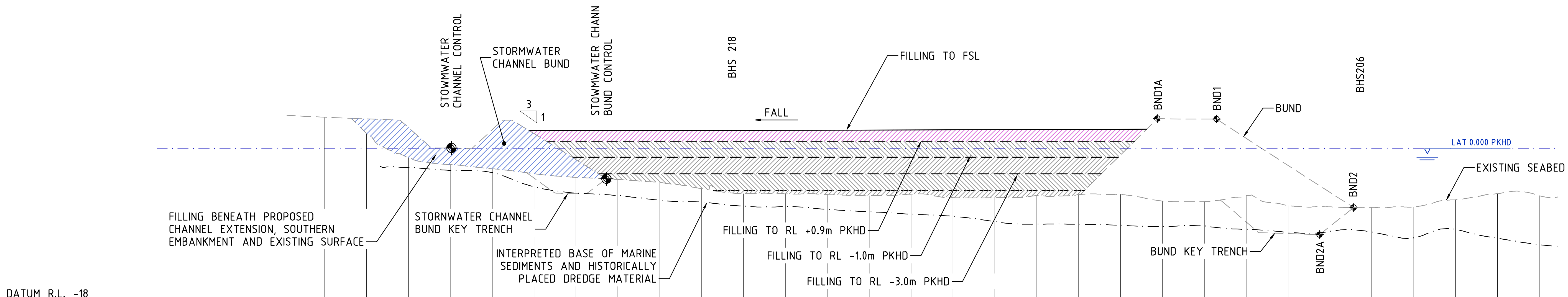
SCALE	1:1000
DRN	M. COLLINGS
CHK	D. LEE
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

EMPLACEMENT FILL GENERAL ARRANGEMENT PLAN

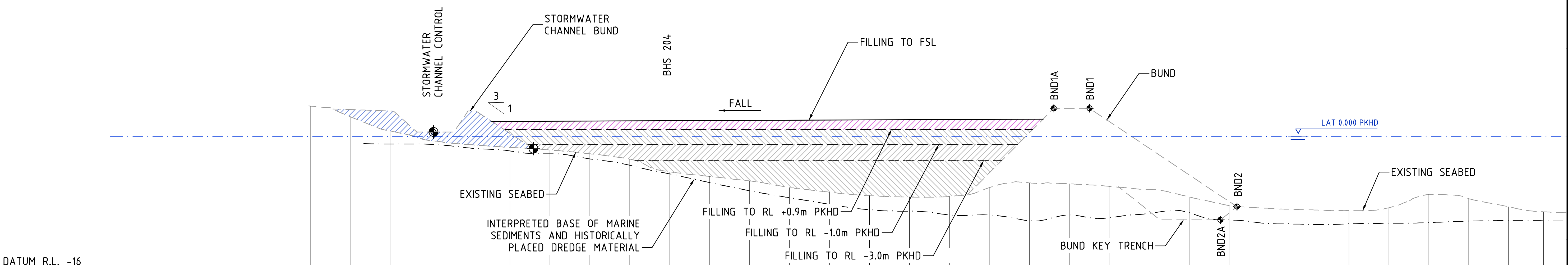
PKGT-SMC-OHC-CIV-DWG-2501 | 05

A1 150 mm ON ORIGINAL



CHAINAGE	TOP OF EMPLACEMENT (FINISHED SURFACE)	EXISTING SURFACE / SEABED
0		
10		
20		3.77
30		1.82
40		-1.03
50		-1.89
60		-2.39
70	2.16	-2.97
80	2.17	-3.41
90	2.17	-3.66
100	2.18	-4.02
110	2.18	-4.74
120	2.19	-5.36
130	2.19	-5.38
140	2.21	-5.47
150	2.22	-5.60
160	2.24	-5.41
170	2.26	-5.84
180	2.27	-5.83
190	2.29	-5.58
200	2.30	-5.47
210	2.32	-5.45
220		-6.24
230		-6.30
240		-5.59
250		-6.78
260		-6.93
270		-6.98
280		-6.95
290		-6.08
300		-5.35
310		-5.60

SECTION R1 / 2501
SCALE 1:500 (H) 1:250 (V)



CHAINAGE	TOP OF EMPLACEMENT (FINISHED SURFACE)	EXISTING SURFACE / SEABED
0		
10		
20		
30		3.82
40		2.51
50		0.72
60		-0.48
70		-0.99
80	1.93	-1.34
90	1.95	-1.66
100	1.97	-2.13
110	1.99	-2.80
120	2.01	-4.39
130	2.03	-4.96
140	2.05	-5.53
150	2.07	-6.38
160	2.09	-6.93
170	2.11	-7.37
180	2.13	-7.55
190	2.15	-7.46
200	2.17	-6.37
210	2.19	-5.77
220		-5.89
230		-6.21
240		-6.59
250		-7.53
260		-8.61
270		-8.96
280		-9.14
290		-9.24
300		-8.88
310		-7.21
320		-7.75
330		-8.76
339		-9.39

SECTION R2 / 2501
SCALE 1:500 (H) 1:250 (V)

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

0 2.5 5 7.5 10 12.5m SCALE 1:250 AT ORIGINAL SIZE
0 5 10 15 20 25m SCALE 1:500 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	25.11.21

PLOT DATE: 03 Jun 2022 TIME: 12:19:23

CLIENT

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2561.dwg

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MMJ BUILDING, 6-8 REGENT STREET WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

SCALE	AS NOTED
DRN	M. COLLINGS
CHK	D. LEE
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

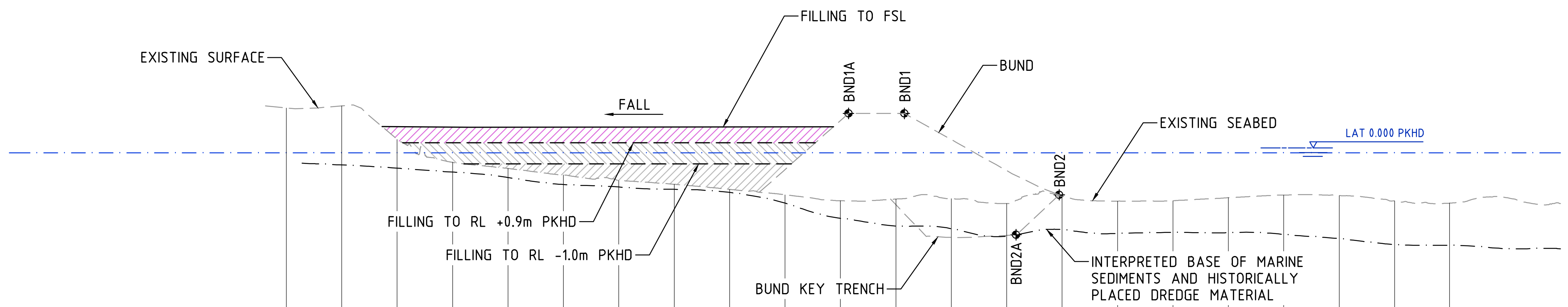
CONSTRUCTION

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

EMPLACEMENT FILL
SITE SECTIONS
SHEET 1

PKGT-SMC-OHC-CIV-DWG-2561 | 03

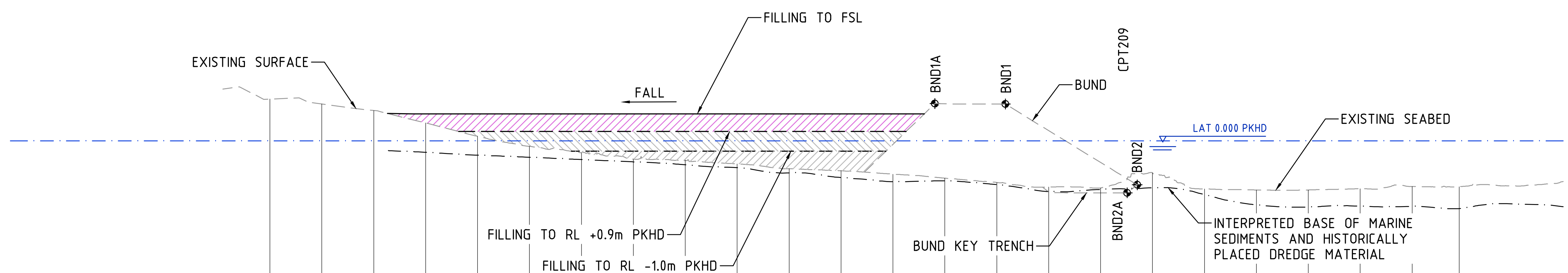
150 mm ON ORIGINAL A1



DATUM R.L. -14

TOP OF EMPLACEMENT (FINISHED SURFACE)						2.34	2.30	2.29	2.30	2.31	2.32	2.33	2.34											
EXISTING SURFACE / SEABED				4.05	4.23	1.21	-0.86	-1.41	-2.00	-2.50	-2.84	-3.30	-3.78	-4.32	-4.17	-4.13	-4.58	-3.92	-4.36	-4.31	-4.05	-3.81	-3.85	-4.34	-4.54
CHAINAGE	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240

SECTION R3 / 2501
SCALE 1:500 (H)
1:250 (V)



DATUM R.L. -14

TOP OF EMPLACEMENT (FINISHED SURFACE)							2.59	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.56										
EXISTING SURFACE / SEABED				4.03	3.55	2.93	1.73	0.45	-0.52	-1.12	-1.76	-1.88	-2.22	-2.70	-2.88	-3.21	-3.59	-4.02	-4.45	-4.54	-3.09	-4.65	-4.74	-4.73	-4.62	-4.41	-4.42
CHAINAGE	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	259

SECTION R3 / 2501
SCALE 1:500 (H)
1:250 (V)

NOTE:

1. REFER DWG 2011 FOR GENERAL NOTES.

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
1289790	P. MOYES	03	ISSUE FOR CONSTRUCTION	DL	PB	SM	PM	02.06.22
1289790	P. MOYES	02	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	07.02.22
1289790	P. MOYES	01	ISSUE FOR CONSTRUCTION	MC	DL	SM	PM	25.11.21

PLOT DATE: 03 Jun 2022 TIME: 12:19:47

CLIENT

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SMEC PROJECT No 30013105

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG\PKGT-SMC-OHC-CIV-DWG-2562.dwg

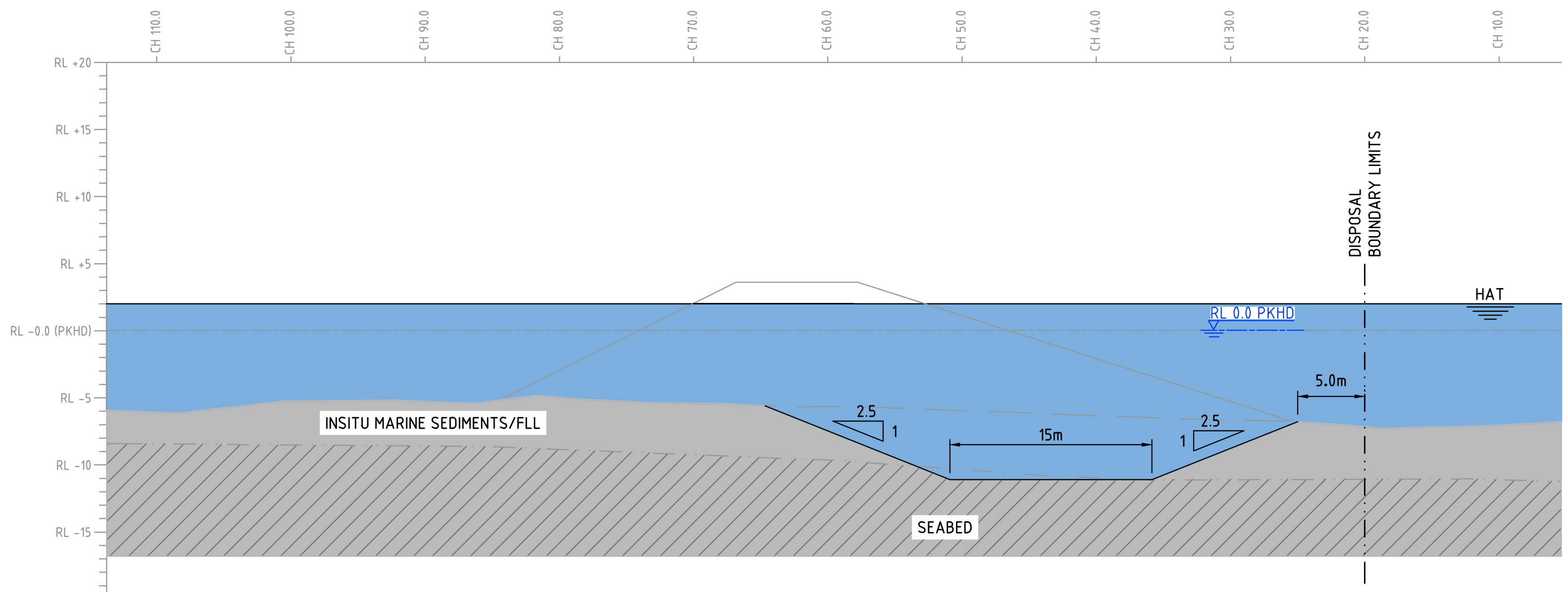
SCALE	AS NOTED
DRN	M. COLLINGS
CHK	D. LEE
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

CONSTRUCTION

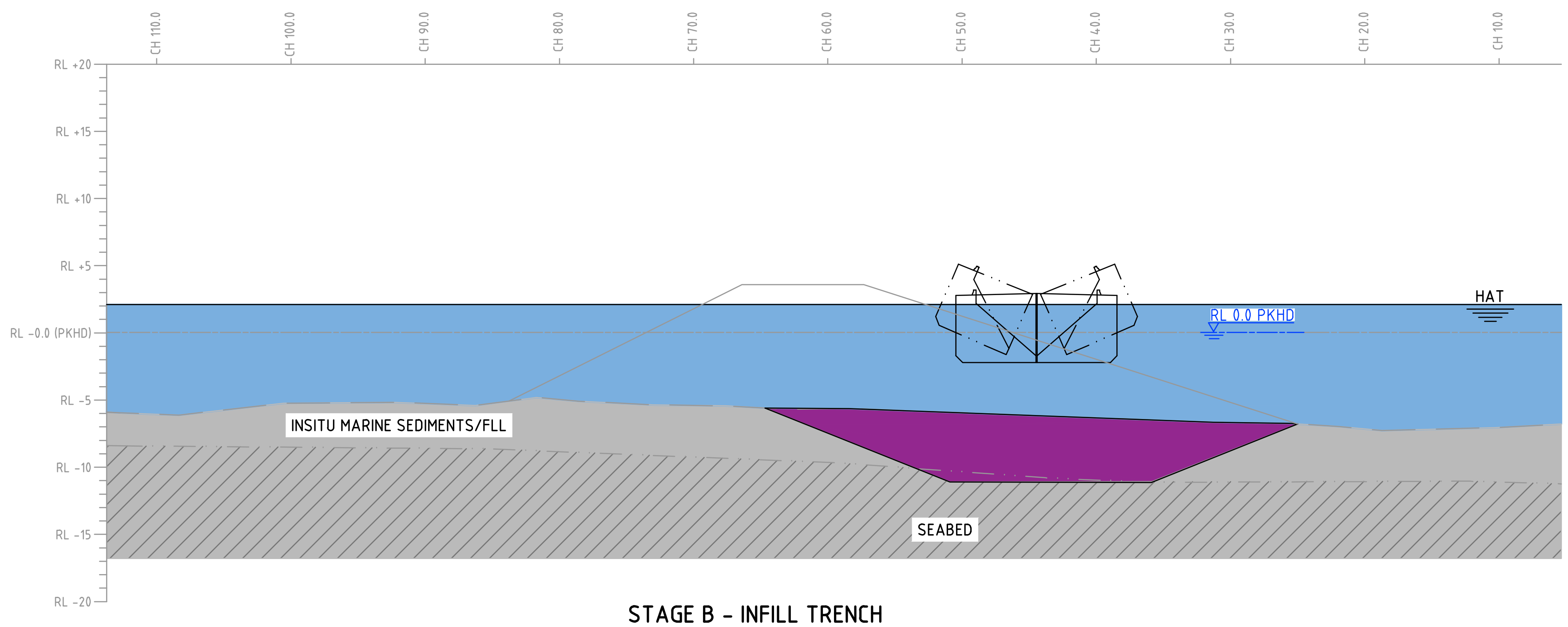
PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
EMPLACEMENT FILL
SITE SECTIONS
SHEET 2

PKGT-SMC-OHC-CIV-DWG-2562 03

150 mm ON ORIGINAL
A1



STAGE A - PRE-DREDGE TRENCH



STAGE B - INFILL TRENCH
(DIRECT DUMPING BY SPLIT HOPPER BARGES)

LEGEND:

WORK IN CURRENT STAGE / WORK IN PREVIOUS STAGE

- FILL UNIT 1A AND 1B DREDGE MATERIAL (UNIT D1)
- DREDGE MATERIALS ALL UNITS EXCLUDING HM, HS AND PRE-DREDGE TRENCH MATERIAL (UNITS D1 & D2)
- DREDGE MATERIALS - ALL UNITS INCLUDING PRE-DREDGE TRENCH MATERIALS (UNITS D1, D2 & D5)
- INSITU MARINE SEDIMENTS/ HISTORICAL DREDGE FILL (UNITS 5 & 6)
- COMPETENT SEA BED (UNITS 2, 3 & 4)
- WATER

STAGE A CONSTRUCTION NOTES

- TRENCH BATTERS TO BE DREDGED AT A GRADE OF 2.5:1 (H:V)
- TRENCH DEPTH WILL BE A FUNCTION OF THE THICKNESS OF UNSUITABLE MATERIAL NEEDING REMOVAL AND POSITION OF CONTROL LINE BND2
- FLOOR OF THE TRENCH WILL BE EXCAVATED HORIZONTALLY WITH REFERENCE TO THE SEAWARD POSITION THE KEY TRENCH TOE
- ALL VERY SOFT TO SOFT/VERY LOOSE TO LOOSE MATERIAL (UNIT 5, UNIT 6) WILL NEED TO BE REMOVED FROM THE FOOTPRINT OF THE TRENCH
- THE TRENCH WILL BE 15m WIDE MEASURED ALONG THE BOTTOM OF THE KEY EXCAVATION.
- REFER TO TECHNICAL SPECIFICATIONS FOR DETAILS ON HOLD POINTS

STAGE B CONSTRUCTION NOTES

- BOTTOM DUMPING UNIT D1 (FILL 1A/1B) USING SPLIT HOPPER BARGES, UP TO TOP OF KEY TRENCH.
- PLACEMENT OF ROCK LAYER IN THE BOTTOM OF THE TRENCH (WHERE DIRECTED BY PRINCIPAL)

NOT FOR CONSTRUCTION

REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
A	100% DETAILED DESIGN	DL	PB	SM	PM	04.02.22

CERTIFIER NO. | CERTIFYING ENGINEER NAME

PLOT DATE: 03 Feb 2022 TIME: 12:14:30

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SCALE	NTS
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

PRELIMINARY

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
INDICATIVE SEQUENCING SECTIONS
SHEET 1

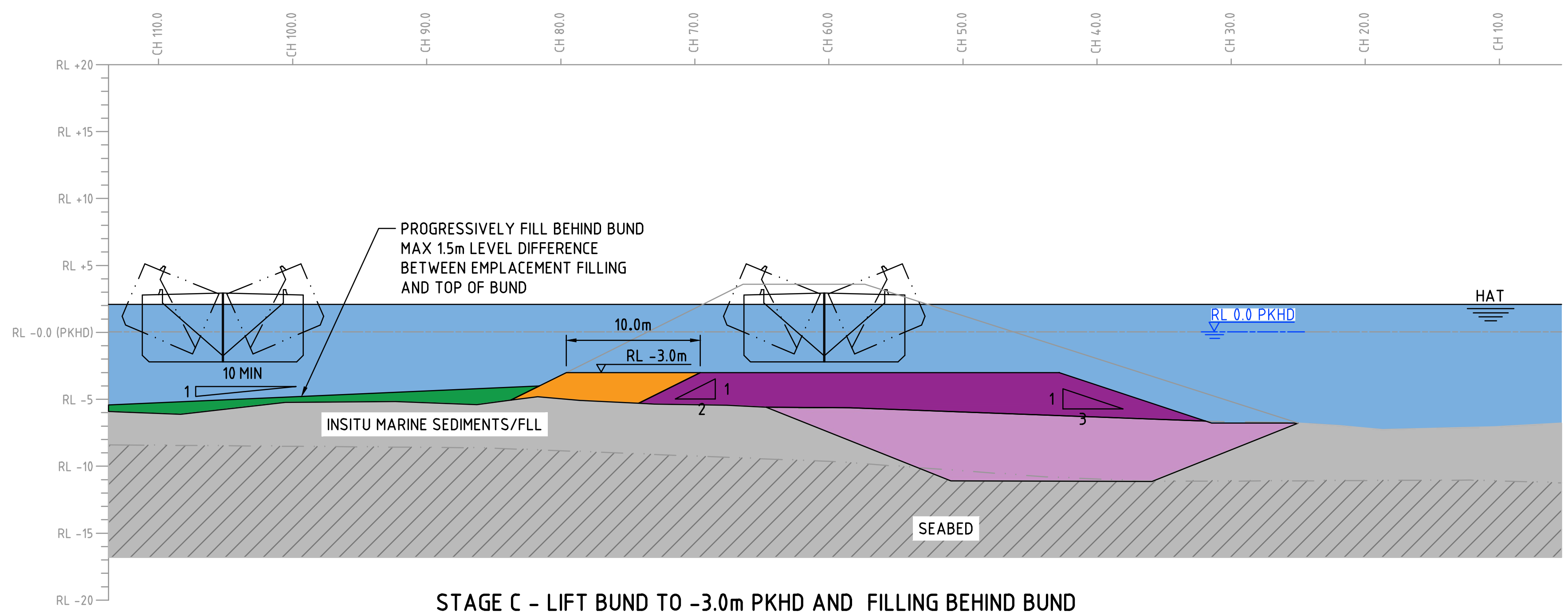
PKGT-SMC-OHC-CIV-DWG-1801 | A

A1 | 150 mm ON ORIGINAL

LEGEND:

WORK IN CURRENT STAGE / WORK IN PREVIOUS STAGE

- FILL UNIT 1A AND 1B DREDGE MATERIAL (UNIT D1)
- DREDGE MATERIALS ALL UNITS EXCLUDING HM, HS AND PRE-DREDGE TRENCH MATERIAL (UNITS D1 & D2)
- DREDGE MATERIALS - ALL UNITS INCLUDING PRE-DREDGE TRENCH MATERIALS (UNITS D1, D2 & D5)
- INSITU MARINE SEDIMENTS/ HISTORICAL DREDGE FILL (UNITS 5 & 6)
- COMPETENT SEA BED (UNITS 2, 3 & 4)
- WATER

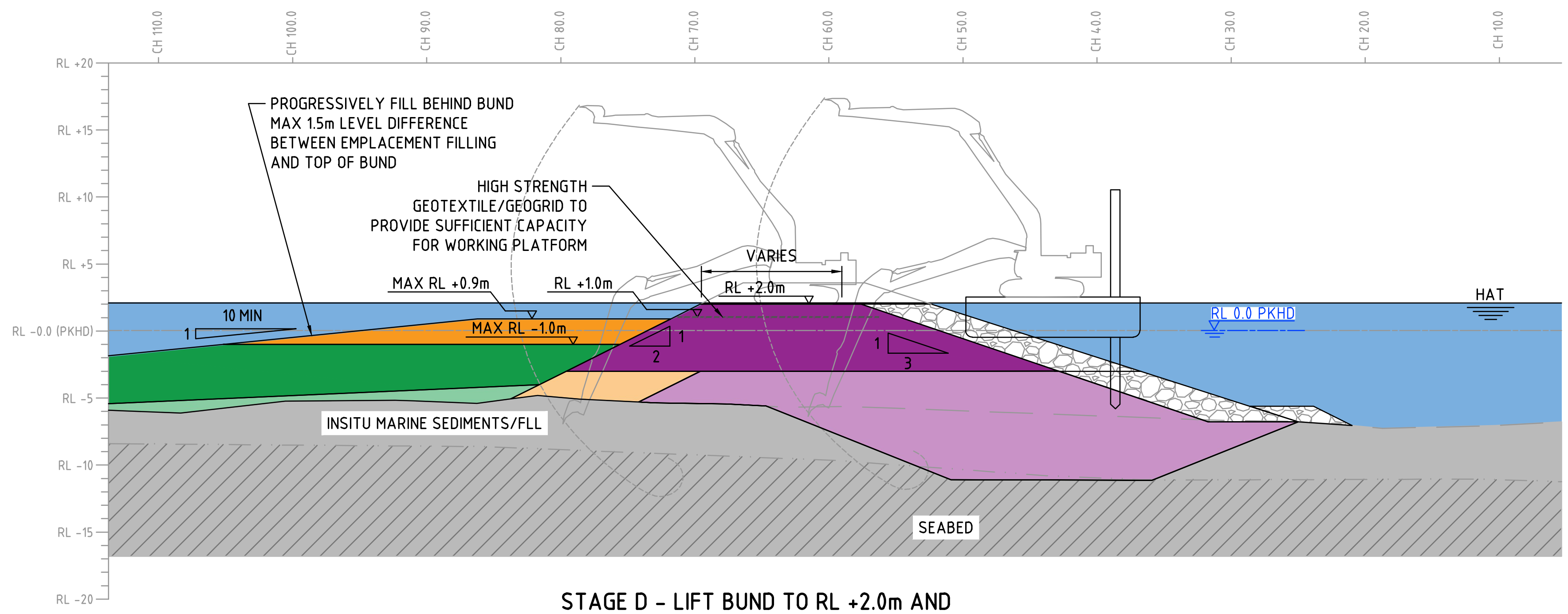


STAGE C - LIFT BUND TO -3.0m PKHD AND FILLING BEHIND BUND

(DIRECT DUMPING BY SPLIT HOPPER BARGES)

STAGE C CONSTRUCTION NOTES

- BUND SEAWARD BATTER GRADIENT NOT STEEPER THAN 3H:1V
- THE LANDWARD SIDE OF THE BUND CAN BE PLACED AT A GRADE OF 2H:1V (MAXIMUM)
- THE HEIGHT DIFFERENCE BETWEEN THE EMPLACEMENT CELL LEVEL AND THE CREST OF THE BUND DURING CONSTRUCTION STAGE IS TO BE OF 1.5m OR LESS THROUGHOUT ALL STAGES OF THE CONSTRUCTION.
- CELL EMPLACEMENT MATERIAL (UNITS D5, D2 AND D1) SHOULD BE PLACED PROGRESSIVELY, SUB-HORIZONTALLY AT AN EQUIVALENT GRADE NO STEEPER THAN 10H:1V.
- THE LEADING EDGE OF THIS EMPLACEMENT MATERIAL SHOULD BE NO THICKER THAN 1.5m.
- INCLUSION OF UNIT D2 WITHIN A 10m WIDE ZONE OF THE BUND, FROM SEABED TO RL -3.0m PKHD.



STAGE D - LIFT BUND TO RL +2.0m AND FILLING BEHIND BUND, CONSTRUCTION OF TEMPORARY AND PERMANENT WORKING PLATFORMS, PLACEMENT OF ROCK ARMOUR FROM SEABED TO +2.0m PKHD

(PLACING FILL USING EXCAVATORS ON UNLOADING BARGES, LAND BASED EARTHMOVING EQUIPMENT AND DIRECT DUMPING FROM PARTIALLY LADEN SPLIT HOPPER BARGES)

STAGE D CONSTRUCTION NOTES

- FILL PLACEMENT (UNIT D1) TO RL +2.0m PKHD
- BUND LEVEL SHOULD BE KEPT WITHIN LESS THAN 1.5m HEIGHT DIFFERENCE FROM THE EMPLACEMENT CELL.
- UNIT D2 CONTAINING ASS MATERIAL WILL BE PLACED UP TO NO HIGHER THAN RL +0.9m PKHD
- THE CELL EMPLACEMENT MATERIAL (D5, D2 AND D1) SHOULD BE PLACED PROGRESSIVELY, SUB-HORIZONTALLY AT A GRADE NO STEEPER THAN 10H:1V.
- THE LEADING EDGE OF THIS EMPLACEMENT MATERIAL SHOULD BE NO THICKER THAN 1.5m.
- ROCK ARMOUR UP TO RL +2.0m PKHD SHOULD BE PLACED DURING THIS STAGE.

NOT FOR CONSTRUCTION

REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
A	100% DETAILED DESIGN	DL	PB	SM	PM	04.02.22

CERTIFIER NO. | CERTIFYING ENGINEER NAME

PLOT DATE: 03 Feb 2022 TIME: 12:15:13

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WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

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SCALE	NTS
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

PRELIMINARY

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
INDICATIVE SEQUENCING
SECTIONS
SHEET 2

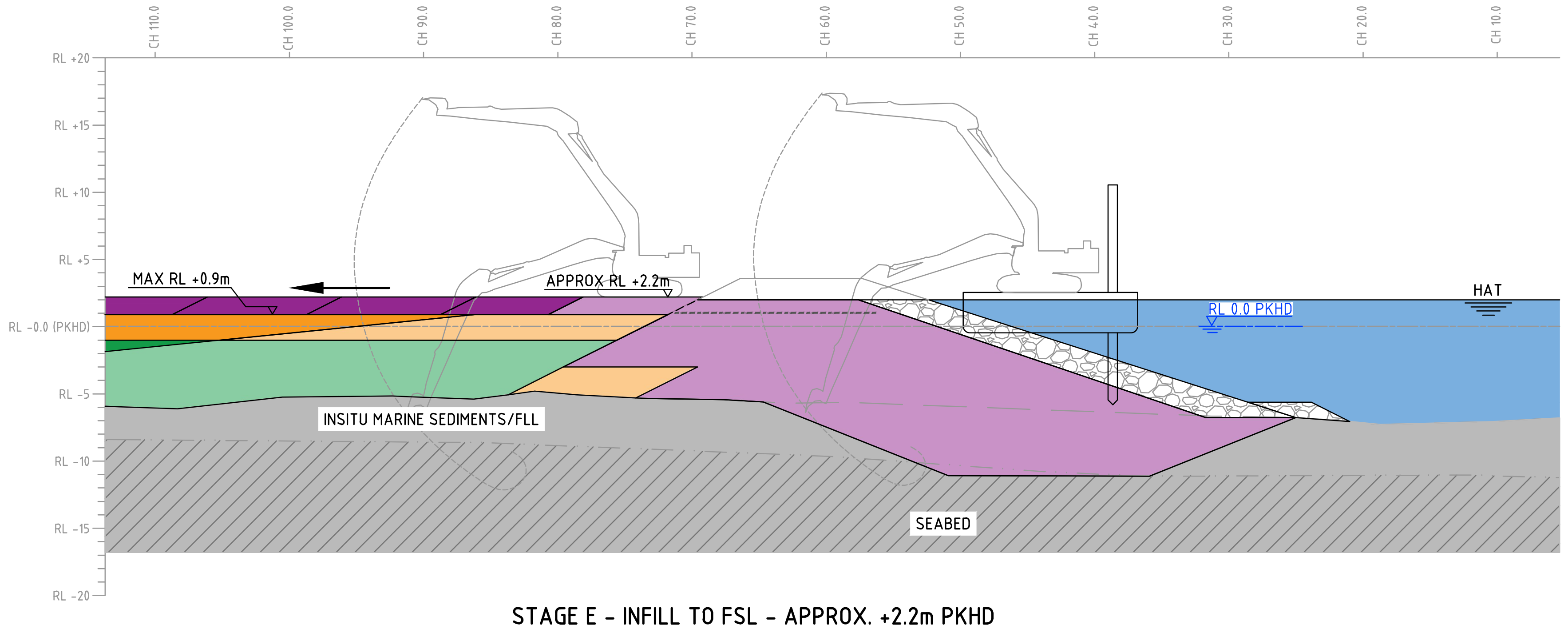
PKGT-SMC-OHC-CIV-DWG-1802 A

A1 150 mm ON ORIGINAL

LEGEND:

WORK IN CURRENT STAGE / WORK IN PREVIOUS STAGE

- FILL UNIT 1A AND 1B DREDGE MATERIAL (UNIT D1)
- DREDGE MATERIALS ALL UNITS EXCLUDING HM, HS AND PRE-DREDGE TRENCH MATERIAL (UNITS D1 & D2)
- DREDGE MATERIALS - ALL UNITS INCLUDING PRE-DREDGE TRENCH MATERIALS (UNITS D1, D2 & D5)
- INSITU MARINE SEDIMENTS/ HISTORICAL DREDGE FILL (UNITS 5 & 6)
- COMPETENT SEA BED (UNITS 2, 3 & 4)
- WATER

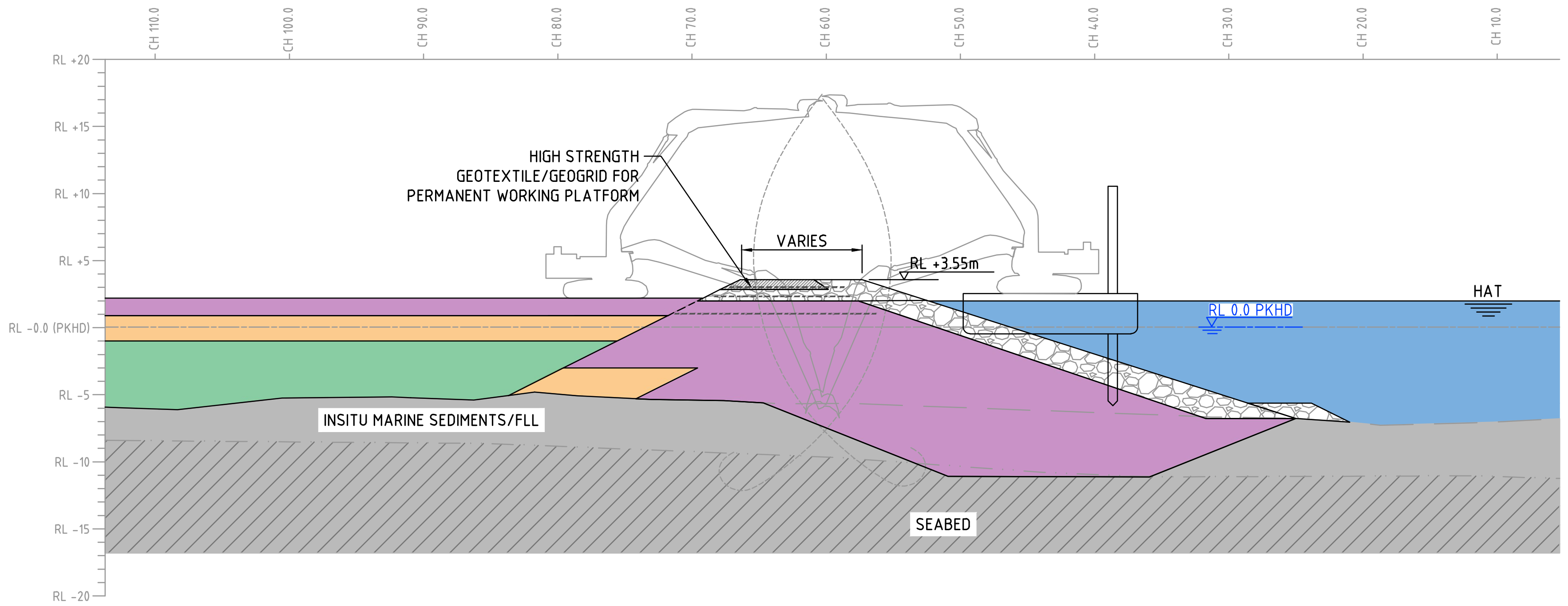


STAGE E - INFILL TO FSL - APPROX. +2.2m PKHD

(PLACING FILL USING EXCAVATORS ON UNLOADING BARGES, LAND BASED EARTHMOVING EQUIPMENT AND DIRECT DUMPING FROM PARTIALLY LADEN SPLIT HOPPER BARGES)

STAGE E CONSTRUCTION NOTES

- UNIT D2 CONTAINING ASS MATERIAL WILL BE PLACED UP TO NO HIGHER THAN RL +0.9m PKHD.
- PROGRESSIVE PLACEMENT OF FILL (UNIT D1 ONLY), FROM BUND TOWARDS SHORE, USING LAND BASED EARTHMOVING EQUIPMENT
- EMPLACEMENT CELL "CAPPING" MATERIAL (UNIT D1) SHOULD BE PLACED PROGRESSIVELY, SUB-HORIZONTALLY AT A GRADE NO STEEPER THAN 10H:1V. THE LEADING EDGE OF THIS MATERIAL SHOULD BE NO THICKER THAN 1.5m.
- ONLY EARTHWORK CONSTRUCTION PLANT SPECIALLY DESIGNED TO UNDERTAKE WORK ON VERY SOFT, PARTIALLY SUBMERGED CONDITIONS SHOULD BE ALLOWED TO OPERATE ON THE EMPLACEMENT CELL DURING CONSTRUCTION STAGES
- PLACEMENT OF ROCK REVETMENT WILL BE CONTINUED AT THIS STAGE
- EMPLACEMENT CELL FINISH LEVEL IS ANTICIPATED TO TERMINATE AT APPROXIMATELY AT RL +2.2m PKHD. THIS COULD VARY DEPENDING ON FILL MATERIAL AVAIBILITY.



STAGE F - LIFT BUND TO RL +3.55m
CONSTRUCTION OF PERMANENT WORKING PLATFORMS

(PLACING FILL USING EXCAVATORS ON UNLOADING BARGES AND LAND BASED EARTH MOVING EQUIPMENT)

STAGE F CONSTRUCTION NOTES

- ROCK REVETMENT PLACEMENT AND WORKING PLATFORM/HAULAGE ROAD WILL BE COMPLETED DURING THIS STAGE.
- BUND CONSTRUCTION UP TO RL +3.55m PKHD INCLUSIVE OF THE ROCK REVETMENT WITH A MINIMUM OF 6.0m CREST WIDTH OR 11.0m WIDTH FOR SPECIFIED VEHICLE PASSING BAYS.
- CONSTRUCT WORKING PLATFORM AND ROCK ARMOUR
- A MINIMUM OF 1% SEAWARD CROSSFALL IS REQUIRED FOR THE HAULAGE ROAD

NOT FOR CONSTRUCTION

CERTIFIER NO.	CERTIFYING ENGINEER NAME	REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
		A	100% DETAILED DESIGN	DL	PB	SM	PM	04.02.22

PLOT DATE: 03 Feb 2022 TIME: 12:15:42

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DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013105\110__CADD\CAD\DWG__ECR\PKGT-SMC-OHC-CIV-DWG-1803.dwg

SCALE	NTS
DRN	D. LEE
CHK	P. BROWN
DES	S. MARTIN
APR	P. MOYES
PM	P. MOYES
PD	S. MORRISON

PRELIMINARY

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL
INDICATIVE SEQUENCING SECTIONS SHEET 3

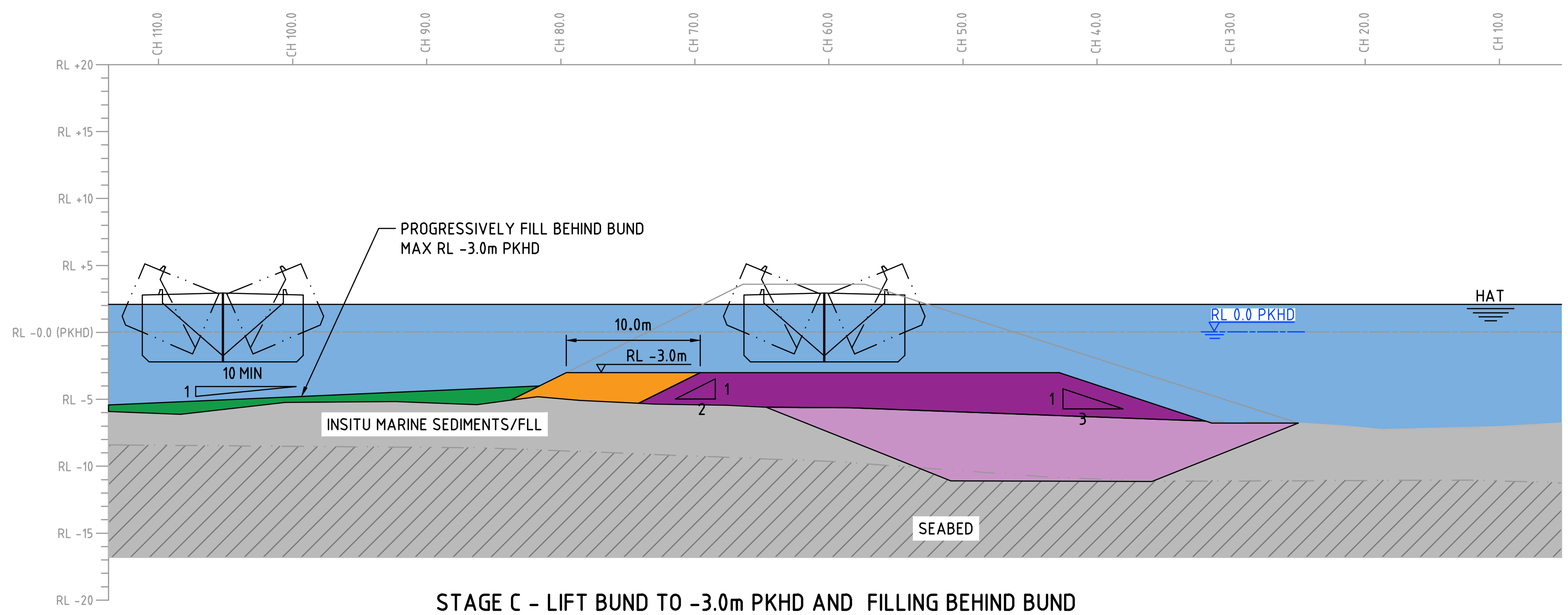
PKGT-SMC-OHC-CIV-DWG-1803 | A

A1 — 150 mm ON ORIGINAL

LEGEND:

WORK IN CURRENT STAGE / WORK IN PREVIOUS STAGE

- FILL UNIT 1A AND 1B DREDGE MATERIAL (UNIT D1)
- DREDGE MATERIALS ALL UNITS EXCLUDING HM, HS AND PRE-DREDGE TRENCH MATERIAL (UNITS D1 & D2)
- DREDGE MATERIALS - ALL UNITS INCLUDING PRE-DREDGE TRENCH MATERIALS (UNITS D1, D2 & D5)
- INSITU MARINE SEDIMENTS/ HISTORICAL DREDGE FILL (UNITS 5 & 6)
- COMPETENT SEA BED (UNITS 2, 3 & 4)
- WATER

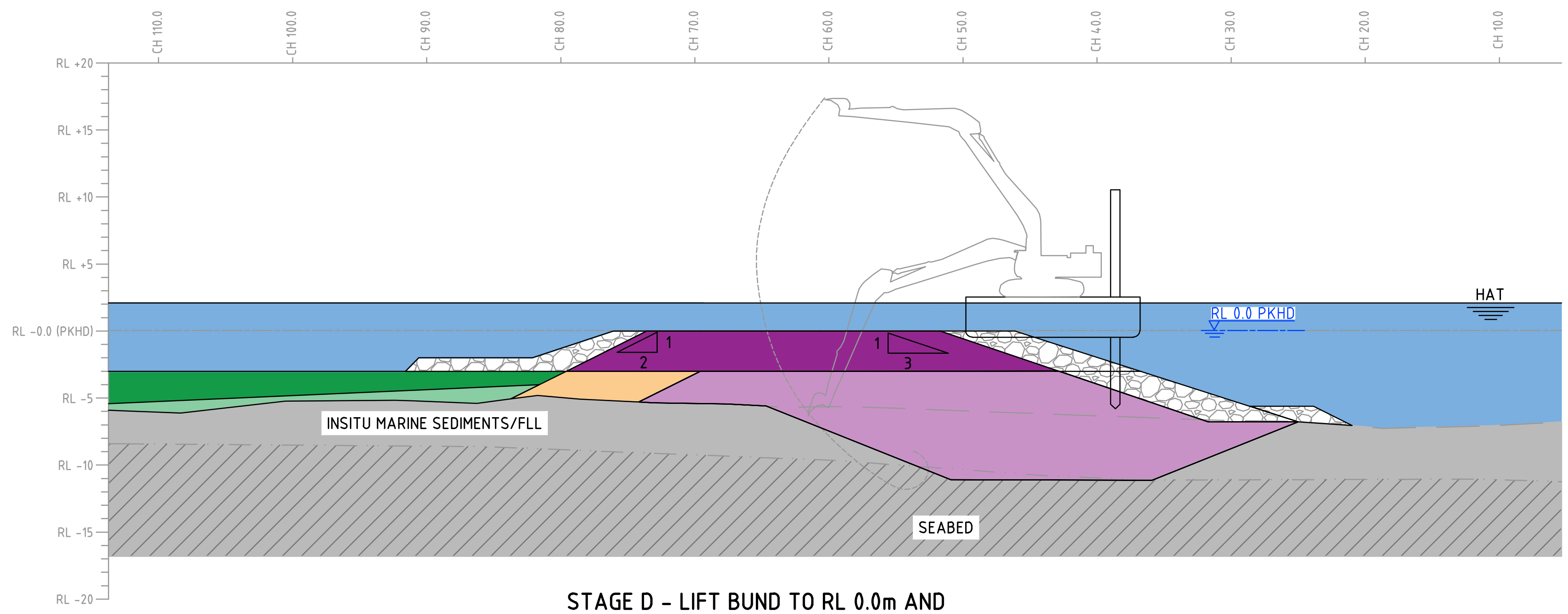


STAGE C - LIFT BUND TO -3.0m PKHD AND FILLING BEHIND BUND

(DIRECT DUMPING BY SPLIT HOPPER BARGES)

STAGE C CONSTRUCTION NOTES

- BUND SEAWARD BATTER GRADIENT NOT STEEPER THAN 3H:1V
- THE LANDWARD SIDE OF THE BUND CAN BE PLACED AT A GRADE OF 2H:1V (MAXIMUM)
- CELL EMPLACEMENT MATERIAL (UNITS D5, D2 AND D1) SHOULD BE PLACED PROGRESSIVELY, SUB-HORIZONTALLY AT AN EQUIVALENT GRADE NO STEEPER THAN 10H:1V.
- THE LEADING EDGE OF THIS EMPLACEMENT MATERIAL SHOULD BE NO THICKER THAN 1.5m.
- INCLUSION OF UNIT D2 WITHIN A 10m WIDE ZONE OF THE BUND, FROM SEABED TO RL -3.0m PKHD.



STAGE D - LIFT BUND TO RL 0.0m AND PLACEMENT OF ROCK ARMOUR FROM SEABED TO 0.0m PKHD

(PLACING FILL USING EXCAVATORS ON UNLOADING BARGES, LAND BASED EARTHMOVING EQUIPMENT AND DIRECT DUMPING FROM PARTIALLY LADEN SPLIT HOPPER BARGES)

STAGE D CONSTRUCTION NOTES

- FILL PLACEMENT (UNIT D1) TO RL 0.0m PKHD
- PLACEMENT OF ROCK REVETMENT TO RL 0.0m PKHD
- ROCK BUTTRESS PLACEMENT ON THE LANDWARD SIDE TO RL 0.0m PKHD.

REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
01	ISSUE FOR REVIEW	KB	CL	HP	PM	16.05.23

CERTIFIER NO. | CERTIFYING ENGINEER NAME

PLOT DATE: 18 May 2023 TIME: 15:20:01

CLIENT

DRAWING FILE LOCATION / NAME V:_Vault\Projects\3001\30013105\110_CADD\CAD\DWG_ECR\PKGT-SMC-OHC-CIV-DWG-1804.dwg

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WOLLONGONG NSW 2500
SMEC PROJECT No 30013105

SCALE	NTS
DRN	K. BOOTH
CHK	D. LEE
DES	H. PANCHALINGAM
APR	P. MOYES
PM	H. PANCHALINGAM
PD	P. MOYES

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

INDICATIVE SEQUENCING - ALTERNATE METHOD
SECTIONS
SHEET 2

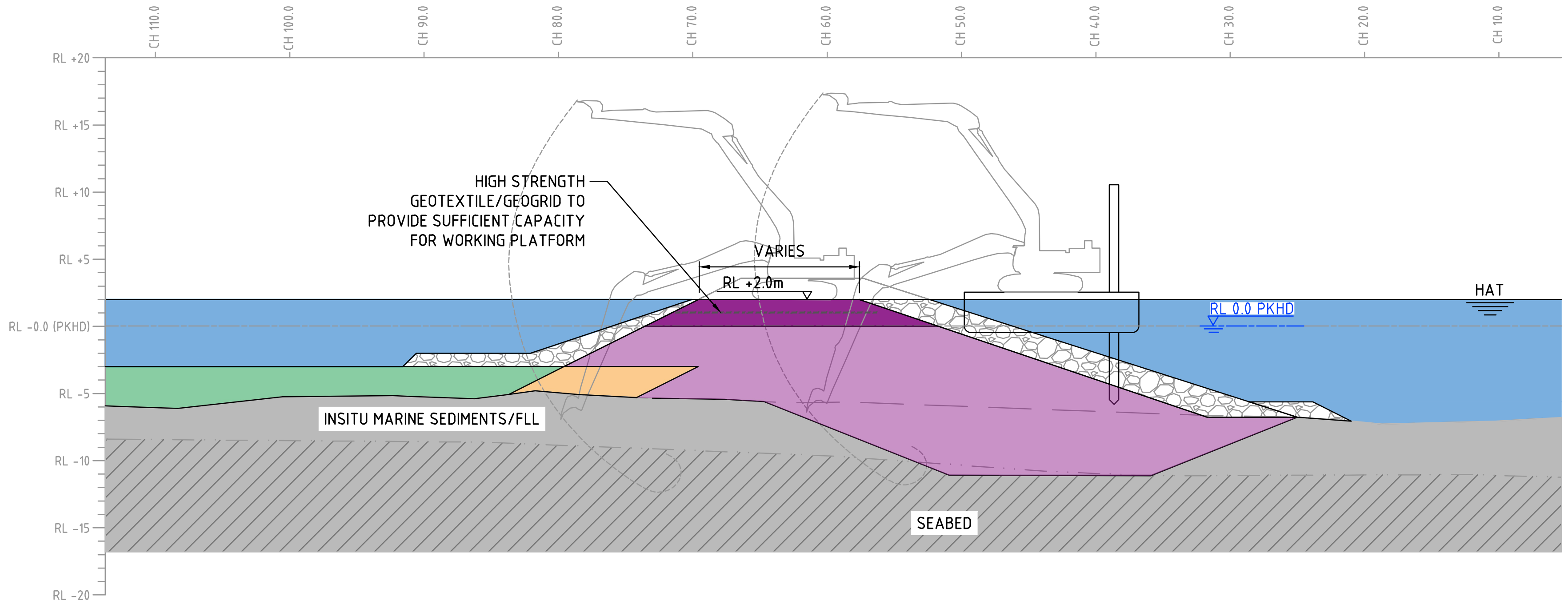
PKGT-SMC-OHC-CIV-DWG-1804 | 01

A1 | 150 mm ON ORIGINAL

LEGEND:

WORK IN CURRENT STAGE / WORK IN PREVIOUS STAGE

- FILL UNIT 1A AND 1B DREDGE MATERIAL (UNIT D1)
- DREDGE MATERIALS ALL UNITS EXCLUDING HM, HS AND PRE-DREDGE TRENCH MATERIAL (UNITS D1 & D2)
- DREDGE MATERIALS - ALL UNITS INCLUDING PRE-DREDGE TRENCH MATERIALS (UNITS D1, D2 & D5)
- INSITU MARINE SEDIMENTS/ HISTORICAL DREDGE FILL (UNITS 5 & 6)
- COMPETENT SEA BED (UNITS 2, 3 & 4)
- WATER

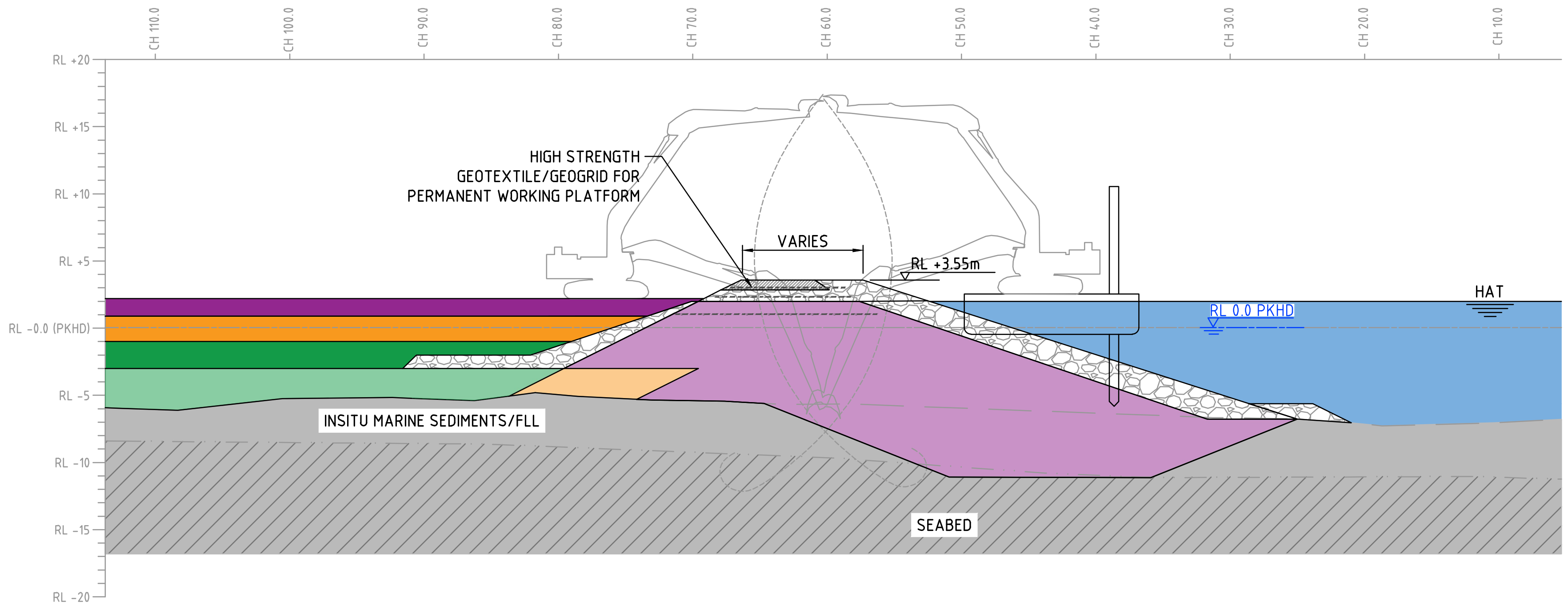


STAGE E - LIFT BUND TO RL 2.0m PKHD

(PLACING FILL USING EXCAVATORS ON UNLOADING BARGES, LAND BASED EARTHMOVING EQUIPMENT AND DIRECT DUMPING FROM PARTIALLY LADEN SPLIT HOPPER BARGES)

STAGE E CONSTRUCTION NOTES

- PLACEMENT OF ROCK REVETMENT WILL BE CONTINUED AT THIS STAGE
- ROCK BUTTRESS PLACEMENT ON THE LANDWARD SIDE WILL BE CONTINUED AT THIS STAGE



STAGE F - LIFT BUND TO RL +3.55m
CONSTRUCTION OF PERMANENT WORKING PLATFORMS

(PLACING FILL USING EXCAVATORS ON UNLOADING BARGES AND LAND BASED EARTH MOVING EQUIPMENT)

STAGE F CONSTRUCTION NOTES

- UNIT D2 CONTAINING ASS MATERIAL WILL BE PLACED UP TO NO HIGHER THAN RL +0.9m PKHD.
- PROGRESSIVE PLACEMENT OF FILL (UNIT D1 ONLY), FROM BUND TOWARDS SHORE, USING LAND BASED EARTHMOVING EQUIPMENT
- EMPLACEMENT CELL "CAPPING" MATERIAL (UNIT D1) SHOULD BE PLACED PROGRESSIVELY, SUB-HORIZONTALLY AT A GRADE NO STEEPER THAN 10H:1V. THE LEADING EDGE OF THIS MATERIAL SHOULD BE NO THICKER THAN 1.5m.
- ONLY EARTHWORK CONSTRUCTION PLANT SPECIALLY DESIGNED TO UNDERTAKE WORK ON VERY SOFT, PARTIALLY SUBMERGED CONDITIONS SHOULD BE ALLOWED TO OPERATE ON THE EMPLACEMENT CELL DURING CONSTRUCTION STAGES
- ROCK REVETMENT PLACEMENT AND WORKING PLATFORM/HAULAGE ROAD WILL BE COMPLETED DURING THIS STAGE.
- BUND CONSTRUCTION UP TO RL +3.55m PKHD INCLUSIVE OF THE ROCK REVETMENT WITH A MINIMUM OF 6.0m CREST WIDTH OR 11.0m WIDTH FOR SPECIFIED VEHICLE PASSING BAYS.
- CONSTRUCT WORKING PLATFORM AND ROCK ARMOUR
- A MINIMUM OF 1% SEAWARD CROSSFALL IS REQUIRED FOR THE HAULAGE ROAD
- EMPLACEMENT CELL FINISH LEVEL IS ANTICIPATED TO TERMINATE AT APPROXIMATELY AT RL +2.2m PKHD. THIS COULD VARY DEPENDING ON FILL MATERIAL AVAIBILITY.

REV	ISSUE DESCRIPTION	DRN	CHK	DES	APR	DATE
01	ISSUE FOR REVIEW	KB	CL	HP	PM	16.05.23

CERTIFIER NO. | CERTIFYING ENGINEER NAME

PLOT DATE: 18 May 2023 TIME: 15:19:54

CLIENT

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SCALE	NTS
DRN	K. BOOTH
CHK	D. LEE
DES	H. PANCHALINGAM
APR	P. MOYES
PM	H. PANCHALINGAM
PD	P. MOYES

PORT KEMBLA GAS TERMINAL
OUTER HARBOUR EMPLACEMENT CELL

INDICATIVE SEQUENCING - ALTERNATE METHOD
SECTIONS
SHEET 3

PKGT-SMC-OHC-CIV-DWG-1805 | 01

150 mm ON ORIGINAL

A1

Appendix A Technical Memo TM-GT-02-B

Technical Memorandum

Memo No.	30013105-TM-GT-02	**Date of Issue**	30/08/2021
Subject	Bulking Factors	**Discipline**	Geotechnical
Project Name	Port Kembla Gas Terminal Development	**Project No.**	30013015
Document No.	30013105-TM-GT-02	**Revision**	1
Author	Geoffroi Renaud-Roy		
Reviewed by	Stephen Martin	**Approved by**	Paran Moyes
Prepared for	Australian Industrial Energy Pty Ltd (AIE)	**Attention to**	Adam Knight
Attachments	Attachment 1 – PRO Dredging Bulking Factors		
References	• WorleyParsons Geotechnical Investigation Interpretive Report 401010-01496-MAS-REP-1404, dated 30th October 2018 • WorleyParsons, *Port Kembla Gas Terminal Berth 101 Marine Structures Dredge/Excavation, General Arrangement*, Drawings 401010-01496-MA-DWG-1201 & 1203-RevB, dated 20.12.2018. • G.H. McNally (1998), *Soil and Rock Construction Materials* • Trenter, NA (2001). *Earthworks: A Guide* • Bell, FG (2004). *Engineering Geology and Construction* • Bray R.N. et al. (1996) *A Handbok for Engineers*, 2nd Edition. • Lee, KA, Lawley, RS and Entwisle, D (2015). *User Guide for BGS Civils - a suite of en gineering properties datasets*. British Geological Survey Internal Report, OR/15/065 • Leo C.V.Rijn, 2019 *Land Reclamation of dredged mud; consolidation of soft soils*, web www.leovanrijn.sediment.com • Australian Standard, 1726 : 2017 : *Geotechnical Site Investigations*, Council of Standards Australia, • Port Kembla Port Corporation, *MPB3 and EB4 dredging and disposal of material to the outer harbour, Environmental Assessment. Issue No3, December 2005*		

1 Background

The capacity of the proposed emplacement cell is a function of both the dredge volumes and associated bulking factors. This memorandum provides a summary of the dredge materials, a comprehensive review of relevant literature, relevant industry experience, and Subject Matter Expert (SME) advice relating to selection of appropriate bulking factors for use in detailed design.

It is noted that other earthworks activities impact the volume balance including transport/handling and placement system losses; compaction and consolidation, which will be considered separately in the concept and detailed design.

1.1 BULKING FACTORS OVERVIEW

During mechanical dredging, in-situ materials undergo a change in density caused by the loosening (increase in void-ratio) of the spoil which leads to a decrease in dry density and increase in volume. The bulking factor is the ratio of in situ density of soil or rock against its dry density following excavation (bank to loose volume).

Bulking factors can be affected by many variables, including the soil/rock condition, excavation/dredging methods, crushing effort, material blending, placement method, etc. Without field trials, replicating the actual conditions and validation of the assessment assumptions, the accuracy of adopted bulking factors may prove unreliable. Limited bulk density testing was carried out during previous investigations for determination of Bulking Factors. Given the lack of site-specific data, it is recommended sensitivity analyses is undertaken within the range of suggested values.

Bulking factors can be expressed as follows:

$$B = \frac{V_{ca}}{V_{in}} = \frac{\gamma_{d.ca}}{\gamma_{d.in}}$$

B : Bulking Factor

V_{ca} : Volume of Dredged material post excavation/post sedimendation

V_{in} : :Total Volume of in situ material to be dredged

$\gamma_{d.ca}$: Dry Density post excavation/post sedimentation

$\gamma_{d.in}$: Dry Density In-Situ

FOR SATURATED CONDITIONS

$$B = \frac{W_{ca} * G_s + 100}{W_{in*} G_s + 100}$$

W_{ca}: Water content of sediment post excavation/post sedimentation

W_{in}: Water content of in situ material

G_s : Specific Gravity

1.2 GEOLOGICAL UNITS

Table 1 presents a summary of the broad geotechnical units at the dredging site. This site geotechnical model is based on the Worley Parsons – Geotechnical Investigation Interpretive Report (2018).

Table 1 : Summary of the site's main geological units.

Unit ID	Anticipated Thickness (m)	Description	Consistency/Relative Density
FILL	0 to 6.0 (Typ. 3.9)	Sand, with lesser amounts of Sandy Gravel / Gravelly SAND and Silty SAND	Very loose to very dense (Typ Medium Dense)
Unit 1A (Marine/Aeolian)	2.7 to 9.3 (Typ 5.1)	"Beach" Sand, gap graded	Loose to Very Dense (Typ Medium Dense)

Unit ID	Anticipated Thickness (m)	Description	Consistency/Relative Density
Unit 1B (Estuarine)	0 to 9.5 (Typ 5.5)	Sand deposits with intermittent lenses of Clayey Sand	Loose to Very Dense (Typ Medium Dense to Dense)
Unit 2 (Estuarine)	0 to 11.9 (Typ 6.1)	Low to High Plasticity Clays and Sandy Clay	Very Soft to Hard (Typically, Stiff or Very Stiff)
Unit 3 (Residual Soil)	0.9 to 10.3 (Typ 4.3)	Mainly Sandy Clay with lesser amounts of Silty Clay, Silty/Clayey Sand and CLAY transitioning into weathered rock.	Stiff to Hard (Typ Very Stiff or Hard)
Unit 4 (Bedrock)	0.3 to 6.3 (Typ 3.4)	Mainly Weathered Siltstone (highly weathered to fresh)	Low to High Strength (Typ Medium to High)
Harbour Mud - HM1	0.9 to 1.5 (Typ 1.1)	Described as "Coal Sludge"	Very Soft/Very Loose to loose
Harbour Mud - HM2	0.9 to 1.5 (Typ 1.1)	Clayey Mud	Very Soft /Very Loose to Loose
Harbour Mud - H3	1.7	Silt Mud	Very Soft /Very Loose to Loose
Harbour Sediment - HS1	Typ 4.2	Fine Silty Sand	Loose
Harbour Sediment - HS2	Typ 4.8	Gravelly, Silty/Clayey Sands	Medium Dense

1.3 DREDGE VOLUMES

The emplacement cell will include dredged material generated during the excavation of Berth 101 and pre-trench material removed along the proposed bund alignment at the Outer Harbour dredging and spoil containment area (OHDSCA). WorleyParsons (2018) produced dredge volumes for each of the Berth 101 geotechnical units as summarised in the table below.

Table 2 : Dredge Volume at Berth 101

Unit ID	Volume (m^3)
FILL	71,617
Unit 1A (sand)	93,524
Unit 1B (sand/clayey sand)	146,179
Unit 2 (clay)	77,485
Unit 3 (clay and weathered rock)	13,226
Unit 4 (rock)	1,061
Harbour Mud (Harbour mud/silt)	26,499
Harbour Sediment (silty/clayey sand)	19,241

Unit ID	Volume (m^3)
TOTAL	**448,832**[(1)]

Notes
(1) No allowance made over-dredging

2 LITERATURE REVIEW

Several technical documents covering the topic of geomaterial bulking factors were reviewed for the purpose of this technical memorandum. It is noted that one of the most significant parameters affecting bulking factors is the excavation method. Dredging techniques such as hydraulic dredging often results in buking factors up to 2.5 times larger than mechanical dredging techniques. As such, only bulking factors associated with typical mechanical excavation techniques and mechanical dredging techniques were reviewed. Bulking factors are generally provided as the transition from in-situ density to excavated density or “bank to loose”.

The publications listed below include both general civil engineering references and dredging specific references.

2.1.1 British Geological Survey: User Guide for ‘BGS Civils’ – a suite of engineering properties datasets (2015)

The ‘Engineering Properties: Bulking of soils and rocks’ dataset was collated by BGS to provide information about bulking factor of geological units as a desk-study tool for the planning and design for construction and planning purposes. The data does not target mechanical dredging practices and covers geomaterial located in the UK. With consideration to the lithology expected on site, a summary of the relevant bulking factors is shown below.

Table 3 : Bulking Factors – BGS (Bank to loose)

Lithology	In-Situ bulk density (t/m3)	Bulking Factor
Sand wet	2.0	1.20 to 1.30
Uniform Sand	1.6 to 2.1	1.10 to 1.15
Sand and Gravel wet	2.31	1.15
Sand and Gravel	1.95	1.15
Well Graded Sand	1.7 to 2.2	1.10 to 1.15
Clay (CL)	1.65	1.30
Clay (CH)	2.1	1.40
Clay and Gravel Wet	1.826	1.41
Clay and Silt	N/A (Approx. 1.70)	1.2 to 1.4
Mud	1.28 to 2.08	1.0 to 1.2
Silt (Organic Silt, Loam) damp	2	1.15 to 1.25
Siltstone	2.42	1.61
Sandstone	2.31 to 2.65	1.40 to 1.85

2.1.2 Trenter, NA (2015). Earthworks: A Guide

Earthworks: A guide presents a generalist approach to bulk earthwork operations. The bulking factors presented in the report represent only a high level approximation of bulking factors based on empirical observations. The bulking factors presented in the guide are for mechanical excavation in non-submerged excavation conditions.

Table 4 : Bulking Factors – Trenter (Bank to loose)

Lithology	Bulking Factor (%)
Granular	1.10 to 1.15
Cohesive	1.20 to 1.40
Sedimentary Rock	1.40 to 1.75

2.1.3 Bell, FG (2004). Engineering Geology

Engineering Geology presents a set of bulking factors based on industry records and empirical data for typical types of soils. Those parameters are for unsaturated / dry ground conditions. It is noted that some of the soil types descriptors are not compliant with Australian Standards 1726-2017, “*Geotechnical Site Investigations*”.

Table 5 : Bulking Factors – Bell (Bank to loose)

Lithology	Density (t/m³)	Bulking Factor
Sand, dry	1.7	1.15
Sand and Gravel, dry	1.95	1.15
Clay, “light”	1.65	1.3
Clay, “heavy”	2.1	1.35
Clay, gravel and sand, dry	1.6	1.3

2.1.4 Bray R.N. et al. (1996) *Dredging, A Handbook for Engineers*

Dredging, A Handbook for Engineers presents the basic principles of dredging earthworks and constitutes an introductory level technical reference for civil engineers. The bulking factors provided are specifically selected for mechanical dredging and association is based on the soil's main type and in-situ consistency. It is noted that some of the consistency descriptors are not compliant with Australian Standards 1726-2017, *Geotechnical Site Investigations*.

Table 6 : Bulking Factors – Bray (Bank to Loose)

Lithology	Bulking Factor
Medium Rock (blasted)	1.40 to 1.80
Hard Rock (blasted)	1.50 to 2.00
Soft Rock (blasted)	1.25 – 1.40
Gravel, Hardpacked	1.35
Gravel, Loose	1.10
Sand, Hardpacked	1.25 to 1.35
Sand, Medium soft to hard	1.15 to 1.25
Sand, Soft	1.05 to 1.15
Silts, freshly deposited	1.00 to 1.10
Silts, Consolidated	1.10 to 1.40
Clay, Very hard	1.15 to 1.25
Clay, Medium soft to hard	1.10 to 1.15
Clay, Soft	1.00 to 1.10
Sand/Gravel/Clay	1.15 to 1.35

2.1.5 Leo C.V.Rijn, (2019) Land Reclamation of dredged mud; consolidation of soft soils

Land reclamation of dredged mud presents a summary of practical experience during dredging of the Holwerd Channel, Wadden Sea, Netherlands. Bulking factors for soft clays and muds excavated using a mechanical dredger, were recorded and are summarised as follows. Bulking factors are correlated to material based on principal component and consistency. Mechanical excavation methods include open grabs/excavator buckets and closed clamshell grabs. The bulking factors provided below are assumed to relate to clamshell grabs which result in lower bulking factors compared to open grabs/buckets.

Table 7 : Bulking Factors -Rijn (Bank to placed)

Lithology	Wet Bulk Density (In-Situ) (t/m³)	Bulking Factor
Mud, Soft	1.25	1.25*
Clay, Soft	1.50	1.25
Clay, Firm	1.80	1.10
Sand	2.00	1.10

* Where muds are placed by split bottom barge, then substantial water (dilution) may be added during the dumping process, resulting in higher bulking factors up to 2.0. (personal communication 26 August 2021)

2.1.6 G.H. McNally (1998), Soil and Rock Construction Materials

Soil and Rock Construction Materials presents a summary of practical considerations associated with the use of geomaterial as construction material. The document is region specific and correlates bulking factors to universal soil classification symbols as per AS 1726 – 2017. In-situ consistency is not used to differentiate between each class of material, but typical in-situ bulk density ranges are provided.

Table 8: Bulking Factor (Bank to loose)

Lithology	USCS	Wet Bulk Density (t/m³) In Situ	Loose	Bulking Factor
Gravel, sandy and clayey	GW	2.20	1.91	1.15
Sand, well graded	SW	2.10	1.83	1.15
Sand, uniformly graded	SP	1.60	1.45	1.10
Clay, sandy	SC	1.73	1.46	1.20
Clay, silty	CL	1.50	1.15	1.30
Clay, heavy	CH	1.40	1.00	1.45
Sandstone, highly weathered		2.30	1.80	1.30
Sandstone, unweathered		2.50	1.67	1.50
Shale, unweathered		2.55	1.85	1.35

2.2 GEOLOGICAL UNITS SPECIFIC BULKING FACTOR

A summary of the bulking factors corresponding to each dredge unit is provided in Table 9 based on the above references. It is noted that some of the references provide a single bulking factor for a given material irrespective of consistency or relative density, while others provide a range of bulking factors for specific classifications. Several of the references do not provide bulking factors applicable to the Harbour Mud and Harbour Sediment (HM/HS) units. It is also noted that material descriptions do not always align with AS 1726-2017 or the descriptions used to describe the dredge materials.

Table 9 : Bulking Factor Summary – Literature Review

Unit ID	Description	Bulking Factor (Loose Volume / Bank Volume)					
		BGS (2005)(1)	Trenter (2015)(1)	Bell (2004)(1)	Bray (1996)(2)	Leo. C.V.R. (2019)(2) (3)	G.H. McNally (1998)(1)
Fill	Sands, variably sandy gravel to gravelly sands and silty sand	1.15	1.10-1.15	1.15	1.15 - 1.25	1.1	1.15
1A	Sand (SP), Marine	1.10-1.15	1.10-1.15	1.15	1.15 - 1.25	1.1	1.1
1B	Sand (SP), intermittent lenses of Clayey Sand, Estuarine	1.10-1.15	1.10	1.15	1.15 - 1.25	1.1	1.1
2	Clays (CL to CH) and sandy clays, Estuarine	1.30-1.40	1.2-1.4	1.35	1.10-1.20	1.1	1.15
3	Sandy Clays (CL to CH) transiting into extremely weathered material	1.30-1.40	1.2-1.4	1.35	1.15-1.25	1.1	1.2
4	Weathered Siltstone (MW to Fr)	1.61	1.40-1.75	N/A	1.25-1.4	N/A	1.35
HM	Silt/Clay Mud with Organic material (recent deposits)	1.0-1.2	NA	N/A	1.0-1.1	1.25	N/A
HS	Sands, variably silty, clayey and/or gravelly (recent deposits)	1.10-1.15	NA	N/A	1.15-1.35	1.25	N/A

Notes : (1) mechanical excavation in non-submerged condition (2) mechanical dredging techniques (3) placed/bank volume

3 DENSITY TESTING - WORLEYPARSONS (2018)

Density testing on samples from Unit 1A and 1B was undertaken by WorleyParsons as part of the 2018 investigation. The WorleyParsons Geotechnical Investigation Interpretive Report provides a correlation between the bulking factor and minimum/maximum density testing results based on the density index (D_r) of these materials derived from adjacent CPT data. A summary of the dry density test results and corresponding bulking factor is provided in Table 10. The bulking factors range from 1.09 to 1.19 with an average of 1.14 and are generally consistent with the published values for these material types.

Table 10 : Bulking Factors – Density Testing

BH ID	Dry Density (t/m^3)		Average D_r from CPT	Bulking Factor
	Min	Max		
BH03 Unit 1A	1.57	1.75	85%	**1.10**
BH05 Unit 1A	1.47	1.77	74%	**1.15**
BH06 Unit 1B	1.37	1.65	71	**1.15**
BH08 Unit 1A	1.43	1.76	74	**1.17**
BH9 Unit 1B	1.40	1.58	74	**1.09**
BH10 Unit 1A	1.51	1.80	100	**1.19**

4 DREDGING CONTRACTOR AND CONSULTANT INPUT

4.1 Heron Construction

Following issue of 30013105-RFI-007 and subsequent discussions with Heron regarding construction methodology and bulking factors for the dredge materials, the following summary of discussions was provided by AIE:

Bulking Factors:

- Not typically a big focus for the dredging companies, particularly for offshore dumping ('is what it is')
- Rule of thumb for BHD operations around 1.1 for sands. Experience at Geelong, which was predominantly clays, was up to 1.2.
- BHD operations considered to bulk the material far less than cutter suction operations, but it is subject to the detailed methodology therein
- Gladstone project by Hall involved barge to dump truck to reclamation, so whilst a bit different, there might be some data obtainable from that project (Heron to explore local contacts)

No further information has been provided regarding experience at Gladstone.

4.2 PRO Dredging & Marine Consultants

Expert advice has been provided by dredging consultants *PRO Dredging & Marine Consultants* regarding applicable bulking factors for the dredge materials form Berth 101. Following review of the geotechnical profile, lithology, excavation and placement methodology, the following recommendations were provided based on their experience. Bulking factors refer to bank to placed volumes assuming no formal compaction.

Placement below water assumes bottom dumping from barges directly into the profile. Placement above water assumes mechanical unloading of barges by excavator, transport by articulated trucks, dumping into the bund profile and shaped in profile by bulldozers and excavators.

Table 11 : Bulking Factors – PRO Dredging

Unit	Placement	Bulking Factor
1A & 1B	below water	1.15
	above water	1.08[1]
2/3	below water	1.22
	above water	1.15
HM	below water	1.70[2]
HS	below water	1.13
	above water	1.07

[1] Lower bulking factors can be achieved where there is substantial passage of earthmoving equipment during construction

[2] It is assumed that Harbour Muds (HM) will not be placed above water. The assigned bulking factor assumes a substantial increase in pore volume resulting in low in situ densities in the emplacement cell. These values are also consistent with the values reported by Rijn where materials are placed by bottom dumping.

5 Summary

Bulking factors are affected by many variables, including the soil/rock condition, particle size distribution, dredging methodology, crushing effort, saturation state, material blending, placement method etc. Without comprehensive field trials replicating the actual conditions and validation of the assessment assumptions, the accuracy of adopted bulking factors may prove unreliable.

Selection of bulking factors has been based on the information compiled in the above sections. It is noted that the relevancy of the data was organised based on the following hierarchy:

1. Site specific data based on interpretation of geotechnical logs, in-situ and laboratory testing
2. Australia based industry specialist input
3. Technical reference specialised in mechanical dredging operation
4. Technical reference for general earthwork operations

The following bulking factors are nominated for each of the geotechnical units from Berth 101. The range of values will be applied to the dredge volumes to provide a robust design with sufficient contingency to accommodate the likely variability which will be encountered during dredging and placement of materials. For example lower bound bulking factors may be critical for estimation of volumes of Fill/Unit 1A/Unit 1B materials available for bund construction, while upper bond values will be critical for estimation of ASS/PASS volumes and ensuring that sufficient capacity is available in the emplacement cell.

The bulked volumes corresponding to the range of bulking factors are presented in Figure 1, with the total upper bound volume being approximately 80,000m^3 greater than the lower bound.

Table 12 : Recommended Bulking Factors (bank to placed)

Unit ID	Location	Lower Bound	Base Case	Upper Bound
FILL/ Unit 1A (sand)/Unit 1B (sand/clayey sand)	Below water	-7.5%	1.15	+7.5%
FILL/ Unit 1A (sand)/Unit 1B (sand/clayey sand)	Above water	-7.5%	1.08	+7.5%
Unit 2 (clay)/ Unit 3 (clay and weathered rock)	Below water	-7.5%	1.22	+7.5%
Unit 2 (clay)/ Unit 3 (clay and weathered rock)	Above water	-7.5%	1.15	+7.5%
Unit 4 (rock)	Below water	-7.5%	1.4	+7.5%
Unit 4 (rock)	Above water	-7.5%	1.3	+7.5%
Harbour Mud (Harbour mud/silt)	Below water	-7.5%	1.7	+7.5%
Harbour Sediment (silty/clayey sand)	Below water	-7.5%	1.13	+7.5%
Harbour Sediment (silty/clayey sand)	Above water	-7.5%	1.07	+7.5%

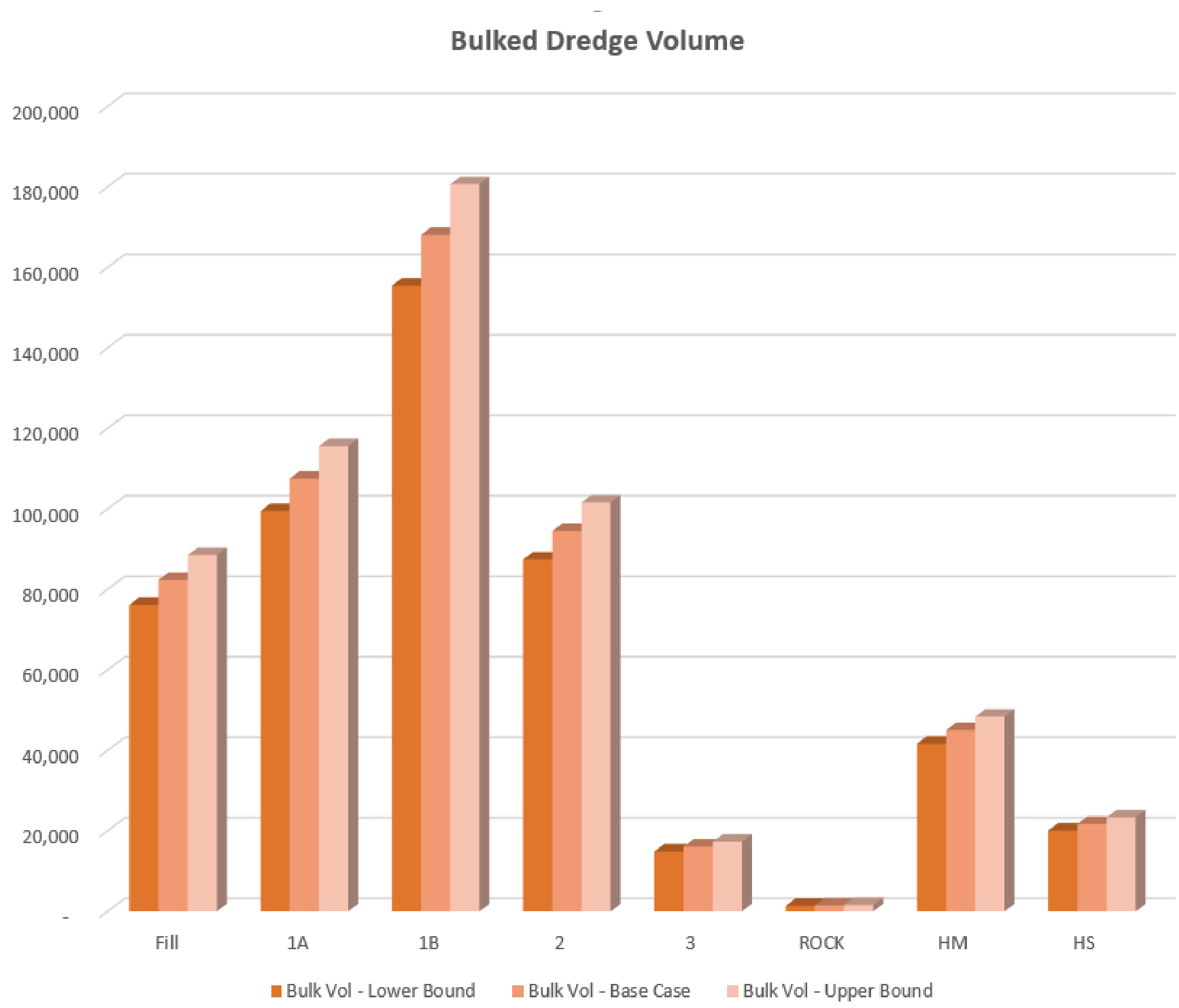

Figure 1 Berth 101 - Bulked Dredge Volumes (m^3)

Pro Dredging and Marine
Consultants Pty Ltd
ABN: 32 140 516 641

P.O. Box 2244, TOOWONG,
QLD 4066, Australia

27/32 Tipuana Place, BARDON,
QLD 4065, Australia

p: +61 (0)7 3369 1812
e: johan.pronk@prodredging.com.au
w: www.prodredging.com.au

SMEC Australia
Sydney, NSW

Attn: Mr. Paran Moyes / Mr. Greg Martin   By email   20 August 2021

Dear Paran and Greg,

Stephen Martin, senior associate engineer-Geotechnics of SMEC has requested Pro Dredging to provide a recommendation on the bulking factors of materials dredged in the Inner Harbour of Port Kembla. The dredging works are part of the proposed Port Kembla Gas Terminal. The materials are dredged from the area of berth 101, Port Kembla Coal Terminal in the Inner Harbour (proposed dredging depth -13.3 m PKHD) and placed into the Emplacement Cell in the Outer Harbour of Port Kembla.

SMEC Australia provided Pro Dredging with the following documents:

- Concept drawings prepared by Worley Parsons;
- Port Kembla Gas Terminal, Factual Geotechnical Investigation Report, Worley Parsons, 2018;
- Port Kembla Gas Terminal, Interpretive Report Geotechnical Investigation, Worley Parsons, 2018; and
- Geological sections prepared by Worley Parsons.

In addition, a table was provided by Stephen Martin (refer to table 1 on the next page), summarizing the description of the materials to be dredged.

Description of materials to be dredged

Based on the description of materials in Table 1 below, the materials were divided in the following groups taking into account the methodology of the dredging contractor for the excavation with the backhoe dredger:

1. Fill, Unit 1A and Unit 1B; typically, loose to dense sandy materials with dry densities varying between 1,54 and 1.70 t/m3. These materials will be used for bund construction and will be excavated in one operation as an 8 to 10 m thick layer. Mixing of the three units will take place during excavation and subsequently loading into the bottom dump barges with a loading capacity of more than 1,000 $m^{3.}$
2. Stiff to very stiff sandy clays (units 2 and 3) dredged separately from the units above with an in-situ density 1.92 t/m^3. These materials will be placed below the level of + 0.6m PKHD;
3. Harbour muds and silts with an in-situ density of 1.50 t/m^3 to be placed below +0.6m PKHD.
4. Sandy Harbour sediments with an in-situ density of 1.90 t/m^3 to be placed below +0.6m PKHD.

Unit ID	Anticipated Thickness (m)	Description	Consistency/Relative Density	Banked Volume (m3)
FILL	0 to 6.0 (Typ. 3.9)	Sand, with lesser amounts of Sandy Gravel / Gravelly SAND and Silty SAND	Very loose to very dense (Typ Medium Dense)	71,617
Unit 1A Sand (Marine/Aeolian)	2.7 to 9.3 (Typ 5.1)	"Beach" Sand, gap graded	Loose to Very Dense (Typ Medium Dense)	93,524
Unit 1B Sand/Clayey Sand (Estuarine)	0 to 9.5 (Typ 5.5)	Sand deposits with intermittent lenses of Clayey Sand	Loose to Very Dense (Typ Medium Dense to Dense)	146,179
Unit 2 Clay (Estuarine)	0 to 11.9 (Typ 6.1)	Low to High Plasticity Clays and Sandy Clay	Very Soft to Hard (Typically, Stiff or Very Stiff)	77,485
Unit 3 Clay and Weathered Rock (Residual)	0.9 to 10.3 (Typ 4.3)	Mainly Sandy Clay withlesser amounts of Silty Clay, Sitly/Clayey Sand and CLAY transiting into weathered rock.	Stiff to Hard (Typ Very Stiff or Hard)	13,226
Unit 4 (Bedrock)	0.3 to 6.3 (Typ 3.4)	Mainly Weathered Siltstone (highly weathered to fresh)	Low to High Strength (Typ Medium to High)	1,061
Harbour Mud/Silt - HM1	0.9 to 1.5 (Typ 1.1)	Described as "Coal Sludge"	Very Soft/Very Loose to loose	
Harbour Mud/Silt - HM2	0.9 to 1.5 (Typ 1.1)	Clayey Marine Mud	Very Soft/Very Loose to Loose	
Harbour Mud/Silt - H3	1.7	Silt Mud	Very Soft/Very Loose to Loose	26,499
Harbour Sediment – Silty/Clayey Sand - HS1	Typ 4.2	Fine Silty Sand to sandy silt with occasional clay horizons	Loose	
Harbour Sediment - Silty/Clayey Sand - HS2	Typ 4.8	Gravelly, Silty/Clayey Sands	Medium Dense	19,241
			Total	**448,833**

Table 1: Description of Units of dredging and quantities.

Bulking factors

To calculate the various bulking factors differentiation will need to be made between placing the materials under water and above water.

The bottom dump barges will dump part of the materials under water directly into profile, either fully loaded or partially loaded. The remainder of the quantity will be mechanically unloaded by excavators, transported by articulated trucks, dumped into bund profile and shaped in profile by bulldozers and excavators (no formal compaction).

1. Bulking of fill, unit 1A and unit 1B:
   Bulking of materials placed below water: 1.15;
   Bulking of materials placed above water: 1.08;
2. Bulking of unit 2: stiff to very stiff sandy clays:
   Bulking of materials placed below water: 1.22;
   Bulking of materials placed above water: 1.15;
3. Bulking factor of the small quantity for unit 3, residual soils: sandy clay and silty, clayey sands:
   This material is considered to be dredged by the backhoe dredger in conjunction with unit 2 and therefore its bulking is included in the bulking factors for unit 2.
   If placed separately we advise that there are only minor differences with the bulking factors of unit 2.

4. Bulking of harbour muds and silts to be placed below water level: 1.7;
   Note: Harbour muds and silts will not be placed above water.
   After some consolidation the bulking factor can be lower.
5. Bulking of sandy harbour sediments:
   Bulking of materials placed below water: 1.13;
   Bulking of materials placed above water: 1.07.

Pro Dredging has arrived at the above bulking factors based on our experience worldwide with methodologies applied during the reclamation and placement of dredged materials.

With regards to placement in the bund lower bulking factors can be achieved if substantial passage of earthmoving equipment and trucks is taking place during construction. As a general guidance an in-situ density of 1.92 t/m3 can be achieved for placement in reclamation operations.

For placement under water little opportunity exists to improve the bulking factors. The bottom dumping results generally in a pretty scattered pattern of discharged materials and especially the harbour silts and muds will spread out considerably. In our calculations we have allowed for a substantial increase in pore volume for the harbour muds and silts which results indeed in low situ densities in the emplacement cell. If accurate placement in pre-determined small sub-cells is prescribed in the specification for the dumping operations, slightly better results can be achieved. Consolidation can improve further once materials are reclaimed in the emplacement cell above water.

We hope that the above summary on bulking factors is to your satisfaction.

Yours faithfully

Pro Dredging and Marine Consultants

Johan Pronk

Appendix B Safety in Design Register

ITEM ID	PHASE		DISCIPLINE CODE	POTENTIAL RISK HAZARD	CAUSE	RISK OWNER	POTENTIAL CONSEQUENCES	Initial Risk Likelihood (0-5)	Initial Risk Consequence (0-5)	Initial Risk Rating	POTENTIAL ELIMINATION MEASURE, DESIGN INITIATIVE or CONTROL (Identify any Standard or Code of practice used)	HOW ISSUE ADDRESSED IN DESIGN AND/OR CONSTRUCTION OF THE WORKS	IS THE RISK ELIMINATED YES/NO	Residual Risk Likelihood (0-5)	Residual Risk Consequence (0-5)	Residual Risk Rating	SFAIRP CONSIDERATIONS / JUSTIFICATION	RESIDUAL RISK OWNER	Date SID Risk closed out	SID Risk Closed Out by:
	Construction	EW	Earthworks	Stability of the foundation trench excavation for the bund	Instability of low strength soil material	SMEC	Disruptions to dredging operation - rework area to maintain the profile, more dredge material reducing storage volume	2	2	4	Design to consider geometry of edges of trench to reduce likelihood of collapse (don't box cut trench) Consider staging of bund trench excavation (excavate all or sections) to reduce risk of instability	Trench has been designed with batter slopes to reduce the likelihood of surface instability or the volume of slope mobilised due to instability. Heron has stated that they will program to excavate the trench within one week and have it backfilled straight away	No	2	2	4	excavation and construciton in a marine environment will be dynamic and risk can be reduced but not eliminated	Heron		
	Construction	EW	Earthworks	Dredge impacting buried jetty piles	Remains of piles and possible structure from Jetty No3 obstructing dredging of bund footprint	SMEC	Increased risk to program from delays Piles would be removed by dredge (wooden piles are readily excavated) Potential disposal issue of material recovered	3	2	6	Identify former Jetty 3 alignment and potential clash with bund and bund excavation during design phase Consider options to deal with piles being encountered Proposed construction methodology is to break the pile at design level	If steel piles are encountered they may be left in place or possibly bend over. If wooden piles encountered and it is possible to break them off then they are to be broken off at dredge level.	No	2	2	4		Heron		
	Construction	EW	Earthworks	Grounding of dredge	Insufficient water depth for draft of dredge during construction	Heron	Increased risk to construction crews Damage to dredge	1	4	4	Barge equipped with survey to reduce likelihood of navigation into shallow waters Fuel tanks are within the hull of the dredge so grounding does not pose risk of fuel spill Operations with excavator at front so that depths in front of barge are known Develop staging plan with Heron so that the emplacement cell staging provides navigable channels	Heron will develop staging with corresponding barge operations and the employment of material handlers to reduce barge movements in shallow water.	No	1	4	4		Heron		
	Construction	EW	Earthworks	Grounding of barge	Insufficient water depth for draft of barge during construction, caused by dumping of material. As sea bed is raised, the water depths change dynamically and require good progressive hydrographic survey to avoid grounding	Heron	Damage to barge	3	3	9	Heron undertake daily survey to maintain current records of seabed depth to inform operations Survey will also inform placement of specific materials in the designed emplacement zones	Heron undertake daily survey to maintain current records of seabed depth to inform operations Survey will also inform placement of specific materials in the designed emplacement zones Heron will develop staging with corresponding barge operations and the employment of material handlers to reduce barge movements in shallow water.	No	2	3	6		Heron		
	Construction	EW	Earthworks	Excavations for the stormwater channel	Falling into excavations, collapse of excavation due to plant loads at crest	SMEC	Increased risk to construction crews Plant falling into excavation	3	3	9	Ensure that code of practice for excavations are complied with. Construct barriers where necessary. Provide shoring where necessary. Design out excavations. Check for underground services.	Understand that Heron propose to excavate the eastern sections of the stormwater channel alignment from the barge to provide suitable foundation for trenching. Other works will be carried out from land with the stormwater channel constructed by placing fill and excavating the trench profile.	No	2	3	6		Heron		
	Construction	GT	Geotechnical	Batter instability	Batter instability due to designed steep batter angle	SMEC	Emplacement cell does not restrict the movement of emplaced material	3	3	9	Assess batter slopes for the proposed bund materials under various loadings	Design has considered various slope stability cases including construction stages. All have met the required MDR. Design risk is eliminated Construction risk in accordance with assessed stability	No	2	3	6		Heron		
	Construction	GT	Geotechnical	Batter instability	Batter instability due to rapid changes in ground conditions in bund foundation (weak / soft material, large changes in level of suitable founding material)	SMEC	Emplacement cell does not restrict the movement of emplaced material, bund collapses	3	3	9	Geotechnical investigation to inform foundation conditions Design of bund for various cases (good, average, poor) Observations from construction will inform the suitability of design based on performance	Geotechnical investigation has informed the revised geotechnical model along the bund alignment. Key trench depth and extent has been formulated based on removing the poorer material and slope stability assessment has been undertaken on the revised geotechnical model. Construction stage SI and survey monitoring will be required as part of the management of this risk	No	2	3	6	As part of the construction works, investigation and survey is to be undertaken to compare design with constructed trench	Heron		
	Construction	GT	Geotechnical	Batter instability (incomplete bund during construction)	Batter instability during construction where incomplete bund fails during a weather or hydraulic event	SMEC	Emplacement cell does not restrict the movement of emplaced material, bund collapses	3	3	9	Consideration of low ARI event in analysis of bund Evaluate stability during stages of construction Possible passing to contractor for management through the construction plan	A set of parameters has been developed whereby the temporary slopes of the bund are to be limited, the bund height is not to exceed the emplacement cell height by more than 1.5m, no more than 4m of filling is to occur in a week, and the geofabric and rock revetment facing is to be progressively installed to maintain the 3H:1V slope of the front face of the bund and reduce the risk of instability	No	2	3	6	Construction parameters are provided to reduce the risk of bund collapse	Heron		
	Construction	GT	Geotechnical	Batter instability	Batter instability due to poor construction / poorer material	SMEC	Emplacement cell does not restrict the movement of emplaced material	2	3	6	Design batter slopes based on the methods of construction to achieve the required Factor of Safety Understand the behaviour of materials from placement with bottom dumping. Consider reshaping activities that will correct bund geometry prior to armouring	There is still a construction risk carried through	No	2	3	6	Still a risk on bund construction	Heron		
	Construction	GT	Geotechnical	Batter instability	Batter instability due to inadequate extent of armouring	SMEC	Hydrodynamic effects on the unarmoured bund slope cause instability	2	4	8	Design batter slopes based on the methods of construction to achieve the required Factor of Safety Understand the behaviour of materials under hydrodynamic forces. Investigate the dredged material behaviour through comparison of 2018 and 2020 Bathymetry to see if batter slopes are flattening out , movement of material. Engineer slopes based on guidance from industry standards based on waterflows.	Revetment rock layers and geofabric have been designed for the long wave, environmental conditions and the prop wash for vessels identified by Port Kembla HM. Heron has been informed of the revetment construction requirements. Revetment design is considered satisfactory. Construction challenges remain	Yes	2	4	8	Construction of the bund will need to managed to manage the risk	Heron		
	Construction	GT	Geotechnical	Batter instability	Batter instability due to movement of emplaced material exerting load on bund	SMEC	Emplacement cell does not restrict the movement of emplaced material	2	4	8	Zoning of emplacement cell to accept quantity of material that does not exert unacceptable load on bund	Emplacement cell is to be constructed in a zoned manner with conditions on the differential in the emplacement cell height vs bund height and the slope of 1V:10H. Design aspects of risks have been reduced	No	2	3	6	Construction of the bund will need to managed to manage the risk. Consequence will be reduced if adhered to because the volume of the material effected will be limited	Heron		
	Construction	GT	Geotechnical	Batter instability	Batter instability due to internal erosion effects	SMEC	Emplacement cell does not restrict the movement of emplaced material	2	3	6	Assess potential migration of bund materials and emplaced material	Bund has been designed to withstand the coastal process and the loads from the emplacement cell. Internal erosion effects may occur if there is an internal discontinuity created during construction. However, the face of the bund will have a geofabric covering and rip rap which will inhibit movement of materials arising from internal erosion	No	2	3	6		Heron / AIE		
	Construction	GT	Geotechnical	Piping and subsidence of bund crest	Poor control over geotextile placement underwater (achieving design lapping, connection etc)	SMEC	Integrity of geotextile compromised during construction	3	3	9	Design to address underwater construction methods, construction sequencing to maintain the integrity of the geotextile Lap lengths to reflect the risk based on the above Reduce length of geotextile installation to maintain control / quality Substitute with sub armour layers / filter layers of smaller aggregate to reduce the risks associated with geotextile installation/placement	Consultation has occurred with Heron during the design process about placement of geotextile underwater. Alternatives such as sand filter / pea gravel have been designed and discussed. However, procurement and constructability assessment is that geotextile is the preferred approach	No	2	3	6		Heron		
	Construction	GT	Geotechnical	Geotextile ineffective	Stability of geotextile once it is placed - geotextile is ineffective because it is the incorrect type	SMEC	Wave action unravels geotextile, bund material is not confined and can flow through the rock armour	2	3	6	Communicate with suppliers regarding installation method, purpose and design life Specification of correct suitable project and non acceptance of non conforming substitutes	Geotextile specification based on supplier information	Yes					SMEC		
	Construction	UT	Utilities or Services	Under / Above Ground Services	Striking services during construction of the stormwater channel / dredging	SMEC	Disruption services, impact on construction equipment	1	5	5	Ensure an investigation is carried out and all services identified. Liaise with utilities owners regarding presence and assess relocation services where practicable. Isolate any live cables e.g. power supply to navigation markers. DBYD and NSW Ports consultation for both permanent works and enabling works activities	DBYD carried out and overlaid on emplacement cell footprint. Services owners have been contacted to clarify the location and serviceability of their utilities. In addition, the outline of the former jetties has been overlaid the footprint of the cell	No	1	4	4	Consequence has been reduced because enquiries regarding the services indicate that overwater services are not live	Heron		
	Construction	EW	Earthworks	Instability in armour	Failure of lifting devices, weight underestimated, instability of elements during lifting and erection of elements.	SMEC	Increased risk to construction crews	1	3	3	Armour placed with excavators (method dependant on whether the rock is delivered landside or harbour side). Maintain isolation around equipment - clear zone for personnel Specify lifting devices with factors of safety. Use a lifting arrangement to reduce lifting effort. Lift elements at a steady pace. Provide specification for rock armour that reduces risk by considering excavator reach	Armour rock sizing has been provided at different stages for Heron to review. Sizing of armour is considered constructible	No	1	3	3		Heron		
	Construction	EW	Earthworks	Inadequate Concrete Strength in drainage channel	Structural collapse, durability issues.	SMEC	Increased risk to construction crews and shore users next to drainage channel	2	3	6	Concrete quality control practices in place. Ensure that design team has been notified as a Non Conformance.	Concrete specification in structural drawings and following specification	No	2	3	6	Still risk in construction with procurement	Heron		

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	Construction	EN	Environmental	Impact on Habitat	Disturbance to adjacent habitat by enabling works for the emplacement cell and the stormwater channel	AIE / Heron	Habitat destruction, disturbance of flora and fauna	2	2	4	Approved management plans to be prepared within consent conditions Limit footprint size of construction activities where appropriate	To be addressed by Heron	No	2	2	4	To be dealt with prior to construction	Heron		
	Construction	DR	Drainage	Flooding, storm events impacting work site	Delays to construction program	SMEC/Heron	Injury / death to construction personnel	2	5	10	Formulate construction staging and methods to reduce impact of flooding or storm events on the works site Emergency Action Plan formulated and enacted on site during construction	Construction staging is to construct the stormwater channel prior to other works so that the stormwater flows from the drain out to the harbour without going through the works area Emergency Plan to have work cease when flooding occurs to reduce risk	No	2	3	6	Consequence reduced if stormwater channel redirects water around the emplacement cell	Heron		
	Construction	EN	Environmental	Acidification of soil/water in the emplacement cell	Oxidation of ASS/PASS soil during dredging / transport ASS/PASS material not identified (in 1A/1B material)	AIE	Environmental damage	1	3	3	ASS/PASS Management Plan to be developed describing handling of material during excavation and placement	Heron has advised that the ASS/PASS material will remain saturated during the dredging process. It is proposed that the material is excavated from Berth 101 and then transported across the harbour and placed in the emplacement cell. The duration of this cycle is a matter of less than a couple of hours which is insufficient time for the ASS/PASS to become unsaturated and start to oxidise. GHD are working on ASS/PASS management plan for the material in Berth 101	No	1	3	3		AIE		
	Construction	EN	Environmental	Acidification of soil/water in the emplacement cell	Oxidation of ASS/PASS soil due to exposure at final emplacement location	SMEC/Heron	Environmental damage	1	3	3	Design for ASS/PASS material to be permanently saturated and placed below the agreed PKHD	Emplacement Cell has been designed to take ASS/PASS volume and contain it below PKHD 0.9m. Contingency measures are to be formulated for potential excess ASS/PASS	No	1	3	3		AIE		
	Construction	EW	Earthworks	Design not constructed	Design does not adequately address constructability	SMEC/Heron	Construction not in accordance with design or design intent leading to some of the risks above	1	4	4	Constructability workshops and interactive workshops ECI part of design development Designer involvement during construction	There have been numerous meetings with Heron about construction through the design process	No	1	4	4		Heron		
	Construction	EW	Earthworks	Contamination encountered during Darcy Road stormwater channel	Identified contamination at the Darcy Road drain (waterborne contamination from Port Kembla Copper)	AIE	Health and Safety risk to construction personnel	2	5	10	Considered approach to construction of the extension of the Darcy Road - reducing the requirement for people to be in the water EPA currently involved - liaison required with them about contamination level	Heron to look at known contamination with assistance of AIE in order to formulate the construction methodology AIE to capture the possible impact and addressing the occurrence in their Trigger Action Reponse Plan AIE to provide publicly available information to Heron for consideration for work health and safety Evaluate / formulation a monitoring regime of the Darcy Road (sampling and analysis) with background monitoring and baseline	No	2	5	10	Risk is yet to be addressed Possible measure is to have a water quality measured upstream of the outlet so that there is baseline data	AIE/Heron		
	Construction	EW	Earthworks	Contamination encountered during emplacement cell construction	Identified contamination on the landside of the emplacement cell	AIE	Health and Safety risk to construction personnel	2	5	10	Knowledge of situation (study completed by GHD) to formulate construction plan	incorporate contingency measures for encountering contamination during Berth 101 dredge Unexpected Finds Protocol in place with GHD to support	no	2	5	10		Heron		
	Construction	EW	Earthworks	Risks to plant and people during construction	Personnel unfamilar with site and operations during construction of the emplacement cell	Heron	Health and Safety risk to construction personnel / damage to equipment	3	4	12	Preparation of safety documentation for the works based on the method statements for construction and the overarching conditions of approval and statutory requirements	Risk assessment undertaken for construction activities prior to mobilisation to site SWMS to be formulated for site activities Project induction to communicate key risks to those on site	No	2	4	8		Heron		
	Operational			**Operational - Emplacement Cell**																
	Operational	GT	Geotechnical	Batter instability	Batter instability due to steep batter angle		Emplacement cell does not restrict the movement of emplaced material	3	4	12	Assess batter slopes for the proposed bund materials under various loadings	Design has considered various slope stability cases including construction stages. All have met the required MDR. Design risk is eliminated	No	2	3	6		Heron		
	Operational	GT	Geotechnical	Batter instability	Batter instability due to poor construction		Emplacement cell does not restrict the movement of emplaced material	3	4	12	Design batter slopes based on the methods of construction to achieve the required Factor of Safety	Design has considered various slope stability cases including construction stages. All have met the required MDR. Design risk is eliminated. Guidance for construction has been provided including maximum height differential, maximum deposit rate, batter slopes to be adopted so that stability is maintained	No	1	4	4		Heron		
	Operational	GT	Geotechnical	Batter instability	Batter instability due to poor construction		Emplacement cell does not restrict the movement of emplaced material	3	4	12	Assess potential and provide adequate area for material retention	Volume cases have been								
	Operational	GT	Geotechnical	No/limited armour protection of bund	Armour rock is not sufficient for required wave events		Emplacement cell bund damaged	2	4	8	Assess armour for different design cases and assess slope angles / conditions for material retention	Armour rock has been sized for anticipated design and forces. Availability of suitable armour rock has been assessed.	Yes	1	4	4		NSWPorts		
	Operational	GT	Geotechnical	No/limited armour protection of bund	Armour rock moves		Emplacement cell bund damaged	2	4	8	Assess armour for different design cases and assess slope angles / conditions for material retention	Armour rock has been sized for design currents and forces. Availability of suitable armour rock has been assessed.	Yes	1	4	4		NSWPorts		
	Operational	GT	Geotechnical	Embankment settlement causes uneven bund crest	The bund crest settles so that the height of bund is lower and allows overtopping from emplacement cell		Emplacement cell bund damaged and emplacement cell compromised	2	4	8	Assess degree of consolidation of bund materials and foundation materials Assess acceptable overtopping discharge for the crest of the bund and the safety of the people on the bund Use construction data to evaluate the actual bulking factors and manage the placement of the material in the emplacement cell and in the bund	Crest elevation has been designed for the assessed potential settlement of <200mm so that freeboard is maintained. During construction, records of material deposition and survey will be maintained to evaluate the volume of material placed for the bund. There will be verification of the trench excavation as per the MDR. Lastly, an instrumentation and monitoring plan will be created which will provide the method for monitoring the bund crest for future settlement.	No	2	3	6		Heron / NSWPorts		
	Operational	GT	Geotechnical	Embankment settlement causes uneven surface	The bund crest settles so that the height of bund is lower and allows overtopping into the emplacement cell		Emplacement cell bund damaged and emplacement cell compromised	2	4	8	Assess degree of consolidation of bund materials and foundation materials during construction so that the bund height is managed during construction by placing more material	Crest elevation has been designed for the assessed potential settlement of <200mm so that freeboard is maintained	Yes					NSWPorts		
	Operational	GT	Geotechnical	Failure of embankment / access road under excavator load	Insufficient strength in embankment crest to allow for maintenance works including excavators restoring rock armour		Increased potential for accidents	2	3	6	Design of crest to be assessed for construction loading Assess operational limitations / guidelines for accessing the crest	Access road has been designed for the proposed construction loading as defined in the MDR. Geofabric / geogrid has been incorporated in the crest design for the access road and has also been incorporated in the in the bund at lower heights to provide sufficient capacity for construction loadings during bund construction	Yes					NSWPorts		
	Operational	GT	Geotechnical	Reduced road width on crest	Restricted manoeuvre width for maintenance vehicles (100T excavator and semi trailer access)		Increased potential for accidents	2	3	6	Comply with minimum design requirements (in AFL) 6m width crest width taking a 100T excavator + semitrailer	Crest geometry has been designed so that the road is the required width. There is also additional width with the top apron of rock armour. Two passing bays have been included in the access road design as well as the refinement of the design so that the bund can be trafficked over its entire length from east to west without requiring a turning circle	No	1	2	2		NSWPorts		
	Operational	HF	Human Factors	Ability to veer off crest	machinery / light vehicle veers off crest		Machinery damage / injury to persons	3	3	9	Only persons inducted in Port procedures allowed to travel along the crest. The risk of no barrier is made clear to all persons upon site induction.	Access road has been designed to be inside the top apron of the rock armour on the berm. The rock armour is at the front of the bund. The slope on the back of the bund is now at 3H:1V so that if a vehicle does veer off it will be onto a shallow slope.	No	2	2	4		NSWPorts		
	Operational	EN	Environmental	Acidification of soil/water in the emplacement cell	Oxidation of ASS/PASS soil		Environmental damage	1	3	3	Formulate for ASS/PASS Management Plan for placement of ASS/PASS below the agreed PKHD ASS/PASS material to remain saturated in the emplacement cell	EC design base case has achieved effective storage of ASS/PASS material below the approved level of PKHD 0.9m.	No	1	3	3		AIE		
	Operational	EN	Environmental	Emplacement Cell does not fulfill objective of containing disposal	Bulking factors and constructed geometry are different to design model	SMEC	Environmental damage - offshore dumping required	3	4	12	Appropriate contingency in design and construction for amendment during construction to reflect bulking density Preloading, surcharging, PVD the alignment of the bund	EC design has evaluated the capacity of the emplacement cell. At 95% stage there was a limited risk that there would not be sufficient capacity with the EC to take the ASS/PASS material below PKHD 0.9m. This could occur if the bulking factors of the base case design are not achieved.	No	1	4	4	AIE are currently evaluating off site disposal for ASS/PASS and other materials as a contingency based on the volumes assessed in the 95% stage report	AIE		
	Operational			**Weather / Environmental Related Events**																
	Operational	DR	Drainage	Flooding	High flow velocities in channel damaging channel lining	SMEC	Damage to channel lining causes serviceability / capacity issues	2	4	8	Design and construction of stormwater channel structure and velocity control structures to reduce potential damage	Stormwater channel designed for maintaining freeboard and keeping velocity down	No	1	4	4		NSWPorts		

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	Operational	DR	Drainage	Flooding	Stormwater channel design does not provide sufficient capacity for flood event	SMEC	Increased potential for accidents upstream	1	4	4	Design to appropriate standard / required flood event (1% AEP)	Stormwater channel depth and width has been designed to reduce the flood impact upstream and also take surface water from the area of the emplacement cell	No	1	4	4		NSWPorts		
	Operational	DR	Drainage	Flooding	Stormwater channel design does not provide sufficient capacity for flood event	SMEC	Increased potential for property damage / utility damage upstream	1	4	4	Design to appropriate standard / required flood event (1% AEP)	Stormwater channel depth and width has been designed to reduce the flood impact upstream and also take surface water from the area of the emplacement cell	No	1	4	4		NSWPorts		
	Operational	GT	Geotechnical	Earthquake	Damage to the bunds emplacing the dredged material	SMEC	Emplacement Cell Compromised	2	4	8	Assess design for seismic loading	Slope stability assessment of the proposed design has been carried out	No	1	4	4		NSWPorts		
	Operational	GT	Geotechnical	Flooding in emplacement cell challenges integrity of emplacement cell	Surface water runoff ravels capping material	SMEC/AIE	Exposure of ASS/PASS	1	3	3	ASS/PASS soil to be below PKHD 0.9m Sufficient capping	Emplacement Cell has been designed to take ASS/PASS volume and contain it below PKHD 0.9m. Contingency measures are to be formulated for potential excess ASS/PASS	Yes					AIE		
	Operational			**Structures Issues - Stormwater Channel**																
	Operational	GT	Geotechnical / Structures	Settlements Culverts	Settlements predicted (total and differential) not achieved (either more or less)	SMEC	Gaps opening --> soil/water inflow, settling of embankment. Gaps closing --> concrete spalling, exposure of bars, durability compromised	2	3	6	Provide more ground treatment, pre load sites to remove construction settlement	Stormwater channel has been designed to reduce potential settlement through ground treatment and engineering of the foundation	No	2	3	6		NSWPorts		
	Operational	ST	Geotechnical / Structures	Settlements Retaining Walls/Culvert Headwalls	Settlements predicted (total and differential) not achieved (either more or less)	SMEC	Gaps opening --> soil/water loss, settling of pavement, barrier and wall. Gaps closing --> concrete spalling, exposure of bars, durability compromised, wall panels damaged.	2	3	6	Provide more ground treatment, pre load sites to remove construction settlement	As above	No	2	3	6		NSWPorts		
	Operational	ST	Structures	Durability	PASS --> AASS, site conditions more aggressive than expected	SMEC	Failure of structure due to accelerated concrete deterioration.	1	4	4	Provide suitable concrete cover, specify minimum diffusion coefficients, specify concrete grade	ASS/PASS materials will be placed below PKHD 0.9m and shouldn't be in contact with stormwater channel. Contingency for excess ASS/PASS is being developed by AIE including offsite disposal reducing the risk that ASS / PASS material will be emplaced near the channel	No	1	4	4		NSWPorts		
	Operational	DR	Drainage	Public accessing stormwater channel	Access to stormwater channel not controlled	AIE /Heron	Drowning	2	5	10	Fencing to prevent access	NSWPorts has leased the adjoining properties along with a pipeline easement. Those site developments are potentially going to provide boundary fencing. Further consultation required between AIE & NSW Ports	No	2	5	10		NSWPorts		
	Operational	DR	Drainage	Scour Protection	Undermining of structures through scour effects	SMEC	Structure out of service	2	4	8	Scour protection assessment	Stormwater channel has been designed with rock rip rap and concrete invert	No	1	4	4		NSWPorts		
	Operational	DR	Drainage	High flow velocities at channel exit causing hazardous conditions in harbour	Stream velocities at exit of stormwater channel creates issues at Jetty 6		Potential damage to vessels moored at Jetty 6, navigation issues for craft using Jetty 6	2	3	6	Design and construction of diffuser at end of stormwater channel	Stormwater channel is slightly further away from Jetty #6 due to the realignment of the bund to provide a continuous access road from Abutment 3. Also rock diffuser designed to reduce velocity at outlet	No	1	3	3		NSWPorts		
	Maintenance			**Maintenance Issues**																
	Operational	GT	Geotechnical	Embankment settlement causes uneven surface	Access road (required by NSWPorts) becomes untrafficable - drivers lose control on access road		Increased potential for accidents	2	4	8	Assess degree of consolidation of bund materials and foundation materials	Access road design now comprises a full width access road along with the top armour of the revetment. The access road comprises engineered layers with geogrid / geofabric reinforcement	No	2	4	8		NSWPorts		
	Operational	GT	Geotechnical	Embankment settlement causes uneven surface	Access road (required by NSWPorts) becomes untrafficable - drivers lose control on access road		Increased potential for accidents	2	4	8	Design to provide crest detail for suitable access road surface	Access road design now comprises a full width access road along with the top armour of the revetment. The access road comprises engineered layers with geogrid / geofabric reinforcement	No	2	4	8		NSWPorts		
	Operational	DR	Drainage	Providing for access for personnel to maintain channel	Poor accessibility for maintenance personnel and equipment		Injury to personnel trying to access to the stormwater channel	2	4	8	Design stormwater channel in accordance with the requirements of NSW Ports for maintenance (if there are requirements)	There are no requirements from NSWPorts for stormwater channel access. Access could be constructed from NSWPorts owned land	No	2	4	8		NSWPorts		
	Operational	GT	Geotechnical	Failure of embankment / access road under excavator load	Insufficient strength in embankment crest to allow for maintenance works including excavators restoring rock armour		Increased potential for accidents	2	4	8	Design of crest to be assessed for construction loading	Access road design now comprises a full width access road along with the top armour of the revetment. The access road comprises engineered layers with geogrid / geofabric reinforcement	No	2	4	8		NSWPorts		

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ID	Phase	Section	Discipline	Discipline Code		Status
	Operational	N0	GE	General		
	Construction	N1	RD	Roads		
	Maintenance	N2	LS	Lines and Signs		
		N3	RF	Road Furniture		
		N4	DR	Drainage		
			PV	Pavement		
			BR	Bridges		
			ST	Structures		
			RW	Retaining Walls		
			NM	Noise Mitigation		
			GT	Geotechnical		
			EW	Earthworks		
			PW	Property Works		
			TS	Traffic Staging		
			TW	Temporary Works		
			US	Utilities or Services		
			SL	Street Lighting		
			LR	Local Road Works		
			FA	Fencing		
			TR	Traffic		
			EN	Environmental		
			TD	Typical Details		
			UD	Urban Design (by JT)		
			LN	Landscape Design		
			AC	Acoustic		
			LA	Land Acquisitions		
			AT	Building Architectural		
			ES	Electrical Services		
			MT	Maintenance		
			SY	Systems		
			SP	Specifications		
			SD	Shop Drawings		
			RP	General Reports		
			SK	Sketches		
			TC	Traffic Control Plans		
			ZZ	Miscellaneous		
			NA	N/A		

Appendix C Project Risk Register

SMEC
Member of the Surbana Jurong Group

Project / Opportunity No:

Risk Identification				Risk Analysis					Risk Treatment / Management Plan							Risk Monitoring				
Objective	**Nature of Risk**	**Identified Risk / Hazard (opportunities & threats)**	**Leading to . . .**	**Existing Controls of Identified Risk / Hazard (If any)**	**Likelihood (1 - 5) ***	**Consequence (1 - 5) ***	**Risk Rating**	**Is the Risk Significant? Yes ≥8 No <8**	**Opportunity from risk**	**Treatment / Action**	**Responsibility**	**Timing**	**Residual Likelihood (1 - 5)**	**Residual Consequence (1 - 5)**	**Residual Risk Rating**	**Date Monitored**	**Monitored by**	**Risk Mgt Action implemented? Yes / No**	**Risk Mgt Action effective? Yes / No**	**Comments**
Dredge material disposal / cla	Quantity of ASS/PASS material in emplacement cell location - this could grow due to unexpected finds and the way it is assessed at the dredge site	There may be insufficient space behind the bund to emplace all the material	Surplus material potentially needing to be disposed offsite or treated for on site disposal above PKHD 0.9m	SMEC to base design on quantities provided in information documents with contingency factors	3	3	9	YES	Provide Contingency measures at design stage	1. assess the possible range of volumes of ASS/PASS material based on review of the Berth 101 volumes and using a range of Bulking Factors. 2. evaluate different cell and bund geometries in order to provide sufficient volume for the base case volumes + a volume range which is considered to have potential to arise due to site / construction factors 3. have a contingency plan for potential excess of ASS material including offsite disposal	1. and 2.: SMEC 3. AIE	Design	3	2	6					
Dredge material disposal / cla	Quantity of material (Unit 1A/B) usable for bund formation. This could change due to unexpected finds of contamination or ASS	There may be insufficient material to construct the bund	Needing to import material and increased cost	SMEC to base design on quantities provided in information documents with contingency factors. Amend the height of the emplacement cell	3	3	9	YES		1. amend the finish level of the emplacement cell and the interface with the bund geometry 2. may be able to place other fill materials that are available (eg NSW Ports) in the bund / emplacement cell	1. SMEC 2 AIE	1. Design 2 Construction	2	3	6					
Dredge material disposal / cla	The staging in which material from the dredge site (Berth 101) comes out so it aligns with staging needed for the bund construction	Bund may take longer to construct due to staging of material supply	Increased environmental controls until bund is created	ECI with Heron so that the material coming out of Berth 101 can be used in construction of ECR to reduce the requirement to stockpile	2	3	6	NO		Formulate dredge management plan to excavate the required materials (unit 1 Unit 2) as they are required to construct the EC and reduce the double handling or lag time Coordinate dredging of the Berth with the construction of the cell	1. Heron 2. AIE	Design / Tender	2	3	6					
Dredge material disposal / classification	How and who is responsible for classifying different types of material at the dredge site	Difficult to control and understand design volumes	constructability issues and increased project costs	SMEC design based on review of Berth 101 quantities with upper and lower bound bulking factors As part of construction contract, requirements for assessment of material identified and controls implemented	3	3	9	YES		1. 0.5m buffer employed in Berth 101 Unit levels during design to evaluate the volumes available 2. Formulate dredge management plan to excavate the required materials (unit 1 Unit 2) as they are required to construct the EC and reduce the double handling or lag time. There is a 12D model of Berth 101 with different units demarcated to assist in extraction and placement 3. Spoil Management Plan to be prepared which describes how this will be done and to comply with Consent Condition 11	Heron	Design / Tender	2	3	6					
Design and documentation of Emplacement Cell	Survey data between bathymetry data and land survey (vertical and horizontal datum differences - AHD/PKHD and GDA94/GDA2020)	Design works being undertaken to different survey datum, dredge disposal footprint set out to GDA94 and not GDA2020.	Design setout does not align with AFL, stormwater does not align with existing levels, emplacement cell volumes incorrect	AIE to provide survey reports confirming datum, and all project data adjusted to PKHD and GDA2020.	1	4	4	NO		All work done to PKHD and GDA2020 Agreed on 22 October 2021 in meeting with AIE, Heron and SMEC	SMEC	Design	1	1	1					
Bund stability	Geotechnical instability of batter slopes	Batter slope stability a function of batter slope angle, design parameters assigned for dredged materials, foundation materials, load cases and corresponding target factors of safety	Bund instability and/or failure - emplacement cell does not restrict the movement of emplaced material	Assess batter slopes for the proposed bund materials under various loading cases/combinations and corresponding FOS, including consideration of consolidation/strength gain effects, facing materials and detail, and selection of appropriate parameters for dredge materials. Analysis of overall rock blanket thickness to be undertaken with tidal lag to confirm stability (on the basis that the geotextile clogs over time).	3	4	12	YES	Design refinement	EC design has evaluated various batter slopes and loading conditions to achieve the required FoS	SMEC	Design	2	4	8					
Bund stability	General instability due to Construction Techniques	Failure of the bund structure due to construction issues	Bund instability and/or failure - emplacement cell does not restrict the movement of emplaced material during Construction	SMEC has assessed generalised staging of works to control Construction Phase Instability and to carry out works in a manner that greatly reduces construction phase failures	3	4	12	YES	Heron to review Construction Techniques in an ECI (Early Contractor Involvement) manner and suggest improvements	Heron has reviewed design and staging, and has provided feedback to SMEC	Heron	Construction	1	4	4					
Bund stability	Foundation instability due to presence of weak marine deposits at seabed	Failure of the bund structure when it is founded on weak marine deposits at or below the base of the bund structure.	Bund instability and/or failure - emplacement cell does not restrict the movement of emplaced material	Detailed CPT investigation to be undertaken to provide details on ground conditions along the bund alignment, which will inform detailed design and pretrench requirements. There is a potential Opportunity from the Port of Brisbane experience; use of a high strength geotextile overlaid by a sand blanket reduced turbidity, reduced material usage, and shortened construction timings.	1	4	4	NO	refine design based on CPT data to reduce requirement for trench reinforcement	CPTs completed and the geotechnical model has been refined so that the design levels for the key trench have been evaluated. Dredge depths have been defined in the design to reduce the risk of the foundation containing weak marine deposits	SMEC	Design	1	4	4					
Bund stability	Hydrodynamic effects on underwater slopes (unarmoured slope above -3m LAT approx.).	Mobilisation of material within the bund	Bund instability and/or failure	Complete bund slope to be armoured as per clarification provided by AIE.	4	3	12	YES	Assess options: pea gravel / geotextile + rip rap / rock armour	SMEC has evaluated various bund protection. Heron to actively re-groom slope during construction. Slumping of slope is expected.	SMEC	Design	2	3	6					
Alignment of dredge and emplacement volumes	Bulking factors assumed for dredge materials	Uncertainty regarding bulking factors which depend on both material characteristics and how materials are dredged, transported and placed. Variability to be expected within individual units given natural variability of materials.	Insufficient volumes to construct bunds and/or insufficient space in emplacement cell	Assigned bulking factors to consider range of values (upper and lower bound, median values), inputs being provided by Heron, and expert advice being provided by Pro Dredging.	2	4	8	YES		Have identified the range of bulking factors. The design has progressed on the basis of a base case using the anticipated bulking factors with a critical case where the bulking factors that would provide an upper bound outcome. Risk management strategy has been developed	SMEC	Design	2	3	6					
Alignment of dredge and emplacement volumes	Uncertainty regarding total volumes and distribution of dredge material types.	Dredge volumes based on 2018 WP information which did not include over water investigation. WP marine geological model based on data from 1965-1979. It is not clear whether WP dredge models have been updated to incorporate GHD vibro-core information or other additional geotechnical investigation information from Berth 101.	Insufficient volumes to construct bunds and/or insufficient space in emplacement cell	Assessment undertaken of Berth 101 volumes using GHD vibrocore information to refine the unit surface in the 12D model to obtain dredge volumes	4	3	12	YES		Berth101 model has been reassessed based on information provided with new Unit boundaries and revised volumes advised to Heron and used for assessment of EC volumes	SMEC	Design	2	3	6					
Bund crest stability - overtopp	Assigning bund RL based on overtopping discharge volumes - damage levels/finished surface on bund.	Damage to crest	Crest failure leading to material release into Outer Harbour	Crest to be designed in accordance with international norms and industry standard empirical design methods. It is understood that verification of overtopping volumes in accordance with the nominated performance criteria within the BOD and/or optimisation of crest design, via physical modelling, is not considered warranted by AIE.	2	4	8	YES		Crest has been designed so that there is sufficient width for the access road and the required width of armour	SMEC	Design	2	3	6					
Safe construction activities	Construction staging inputs critical to design - impacts on assumptions related stability assessment of intermediate stages.	Batter slope stability during construction a function of temporary batter slope angle, methods of construction, loading (equipment on bund etc) and corresponding target factors of safety	Bund instability and/or failure - emplacement cell does not restrict the movement of emplaced material, equipment becoming bogged - tipping etc	Assess batter slopes for the proposed bund materials under various loading cases/combinations and corresponding FOS, including consideration of consolidation/strength gain effects, facing materials and detail, and selection of appropriate construction methods for equipment on placed materials	2	4	8	YES		Slope stability assessment has ben undertaken on various stages of construction. The construction staging has been assessed for a maximum height differential between bund and emplacement cell of 1.5m. This is to be adhered to during construction. SMEC has also assessed the stability of the bund being constructed from a barge and also then by land based equipment as well	SMEC	Design	2	3	6					

SMEC
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Project / Opportunity No:

Risk Identification				Risk Analysis					Risk Treatment / Management Plan							Risk Monitoring				
Objective	**Nature of Risk**	**Identified Risk / Hazard (opportunities & threats)**	**Leading to . . .**	**Existing Controls of Identified Risk / Hazard (If any)**	**Likelihood (1 - 5) ***	**Consequence (1 - 5) ***	**Risk Rating**	**Is the Risk Significant? Yes ≥8 No <8**	**Opportunity from risk**	**Treatment / Action**	**Responsibility**	**Timing**	**Residual Likelihood (1 - 5)**	**Residual Consequence (1 - 5)**	**Residual Risk Rating**	**Date Monitored**	**Monitored by**	**Risk Mgt Action implemented? Yes / No**	**Risk Mgt Action effective? Yes / No**	**Comments**
Material contained in emplac	Potential for ASS/PASS and/or contaminated materials to be present in pre trench excavations and requirements to place these materials below a specific RL	There may be insufficient space behind the bund to emplace all the material	Surplus material potentially needing to be disposed offsite	Design to include assessed contingency of additional material. Revise design so that additional storage is achieved within the bund for possible ASS/PSS material	2	4	8	YES	Cell design and identification of contingencies	Design cell to accommodate the anticipated volume of ASS/PASS (SMEC) Identify contingency measures based on critical case volumes so that the documentation and approvals is in place in the event off site disposal is required (AIE)	SMEC /AIE	Design	2	3	6					
Material contained in emplac	Dispersal of sediment and contaminant mobilisation	Environmental damage	Fines, litigation	SMEC design to clearly assume our bund design is a physical barrier (not impermeable barrier). Identification of methods by which risk is reduced to be discussed in ECR	1	4	4	NO	ECR Approval	1. SMEC to identify in the report the factors that reduce the likelihood of migration including width of sand bund, geofabric etc 2. Spoil Management Plan to be prepared which describes how this will be done and to comply with Consent Condition 11	SMEC	Design	1	4	4					
Material contained in emplac	Acidification of emplaced materials	Environmental and/or structural damage	Fines, litigation	SMEC base design on the MDR, assumptions on the SCSB ASSMP and accompanying Fox Environmental Report which specify the level where ASS can be buried	2	4	8	YES	Cell design and identification of contingencies	Design cell to accommodate the anticipated volume of ASS/PASS (SMEC) Identify contingency measures based on critical case volumes so that the documentation and approvals is in place in the event off site disposal is required (AIE)	SMEC /AIE	Design	2	3	6					
Sequencing	Stockpiles cannot be stored for longer than 12 months before they are either used or disposed.	Implications on staging	Potential for material not being able to be used and therefore needing offsite disposal - increased cost	Design for construction to comprise material won from Berth 101 being placed directly in the emplacement cell / bund	2	4	8	YES	Reduce the requirement for double handling	Dredge management plan to identify source material and quantities required at certain stages to drive the dredge plan so that material handling is reduced	Heron	Design / Tender	2	3	6					
Ambient Conditions / Temporary Bund Design	Operational / ambient wave conditions in the Outer Harbour; 50% Hs = 0.3m	Wave climate which causes temporary bund instability Wave climate which causes contractor downtime	Downtime / bund instability / construction delays	AIE having an appreciation of operational limits of Heron's equipment is recommended. This will allow AIE/Heron to estimate potential downtime. Temporary bunds designed for a 1 year ARI wave climate.	3	3	9	YES		Contractor to manage risk of bund instability through construction sequencing and timing	Heron	During Construction	3	3	9					
Rock Protection Structure	Contractor interfacing between Heron / Cleary's for dredging / bund construction.	Advice provided during ECI phase cannot be relied upon for design purposes.	Constructability issues on site	AIE to consider bringing Heron's Civil Contractor into the ECI discussions.	3	3	9	YES	Identify issues based on ECI phase and work in with design	Contractor to undertake further work on sequencing and staging as part of formulation of the dredge management plan and construction management plan	AIE / Heron	Design / Tender	2	2	4					
Rock Protection Structure	Undersizing and/or oversized rock mass	It is understood that physical modelling will not be undertaken. This highlights the design verification risk introduced, and conversely highlights the opportunity that physical modelling brings to refine the design.	Potential for either undersized and/or oversized rock mass. Design based on empirical methods only.	SMEC has designed the rock protection structure in accordance with international norms and industry standard empirical methods. It is understood that verification of rock stability in accordance with nominated performance criteria and/or optimisation of rock gradings under design event loading, via physical modelling, is not considered warranted by AIE. A FOS has been applied. Refer to Basis of Design report for discussion on this matter. SMEC will discuss the availability of suitable armour rock with local suppliers to understand the properties of the available rock	2	4	8	YES	At design stage understand availability of rock	SMEC has contacted Cleary Bros, Bass Point Quarry and Dunmore Quarry to ascertain the availability of suitable rock. The design has taken into consideration rock type and density available locally. Quarries have indicated that the rock type (grading, strength and density) required is available.	SMEC	Design	1	4	4					
Rock Protection Structure	Reuse of rock at Berth 101 (~10,000m^3) and existing stockpile adjacent to the drain (94,000m^3 approx. - refer to FOR INFO drawing 1210 rev A)	Very little is known about the existing rock revetment and stockpile. The GHD Spoil Management Plan – Early Enabling Works report provides design drawings, however there is no detail provided on the rock revetment, only the overall layer thickness. There is no detail on the stockpile adjacent to the drain.	With no knowledge of the rock, integrating reuse of rock into the design cannot proceed.	SMEC Geologist has visited site to visually assess the properties of the rock and provide commentary on nature and suitability of the available material for reuse	4	3	12	YES	Based on assessment there is opportunity to reuse up to 10,000m^3 of armour rock (revised volume)	SMEC has identified that existing armour rock may be utilised in the toe berm of the revetment. Recommended that broad suitability is assessed as rock is recovered from Berth 101	Heron	Construction	2	3	6					
Rock Protection Structure	Protection of works / temporary structure due to staging	It's understood that staged construction of the bund will occur. If so, it is currently no clear what period of time the temporary bund would be exposed to metocean conditions.	Bund instability due to exposure to metocean conditions.	Heron to provide general construction staging and sequencing method, to inform design, highlighting maximum period of time the temporary bund structure will be exposed to metocean conditions. Heron to confirm that rock production can meet placement production.	4	3	12	YES	Construct berm first so that emplacement cell is complete	Heron to make assessment of the duration of various construction stages , the production of dredged material (quantity and type), the type and number of plant available to construct the bund	Heron	Construction	2	3	6					
Rock Protection Structure	Geotextile placement underwater	Constructability of geotextile	Design detail that cannot be constructed.	Heron to provide general construction staging and sequencing method, to inform design.	4	4	16	YES	Simplified construction	Heron has advised that geotextile can be placed underwater. Compared to gravel filter there is some simplification of construction	Heron	Construction	2	4	8					
Rock Protection Structure	Geotextile puncture	Damage to geotextile due to rock layers immediately either side	Damage to geotextile	Discussion with geotextile suppliers. Identification of geotextile properties required to reduce the risk of puncture so that it can be procured for the project. Details provided in Specification Heron to undertake dry trials of geotextile placement, layering of rock, trimming rock	4	3	12	YES	Simplified construction	Specification of geotextile properties - SMEC Procurement in accordance with Specification and dry trials - Heron	Heron	Design / Construction	2	3	6					
Rock Protection Structure	Tidal lag	Tidal lag due to geotextile, bund staging and compartment filling. This is a particular risk for closed bund construction if the geotextile is on the inside of the compartment and a risk to geotextile placed on the outside of the bund (sufficient thickness of rock required).	Geotextile instability	Heron to provide general construction staging and sequencing method, to inform design, i.e. open or closed bund construction to be confirmed. BOD provides criteria for tidal lag under temporary and permanent conditions. Heron to confirm open bund construction methodology. SMEC to undertake analysis of rock blanket thickness required, for geotextile placed on outside of bund.	3	4	12	YES	revetment design to reduce risk of tidal lag	SMEC has undertaken analysis of the effects of tidal lag. Rock revetment has been designed with suitable thickness to reduce risk of tidal lag	SMEC	Design	1	4	4					
~~Submerged Disposal Structu~~	~~Mobilisation and drift of material outside of the AFL~~	~~Material migrates over time outside the AFL~~	~~Non compliance with Conditions of Approval~~	~~SMEC has produced a delta plot of surveys to assessment material movement overtime.~~ ~~SMEC to rely on empirical based methods to assess material stability in combination with assessment of surveys. Numerical modelling of material in both temporary and/or permanent position is not proposed.~~ ~~Harbourmaster has confirmed that application of full power should be assumed for Tugs at Berth 206. This will likely result in submerged material migrating outside the AFL. AIE have been informed of this risk.~~	~~5~~	~~4~~	~~20~~	~~YES~~	~~evaluate requirement for the emplacement cell~~	~~Submerged emplacement cell has been removed from the design~~	~~AIE~~	~~Design~~	~~1~~	~~1~~	~~1~~					
Bund stability	Rock revetment instability	Prop wash induced currents below -3m PKHD	Rock instability / revetment damage	Rock revetment has been designed for prop wash separation distance from tug to bund of 60m. If the separation distance between tug/s and the bund is less than 60m, on full application of power, rock instability below -3m PKHD could occur.	4	4	16	YES	Discussion required around tug operational limits recommended	Discussion required around tug operational limits recommended	AIE	Design	1	1	1					

Project / Opportunity No:

Risk Identification					Risk Analysis				Risk Treatment / Management Plan							Risk Monitoring				
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Bund stability	Protection of works / temporary structure due to staging	Displacement of water from within the emplacement during placement of dredged materials - after bund closure. Preferential to include a weir structure within the bund wall to avoid displaced water pushing through the bund.	Bund instability	Heron to provide general construction staging and sequencing method, to inform design.	3	3	9	YES	Design of stormwater channel to provide temporary works drainage	As it is proposed to construct the berm to fully enclose the emplacement cell, the stormwater channel is designed to provide temporary drainage of the cell through pipes installed at regular intervals through the seaward bund of the stormwater channel. The drainage pipes will be installed at a suitable elevation below the anticipated finish level of the emplacement cell to provide drainage of the water displaced during the placement of the cell material. Heron has advised SMEC that they anticipate placing of the order of 4000m^3 per day.	SMEC / Heron	Design / Construction	2	3	6					
Silt curtain stability	If a silt curtain is used by Heron, instability may occur due to currents, prop wash, wind waves, long period infragravity waves.	Silt curtain becomes unstable leading to downtime and environmental risk.	Downtime / environmental risk	SMEC to create a performance specification for the silt curtain design, with environmental conditions and environmental criteria nominated. SMEC to inform AIE on the risk profile associated with the environmental conditions adopted within the performance specification.	4	3	12	YES		Heron to engage a specialist silt curtain designer to design the curtain and anchoring system to resist the nominated environmental conditions and environmental criteria nominated.	Heron	Construction	2	3	6					
Drainage of surface water from emplacement cell	Stormwater runoff on emplacement cell	Stormwater accumulates on the surface of the emplacement cell, ineffective drainage of the emplacement cell	water infiltration of emplacement cell	Requirements for crossfall on cell towards bund? Where is this picked up - top of cell may not align with top of bund? Western end of bund also expect to be lower due to beach/existing levels	3	2	6	NO	Coordinated design of stormwater channel and emplacement cell	Cell has been designed with a crossfall to the stormwater channel. Inlets and pipes have been designed within the cell and the stormwater channel to collect run off water from the cell and discharge it in the channel	SMEC	Design	2	2	4					
Darcy Road drain - temporary outlet	Temporary drainage/outlet required during construction	Staging of stormwater channel works relative to emplacement cell filling. Assume filling to be completed prior to construction of channel - requires temporary drainage arrangement for existing outlet	Upstream flooding in storm event	Coordination with construction activities required. Needs to be included in the construction plan and timeline to reduce risk of flooding during construction	1	4	4	NO	Design of stormwater channel to provide temporary works drainage	As it is proposed to construct the berm to fully enclose the emplacement cell, the stormwater channel is designed to provide temporary drainage of the cell through pipes installed at regular intervals through the seaward bund of the stormwater channel. The drainage pipes will be installed at a suitable elevation below the anticipated finish level of the emplacement cell to provide drainage of the water displaced during the placement of the cell material. Heron has advised SMEC that they anticipate placing of the order of 4000m^3 per day.	SMEC / Heron	Design / Construction	1	4	4					
Fencing	Unauthorised access to the surface of the emplacement cell and the bund following completion of the works	Unauthorised landside access to the emplacement cell area by public	Potential for injury	Existing control: existing port security fence restricts access to the area.	2	3	6	NO	NSWPorts to demarcate areas for possible reuse	Fencing to the top of the revetment: no fence proposed, which is consistent with the other undeveloped landforms in the area of the Outer Harbour. Existing port security boundary fence along the majority of the Emplacement Cell boundary to be maintained. It is assumed that the boundary fence on the southern boundary and to old Jetty No 3 will be installed by NSWPorts or on behalf of NSWPorts as part of the new development of the adjacent lots.	NSW Ports	Completion	1	3	3					

*See SMEC's Risk Acceptance Criteria G-CLR10402

Appendix D **Detailed Design Report**

Refer to ACONEX Document Register
Emplacement Cell Detailed Design Report
PKGT-SMC-OHC-CIV-RPT-0004

Appendix E Geotechnical Investigation Report

Refer to ACONEX Document Register
Geotechnical Investigation Reportt
PKGT-SMC-OHC-GEO-RPT-0008

Appendix F Stormwater Channel Report

Refer to ACONEX Document Register
Stormwater Channel Report
PKGT-SMC-OHC-CIV-RPT-0002

Appendix G References

Document Reference Register for Port Kembla Gas Terminal Development - Emplacement Cell Design

Client:	Australian Industrian Energy	Principal Contractor:	SMEC Australia
Project Name:	Port Kembla Gas Terminal Development - Emplacement Cell Design	SMEC Project Number:	30013015
Location:	Port Kembla Outer Harbour	Date:	31/01/2022

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No.	AIE Document Register Title	AIE Document Register Location	AIE Document Register Reference No.	File Document Title	File Reference No.	Revison	Author / Company	Date of Issue
1	Engineering Requirements Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-TEC-SPC-0001	Engineering Requirements Specification	PKGT-AIE-PMT-TEC-SPC-0001	0	Australian Industrial Energy	01-June-2021
2	Engineering Drawing Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-TEC-SPC-0003	Engineering Drawing Specification	PKGT-AIE-PMT-TEC-SPC-0003	0	Australian Industrial Energy	01-June-2021
3	Aconex Use Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-CON-SPC-0001	Aconex Use Specification	PKGT-AIE-PMT-CON-SPC-0001	0	Australian Industrial Energy	01-June-2021
4	Controls Requirements Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-CON-SPC-0002	Controls Requirements Specification	PKGT-AIE-PMT-CON-SPC-00002	0	Australian Industrial Energy	01-June-2021
5	Documentation Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-MGT-SPC-0001	Documentation Specification	PKGT-AIE-PMT-MGT-SPC-0001	7	Australian Industrial Energy	01-June-2021
6	Land Access Requirements Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-MGT-SPC-0003	Land Access Requirements Specification	PKGT-AIE-PMT-MGT-SPC-0003	C	Australian Industrial Energy	01-June-2021
7	Quality Requirements Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-QUA-SPC-0001	Quality Requirements Specification	PKGT-AIE-PMT-QUA-SPC-0001	0	Australian Industrial Energy	01-June-2021
8	ITP Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-QUA-SPC-0003	Inspection and Test Plan Specification	PKGT-AIE-PMT-QUA-SPC-0003	0	Australian Industrial Energy	01-June-2021
9	HSSE Specification	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-HSE-SPC-0003	Health, Safety, Security and Environment Specification	PKGT-AIE-PMT-SPC-0001	0	Australian Industrial Energy	01-June-2021
10	AFL – Schedule 3 – Minimum Design Requirements	Appendix 1 - Specifications Codes and Standards	PKGT-AIE-PMT-MGT-AGR-0004	Minimum Design Requirements Outer Harbour	PKGT-AIE-SPC-0007	0	Australian Industrial Energy	01-October-2020
11	Not Included in Document Register	Not Referenced in Document Register 070721	Not Shown	Emplacement Cell Engineering Specification	PKGT-AIE-OHC-TEC-SOW-00001-EC	0	Australian Industrial Energy	01-June-2021
12	Not Included in Document Register	Not Referenced in Document Register 070721	Not Shown	Schedule 5: Outer Harbour Works	PKGT-AIE-AGR-018-Schedule_5	0	Australian Industrial Energy	01-October-2020
13	Not Included in Document Register	Not Referenced in Document Register 070721	Not Shown	Schedule 18: Outer Harbour Laydown Areas	PKGT-AIE-AGR-018-Schedule_18	0	Australian Industrial Energy	01-October-2020
14	Not Included in Document Register	Not Referenced in Document Register 070721	Not Shown	Environment Protection Licence	Number 21529	Draft	Environmental Protection Agency	Not shown
15	Not Included in Document Register	Not Referenced in Document Register 070721	Not Shown	Emplacement Cell Design - Functional Specificaiton	None shown	0	Australian Industrial Energy	Not shown
16	Cardno Report "Port Kembla Wave Modelling: PKGT-Design Wave Parameters at Southern Bund"	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0593	Design Wave Parameters at Southern Bund - Outer Harbour - Containment Cell's Input for Bund Design	SCSB-AIE-PKGT_PFID-REP-005	C	SCSB JV	01-May-2020
17	Factual Geotechnical Investigation Report	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0675	Factual Geotechnical Investigation Report for Proposed Marine Structures at Berth 101 in Port Kembla Gas Terminal	9775-GR-1-1 RevD	D	Alliance Geotechnical	01-December-2020
18	Geotechnical Investigation for the Proposed Quay Wall	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0658	Port Kembla Gas Terminal Geotechnical Investigation for the Proposed Quay Wall	2127477	2	GHD	01-February-2021
19	Additional Factual Geotechnical Investigation Report	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0582	Berth101 Additional Factual Geotechnical Investigation Report - Part 1 Required for the Basis of Design	SCSB-AIE-PKGT-GTE-RPT-001	B	SCSB JV	01-May-2020
20	Long Wave - Infragravity Wave (IG) - Wave Modelling Report	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0588	Port Kembla Wave Modelling, PKGT - Long Wave Modelling	V190925 PKGT - Long Wave Modelling_Rev0	0	Cardno	01-May-2020
21	Passing Ship Wave Modelling Report	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0589	Port Kembla Wave Modelling, PKGT -Passing Ship Wave Modelling	V190925 PKGT - Passing Ship Wave Modelling_Rev0	0	Cardno	01-May-2020
22	Observation and Simulation of Infragravity and Far-Infragravity Waves	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0155	Port Kembla Gas Terminal Obervation and Simulation of Infragravity and Far-Infragravity Waves	401010-01496-MA-1401 Rev0	0	Worley Parsons	01-May-2019
23	WorleyParsons - Infragravity Waves Characteristics and Occurrences	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0160	Port Kembla Gas Terminal Infragravity Wave Characteristics and Occurrences	401010-01496-MA-REP-1407 Rev0	0	Worley Parsons	01-May-2019
24	Worley Factual Investigation Report	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0157	Port Kembla Gas Terminal Factual Geotechnical Invstigaiton Report	401010-01496-MA-REP-1403	B	Worley Parsons	01-October-2018
25	Port Kembla Port Corporation Proposed Spoil Disposal Cell Geotechnical	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0859	Proposed Spoil Disposal Cell Geotechnical Investigation, Outer Harbour, Port Kembla	S22101/5-AA	-	Coffey	01-September-2005
26	Port Kembla Bathymetry May 2018	Appendix 2 - Relied Upon Information	PKGT-AIE-FEED-0638	Not in folder	Not in folder	Not in folder	Not in folder	Not in folder
27	Hydrographic Survey Report	Appendix 2 - Relied Upon Information	PKGT-PAN-BTH-CIV-RPT-0001	Survey Report - Port Kembla Berth 101 and Southern Outer Harbour	PKGT-PAN-BTH-CIV-001 Hydrographic Survey Report	0	Port Authority of NSW	01-October-2020
28	Hydrographic Survey Report - Data 1	Appendix 2 - Relied Upon Information	PKGT-PAN-BTH-CIV-RPT-0002	PKGT-PAN-BTH-CIV-002 Hydro_Data_CUBE	PKGT-PAN-BTH-CIV-002 Hydro_Data_CUBE	0	Not Shown	Not Shown
29	Hydrographic Survey Report - Data 2	Appendix 2 - Relied Upon Information	PKGT-PAN-BTH-CIV-RPT-0003	PKGT-PAN-BTH-CIV-003 Hydro_Data_SDTP	PKGT-PAN-BTH-CIV-003 Hydro_Data_SDTP	0	Not Shown	Not Shown
30	Environmental Condition Report Outer Harbour Drone Survey 2021	Appendix 2 - Relied Upon Information	PKGT-GHD-OHC-CIV-SRV-0001	PKGT-GHD-OHC-CIV-SRV-0001_Environmental_Condition_Report_OH_Drone_Survey	PKGT-GHD-OHC-CIV-SRV-0001_Environmental_Condition_Report_OH_Drone_Survey	-	Not Shown	Not Shown
31	Emplacement Cell Report	Appendix 3 - Reference Information	PKGT-AIE-FEED-0566	Port Kembla Gas Terminal Emplacement Cell Report	SBSC-AIE-PKGT-ENV-SCR-001	D	SCSB JV	01-September-2020

Document Reference Register for Port Kembla Gas Terminal Development - Emplacement Cell Design

Client	Australian Industrian Energy	Principal Contractor:	SMEC Australia
Project Name:	Port Kembla Gas Terminal Development - Emplacement Cell Design	SMEC Project Number:	30013015
Location:	Port Kembla Outer Harbour	Date:	31/01/2022

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No.	AIE Document Register Title	AIE Document Register Location	AIE Document Register Reference No.	File Document Title	File Reference No.	Revison	Author / Company	Date of Issue
32	Outer Harbour Dredged Spoil Containment Area - Basis of Design	Appendix 3 - Reference Information	PKGT-AIE-FEED-0456	Prot Kembla Gas Terminal - Part 2 Containment Cell Basis of Design Outer Harbour	PKGT-GEN-BOD-5101	3	SCSB JV	01-September-2020
33	Environmental Protection Licence (EPL)	Appendix 3 - Reference Information	PKGT-EPA-PMT-ENV-PLN-0001					
34	Air Quality Management Plan, Revision 01, dated 26-May-2021	Appendix 3 - Reference Information	PKGT-GHD-PMT-ENV-PLN-0002	Port Kembla Gas Terminal Air Quality Management Plan Early Enabling Works	Project Number 2127477	1	GHD	01-May-2021
35	DPIE approval of above plan dated 29-May-2021	Appendix 3 - Reference Information	PKGT-AIE-FEED-1020					
36	AIE Pollution Incident Response and Management Plan	Appendix 3 - Reference Information	PKGT-GHD-PMT-ENV-PLN-0005					
37	Construction Traffic Management Plan, Revision 01, dated 27-May-2021	Appendix 3 - Reference Information	PKGT-GHD-PMT-ENV-PLN-0003	Port Kembla Gas Terminal Construction Traffic Management Plan Early Enabling Works	Project Number 2127477	1	GHD	01-May-2021
38	DPIE approval of above plan dated 29-May-2021	Appendix 3 - Reference Information	PKGT-AIE-FEED-1019					
39	Construction Water Quality Management Plan, Revision 01, dated 27 May 2021;	Appendix 3 - Reference Information	PKGT-GHD-PMT-ENV-PLN-0004	Port Kembla Gas Terminal Construction Water Quality Management Plan Early Enabling Works	Project Number 2127477	1	GHD	01-May-2021
40	DPIE approval of above plan, dated 31 May 2021	Appendix 3 - Reference Information	PKGT-AIE-FEED-1025					
41	Environmental Management Strategy, Revision 01, dated 27 May 2021	Appendix 3 - Reference Information	PKGT-GHD-PMT-ENV-PLN-0006	Port Kembla Gas Terminal Environmental Management Strategy Early Enabling Works	Project Number 2127477	1	GHD	01-May-2021
42	DPIE approval of above strategy dated 31 May 2021	Appendix 3 - Reference Information	PKGT-AIE-FEED-1023					
43	Flora and Fauna Management Plan '(SCSB-AIE-PKGT-ENV-EMP-010)', Revision 0, dated 8 Aug 2019	Appendix 3 - Reference Information	PKGT-AIE-FEED-0574	Port Kembla Gas Terminal Flora and Fauna Management Plan	SCSB-AIE-PKGT-ENV-EMP-010	0	SCSB JV	01-August-2019
44	Out of Hours Works Approval 'dated 20 Nov 2020	Appendix 3 - Reference Information	PKGT-AIE-FEED-0876					
45	Port Navigation Plan '(SCSB-AIE-PKGT-ENV-EMP-011)', Revision 1, dated 22 Oct 2019	Appendix 3 - Reference Information	PKGT-AIE-FEED-0575	Port Kembla Gas Terminal Port Navigation Plan	SCSB-AIE-PKGT-ENV-EMP-011	1	SCSB JV	01-October-2019
46	Rehabilitation Plan '(SCSB-AIE-PKGT-ENV-EMP-003)', Revision 0, dated 8 Aug 2019	Appendix 3 - Reference Information	PKGT-AIE-FEED-0569	Port Kembla Gas Terminal Rehabilitation Plan	SCSB-AIE-PKGT-ENV-EMP-003	0	SCSB JV	01-August-2019
47	Unexpected Finds Protocol (Heritage) Revision 01, dated 27-May-2021	Appendix 3 - Reference Information	PKGT-GHD-PMT-ENV-PLN-0007	Port Kembla Gas Terminal Heritage Unexpected Finds Protocol Early Enabling Works	Project Number 2127477	1	GHD	01-May-2021
48	DPIE approval of above protocol, dated 29-May-2021	Appendix 3 - Reference Information	PKGT-AIE-FEED-1018					
49	Vegetation Clearing Procedure '(SCSB-AIE-PKGT-ENV-PRO-002)', Revision 0, dated 8 Aug 2019	Appendix 3 - Reference Information	PKGT-AIE-FEED-0579	Port Kembla Gas Terminal Rehabilitation Plan	SCSB-AIE-PKGT-ENV-PRO-002	0	SCSB JV	01-August-2019
50	Draft Spoil and Waste Management Plan '(SCSB-AIE-PKGT-ENV-EMP-007)', Revision H, dated 26 Mar 2021	Appendix 3 - Reference Information	PKGT-AIE-FEED-0572					
51	DPIE approval of appoint of experts for the preparation of the Emplacement Cell Report 'PKGT-DPIE-APP-205', dated 3 Dec 2019.	Appendix 3 - Reference Information	PKGT-AIE-FEED-1022	Appointment of Experts for Emplacement Cell Report Preparation	PKGT-DPIE-APP-205	-	NSW Department of Planning, Industry and Environment	01-December-2019
52	Dredging/Excavation General Arrangement	Appendix 3 - Reference Information	PKGT-AIE-FEED-0143.dwg	Dredge/Excavation General Arrangement	401010-01496-MA-DWG-1201	B	Worley Parsons	
53	Dredging/Excavation Sections Sheet 1	Appendix 3 - Reference Information	PKGT-AIE-FEED-0144.dwg	Dredge Cross Sections Sheet 1	401010-01496-MA-DWG-1202	A	Worley Parsons	
54	Dredging/Excavation Sections Sheet 2	Appendix 3 - Reference Information	PKGT-AIE-FEED-0145.dwg	Dredge Cross Sections Sheet 1	401010-01496-MA-DWG-1203	A	Worley Parsons	
55	Spoil Disposal General Arrangement	Appendix 3 - Reference Information	PKGT-AIE-FEED-0146.dwg	Spoil Disposal General Arrangement	401010-01496-MA-DWG-1210	A	Worley Parsons	
56	Spoil Disposal Typical Sections	Appendix 3 - Reference Information	PKGT-AIE-FEED-0147.dwg	Spoil Disposal Typocal Cross Sections	401010-01496-MA-DWG-1211	B	Worley Parsons	
57	Spoil Disposal Construction Sequence Plans - Sheet 1	Appendix 3 - Reference Information	PKGT-AIE-FEED-0148	Spoil Disposal Sequence Plans Sheet 1	401010-01496-MA-DWG-1212	B	Worley Parsons	
58	Spoil Disposal Construction Sequence Plans - Sheet 1	Appendix 3 - Reference Information	PKGT-AIE-FEED-0148.dwg	Spoil Disposal Sequence Plans Sheet 1	401010-01496-MA-DWG-1212	B	Worley Parsons	
59	Spoil Disposal Construction Sequence Plans - Sheet 2	Appendix 3 - Reference Information	PKGT-AIE-FEED-0149	Spoil Disposal Sequence Plans Sheet 2	401010-01496-MA-DWG-1215	B	Worley Parsons	
60	Spoil Disposal Construction Sequence Plans - Sheet 2	Appendix 3 - Reference Information	PKGT-AIE-FEED-0149.dwg	Spoil Disposal Sequence Plans Sheet 2	401010-01496-MA-DWG-1215	B	Worley Parsons	
61	Spoil Disposal Construction Sequence Typical Sections - Sheet 1	Appendix 3 - Reference Information	PKGT-AIE-FEED-0150	Spoil Disposal Sequence Sections Sheet 1	401010-01496-MA-DWG01214	B	Worley Parsons	
62	Spoil Disposal Construction Sequence Typical Sections - Sheet 1	Appendix 3 - Reference Information	PKGT-AIE-FEED-0150.dwg	Spoil Disposal Sequence Sections Sheet 1	401010-01496-MA-DWG01214	B	Worley Parsons	
63	Spoil Disposal Construction Sequence Typical Sections - Sheet 2	Appendix 3 - Reference Information	PKGT-AIE-FEED-0151	Spoil Disposal Sequence Sections Sheet 2	401010-01496-MA-DWG01213	B	Worley Parsons	
64	Spoil Disposal Construction Sequence Typical Sections - Sheet 2	Appendix 3 - Reference Information	PKGT-AIE-FEED-0151.dwg	Spoil Disposal Sequence Sections Sheet 2	401010-01496-MA-DWG01213	B	Worley Parsons	
65	Revetment General Arrangements	Appendix 3 - Reference Information	PKGT-AIE-FEED-0152.dwg	Revetment General Arrangements	401010-01496-MA-DWG-1301	C	Worley Parsons	

Document Reference Register for Port Kembla Gas Terminal Development - Emplacement Cell Design

Client	Australian Industrian Energy	Principal Contractor:	SMEC Australia
Project Name:	Port Kembla Gas Terminal Development - Emplacement Cell Design	SMEC Project Number:	30013015
Location:	Port Kembla Outer Harbour	Date:	31/01/2022

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No.	AIE Document Register Title	AIE Document Register Location	AIE Document Register Reference No.	File Document Title	File Reference No.	Revison	Author / Company	Date of Issue
66	Revetment Typical Cross Sections	Appendix 3 - Reference Information	PKGT-AIE-FEED-0153.dwg	Northern Revetment Typical Sections	401010-01496-MA-DWG-1303	B	Worley Parsons	
67	Revetment Typical Cross Sections	Appendix 3 - Reference Information	PKGT-AIE-FEED-0153.dwg	Southern Revetment Typical Sections	401010-01496-MA-DWG-1302	C	Worley Parsons	
68	Port Kembla Reclamation Clearance Survey May 2018.img	Appendix 3 - Reference Information	PKGT-AHS-BTH-CIV-DWG-0003	Port Kembla Reclamation Clearance Survey	Reclamation 0518	-	Port Authority of NSW	01-August-2018
69	Port Kembla Reclamation Clearance Survey May 2018	Appendix 3 - Reference Information	PKGT-AHS-BTH-CIV-DWG-0004	Port Kembla Reclamation Clearance Survey	Reclamation 0518	-	Port Authority of NSW	01-August-2018
70	Dredged Spoil Disposal Bund Memorandum (includes SLOPEW FoS output zip)	Appendix 3 - Reference Information	PKGT-AIE-FEED-0063	Dredged Soil Disposal Bund Geotechnical Slope Stability Assessment	401010-01496-GE-MEM-0003	B	Advisian	01-October-2018
71	Port Kembla Outer Harbour Reclamation, Phase 2 Factual and Interpretive Report SMEC (Phase 2 GSIR Rev3 Final combined)	Appendix 3 - Reference Information	PKGT-AIE-FEED-0609	Port Kembla Outer Harbour Reclamation Phase 2 Factual and Interpretive Report	3001792-Phse2-GSIR-Rev3	3	SMEC	01-May-2011
72	Outer Harbour Dredged Spoil Containment Area - Geotechnical Interpretative Report	Appendix 3 - Reference Information	PKGT-AIE-FEED-0474	Port Kembla Gas Terminal Geotechnical Investigation - Interpretive Report	401010-01496-MA-REP-1404	B	Worley Parsons	01-October-2018
73	NSW Government Project Approval_Stage 1 of Port Kembla Harbour Development_2011	Appendix 3 - Reference Information	PKGT-AIE-FEED-0635					
74	Port Kembla Borehole & Subbottom Profiler Data Summary - Additional Sediment Units across AIE Analysis Area	Appendix 3 - Reference Information	PKGT-AIE-FEED-0700					
75	Infrustructure Approval (Schedule 2 Administrative Conditions) Mod 2	Not Referenced in Document Register 070721						
76		Not Referenced in Document Register 070721	PKGT-AIE-Spoil_Management_Plan_Stage_1_27_05_2	Spoil Management Plan (Early Enabling Works)	Project Number 2127477	0	GHD	26-May-2021
77		Not Referenced in Document Register 070721		Environmental Impact Assessment	NA		GHD	05-November-2018
78		Not Referenced in Document Register 070721	SCSB-AIE-PKGT-ENV-EMP-008-ASSMP-RevD.pdf	Acid Sulfate Soils Management Plan	NA	D	SCSB JV	23-September-2020
79				Port Kembla Gas Terminal Dredged Emplacement Area - Expert Advice and Literature Review Acid Sulfate Soils	FEC200106AB-L002 Final	0	Fox Environmental Consulting	25-January-2022
80				Port Kembla Gas Terminal Berth 101 Dioxin Characterisation Assessment	2127477	0	GHD	22-December-2021
81				Targeted Site Investigation (Terminal Site) Berth 101, Port Kembla NSW	2127477	0	GHD	04-November-2021
82				Containment Cell Condition 8 (b) - supporting Commentary Supplement to Interim Audit Advice #11	2127477	0	GHD	23-November-2021

Appendix H Supplementary Design Report

Refer to ACONEX Document Register
Supplementary Design Report
PKGT-SMC-OHC-GEO-RPT-0011

Appendix I 56% Dredging Completion: Apparent Dredge Material Shortage

Refer to ACONEX Document Register
56% Dredging Completion: Apparent Dredge Material Shortage_Executive
PKGT-SMC-OHC-DRE-LET-0002

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