Appendix 6

Stuarts Point Sewerage Scheme – Effluent Transfer and Disposal Concept Design Report

GHD (2023)

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Stuarts Point Sewerage Scheme – Effluent Transfer and Disposal Design

Concept Design Report

Kempsey Shire Council

31 January 2023

→ The Power of Commitment

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Contents

Table index

Figure index

Appendices

1. Introduction

GHD Pty Ltd (GHD) has been engaged by Kempsey Shire Council (Council) to undertake the design of the effluent transfer and disposal system from the proposed Stuarts Point Wastewater Treatment Plant (WWTP) to a dunal disposal area on the eastern side of the Macleay Arm.

The project involves determining the preliminary size of the effluent transfer pipeline and establishing a preferred alignment from the WWTP through Stuarts Point to the dunal disposal area. A riser pipe has been proposed to bring the treated effluent from the effluent pipeline to the surface and a pipe network to distribute the effluent across the disposal site and discharge either directly on, or just below, the ground surface.

The conceptual design and environmental assessment for the effluent transfer pipeline and the dunal disposal at Stuarts Point will be used:

– For information, to be developed further in a proposed Design and Construct tender
– To support planning approvals and environmental assessment works

1.1 Purpose of this report

The report outlines the concept design for the proposed works. The purpose of this report is to:

– Document the key issues, constraints, and requirements for the concept design.
– Summarise the methodologies used to develop the concept design, including alternative solutions considered, and a brief narrative to justify selection of key details.
– Provide details of adopted design features.
– Identify key issues encountered throughout the concept design process.
– Provide information to allow key stakeholders to understand the key risks and opportunities, and to review, comment, and eventually endorse the concept design prior to detail design stage.

1.2 Scope and limitations

The scope of works for the concept design of the effluent transfer and disposal system includes the following components:

– Review of proposed alignment in conjunction with Before You Dig Australia (BYDA) services information and field survey data to determine the least constrained road sides along the alignment.
– Provide trenchless advice on the crossing of the Macleay Arm.
– Development of a ground profile (based off preferred alignment) between the WWTP and dunal disposal point.
– Development of a hydraulic grade line for the system based on the effluent disposal rate agreed upon with Council.
– Dunal disposal system.
– Concept design drawings and report.

This report: has been prepared by GHD for Kempsey Shire Council and may only be used and relied on by Kempsey Shire Council for the purpose agreed between GHD and Kempsey Shire Council as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Kempsey Shire Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

2. Background

2.1 Supporting documentation

The following supporting documentation was relied upon for the development of the concept design:

– Spatial data including cadastre, infrastructure, existing survey, and aerial imagery
– Stuarts Point Project Report - Topographic Survey of beach front parcel by drone-LiDAR and photogrammetry (Diospatial, 2022)
– Stuarts Point Sewerage System – Effluent Transfer and Disposal Design - Geotechnical Report (GHD, 2022)

2.2 Design information

The concept design of the effluent transfer pipeline is based on the following:

– Effluent disposal system battery limit at WWTP – GHD reference design team
– Effluent disposal rates (L/s) – GHD reference design team
– Survey confirmation of the road reserve/cadastre/services – previous GHD project stage
– Dunal disposal plan area- previous GHD groundwater project stage

2.3 Consultation

All consultation to date on this project with external stakeholders has been carried out by KSC.

2.4 Desktop location of services

GHD undertook a BYDA search for the project area on 8 July 2022. Existing services are shown in the design drawings. The following are the existing services within close proximity to the new effluent transfer pipeline alignment:

– Essential Energy low voltage (LV) underground cabling along Ocean Ave.
– Essential Energy underground earth or wire along Ocean Ave and Fourth Ave.
– Council watermain along Second Ave, Ocean Ave, and Fourth Ave.
– Telstra cables/conduits run adjacent to the pipeline for the majority of the route.

3. Site conditions

An overview of the site, including the proposed effluent transfer pipeline alignment, is provided in Figure 3.1.

Figure 3.1 Site over-view plan

3.1 Location and site survey

3.2 Significant features

The following site significant features are noted:

- The proposed alignment runs adjacent to several residences and Stuarts Point primary school.
- Several road crossings along the proposed alignment are required, trenched construction proposed.
- Very limited construction space along residential streets in Stuarts Point village.
- Significant number of services in proximity to proposed effluent transfer pipeline alignment.
- Current concept design involves a trenchless crossing of the Macleay Arm.
- Effluent disposal point in the dunal area on the eastern side of the Macleay Arm.
- A review of the Kempsey Shire Council LEP 2013 determined:
  - The section of alignment adjacent to the Stuarts Point WWTP site is in a Class 4 acid sulfate soil risk area.

- The section of alignment passing through the Stuarts Point village is in a Class 3 acid sulfate soil risk area.
- No heritage items or places (listed in Schedule 5) are within the vicinity of the proposed pipeline alignment.
- The entire Stuarts Point area is subject to a Koala Management Plan.

3.3 Flooding

No flood studies have been undertaken by GHD as part of the concept design phase. However, all structures are assumed to be submerged for long periods and should be designed to be stable under these conditions.

3.4 Groundwater

Groundwater monitoring was undertaken as part of the geotechnical investigations for this project. Findings from the groundwater monitoring are provided in Section 4 of this report.

3.5 Mine subsidence

The site is not located in a mine subsidence area.

3.6 Geotechnical investigations

Key findings from the geotechnical and geophysical investigations for the concept design are provided in Section 4 of this report.

4. Geotechnical and geophysical investigations

4.1 Geotechnical

Geotechnical investigations were undertaken by GHD on 26-27 May 2022 and 7 June 2022. The geotechnical investigation sites are presented in Figure 4.1. The Geotechnical Report prepared by GHD is provided in Appendix A.

Figure 4.1 Geotechnical Investigation Locations

4.1.1 Dunal disposal area

The geotechnical investigation at the dunal disposal area comprised the drilling of three boreholes, each to a depth of 6m.

The subsurface conditions at each borehole are described below:

– BH01 – loose to medium dense sand to 18 m depth, overlying very loose to loose sand
– BH02 – loose sand to 0.8 m depth, overlying medium dense sand
– BH03 – very loose to loose sand to 1.3 m depth, overlying medium dense sand

4.1.2 Transfer pipeline launch

The geotechnical investigation of the Macleay crossing launch site involved drilling one borehole to a depth of 20.28 m.

Subsurface conditions encountered at the proposed launch site (borehole BH04) comprised of poorly graded medium grained sand of marine origin. The results of the in-situ testing are described below:

– BH04 – loose to medium dense sand to a depth of 7.0 m, very dense sands below this.

The geotechnical report states that bore support is likely required if the proposed vertical alignment of the pipeline is to be located in sands where the likely support would be either casing or slurry of some description.

4.1.3 Groundwater

Groundwater was encountered at a depth of 0.8m in each of the boreholes at the dunal disposal area. Drilling techniques prevented groundwater being observed at the transfer pipeline launch site.

Groundwater piezometers were installed in each borehole at the site to monitor groundwater. Groundwater depth in the monitored wells was found to vary between 0.1-0.8m over the monitoring period.

4.2 Geophysical

The marine geophysical investigation of the proposed trenchless crossing site on the Macleay Arm was undertaken by GBG Group on behalf of GHD.

The investigation included Single Beam Echosounder (SBES), Sub-Bottom Profiling (SBP) and Marine Seismic Refraction in both Transition Zone and Continuous configurations. The Macleay Arm HDD Marine Geophysical Investigation Report is provided in Appendix B.

5. Design basis

Parameters for the design basis of the effluent transfer pipeline concept design were gathered from the following sources:

– Stuarts Point Sewerage Scheme Revised ETs ad Flows Technical Memorandum (GHD, 2019)
– Stuarts Point Sewerage Servicing Concept Design Report (Pressure System Solutions, 2021)
– Stuarts Point WWTP - Reference Design (GHD, 2022)

Projected 2038 (ultimate) flows were used to inform the effluent transfer pipeline design. Design basis parameters are provided in Table 5.1.

Table 5.1 Design Basis Parameters - Stuarts Point WWTP – Reference Design (GHD, 2022)

Parameter	Value	Source
Equivalent Tenements (off-peak)	1652 ET	Stuarts Point Sewerage Scheme Revised ETs and Flows Technical Memorandum (GHD, 2019)
Equivalent Tenements (holiday)	2283 ET	Stuarts Point Sewerage Scheme Revised ETs and Flows Technical Memorandum (GHD, 2019)
Flow contribution	164 kL/ET/year	Stuarts Point Sewerage Scheme Revised ETs and Flows Technical Memorandum (GHD, 2019)
AWDF (holiday)	11.89 L/s	Calculated from Stuarts Point Sewerage Servicing Concept Design Report (Pressure System Solutions, 2021)
PWWF: ADWF	5.0	5 x ADWF as per Stuarts Point Sewerage Servicing Concept Design Report (Pressure System Solutions, 2021)
PWWF (holiday)	73.56 L/s	Stuarts Point Sewerage Scheme Revised ETs and Flows Technical Memorandum (GHD, 2019). Q= AN + B, where Q is design flow in L/min, A is coefficient specified by bstsem supplier, typically 1.9. N=ET, B = a factor nominated by system supplier, typically 76.

Ultimate PWWF during holiday periods was adopted as the maximum flowrate the effluent transfer pipeline would be required to accommodate.

6. Concept design

Following a review of the survey and geotechnical information, the concept design development process involved resolution of the following key design elements:

– Horizontal and vertical pipeline alignments
– Pipeline material selection and sizing
– Hydraulics and flowrate
– Pipeline connection to Stuarts Point WWTP
– Design of pipework through residential area of Stuarts Point
– Design of road crossings within Stuarts Point village
– Design of trenchless crossing of the Macleay Arm
– Dunal disposal system
– Appurtenances (valves, scours, air valves, etc.)
– Access for maintenance
– Construction considerations

6.1 Pipeline alignment

6.1.1 Horizontal alignment

The horizontal alignment for the effluent transfer pipeline was determined based on the following considerations:

– Proximity to existing services
– Minimising need for vegetation clearance
– Minimising impact on residents during construction
– Minimising hydraulic losses throughout the system

The alignment commences on the southern side of the Stuarts Point WWTP site, extending west before turning north and continuing along the fire trail (Boundary Trail) towards Stuarts Point village. The pipeline continues north along the entire length of Second Ave, before being transferring west onto Ocean Ave. The alignment turns north onto Fourth Ave, continuing along the western edge of the Stuarts Point sports fields. The pipeline then is directed east onto Walter Conn Rd, before crossing to the eastern side of Marine Pde and heading north towards the trenchless launch site on the western bank of the Macleay Arm. The alignment includes several road crossings within the Stuarts Point village.

6.1.2 Vertical alignment

The key considerations for the vertical alignment were maintaining minimum vertical clearance from existing services and ensuring minimum surface cover is maintained along the entire alignment. The minimum depths of pipe cover as specified in WSA 03-2011-3.1 are provided in Table 6.1.

Table 6.1 Minimum depths of pipe cover

Location	Minimum Cover (mm)
Non-trafficable areas	
– General (parks, footways, easements, etc.)	450
– Driveways in residential areas	450
– Footways in local road reserves	450
Trafficable areas	
– Carriageways and verges of sealed local roads	600

6.2 Pipe size and material selection

The effluent transfer pipeline was sized to accommodate a flowrate of 74L/s. The pipe size was determined with the consideration of achieving the optimal flow velocity between 0.8-1.4m/s as specified in WSA 03-2011-3.1 (Water Supply Code).

Varying HDPE sizes were investigated for a flowrate of 74L/s, and it was determined that a DN315 HDPE was the most suitable option.

DN315 HDPE pipe has an internal diameter of 256.3 mm and at a flowrate of 74L/s achieves a flow velocity of 1.43m/s, whilst balancing the friction loss and over system head requirements, refer Section 7.

HDPE PE100 PN16 was selected for the effluent transfer pipeline due to the spatial constraints that are present along the proposed alignment (existing services, driveways, overhead power/poles, restricting construction corridor in some locations). The number of services along the proposed alignment make the inclusion of thrust blocks associated with other pipe materials (e.g. DICL, PVC-U) extremely difficult.

PE pipe is considered a suitable option for this project as it offers the advantage of welded construction and bends (without thrust blocks). PE is chemically resistant to potentially aggressive soils (not relevant to this site), and is naturally flexible, durable, and cost efficient.

6.3 Trenchless crossing (Macleay Arm)

The preliminary concept design for the trenchless crossing of the Macleay Arm was undertaken by Underbore Solutions on behalf of GHD. The trenchless crossing design undertaken by Underbore Solutions was based on the subsurface conditions that were encountered in the geotechnical investigation undertaken by GHD. The most suitable trenchless technique for the pipeline crossing of the Macleay Arm has been determined by Underbore Solutions to be horizontal directional drilling (HDD) dense sand layer just above the estimated depth of rock with Underbore Solutions noting that:

– This can be difficult soil medium for drilling through especially with very low N values shown, though it is still suitable for HDD and can be managed with suitable drilling fluids and experienced contractors.
– To limit the risk of fracout an underbore of at least 10m below the riverbed in the dense to very dense sands is likely to be suitable. An indicative profile in the concept design shows an underbore which could be achievable below Macleay Arm.
– The option to drill deeper (15m+) below the river was briefly looked at and likely will further limit the risk of fracout and settlement by encountering the potentially stiffer ground conditions shown in the Seismic Analysis though this may also encounter gravels or cobbles in the layers above the rock. The drilling between the softer and hard materials may also then require casing pipes to limit the potential for fracout at the sand rock interface.

The proposed trenchless crossing of the Macleay is a 450 m section of pipe, divided into the following segments (west to east):

– 15.52m straight section at the HDD entry
– 109.2m arc length
– 214.58 m straight section
– 109.2m arc length
– 4.95m straight section at HDD exit into dunal disposal area

Please refer to the preliminary assessment report of the HDD analysis for the Macleay Arm crossing completed by Underbore Solutions provided in Appendix C for further details.

6.4 Appurtenances (valves, scours, air valves, etc.)

Air valves are to be located at high points of the alignment to assist venting air in and out of the effluent transfer pipeline.

Scour valves will be included generally at the low points along the pipeline for draining down during maintenance or to repair main breaks. It is proposed that the scours will be pump out, however further investigations may identify that these may not be required.

All isolation valves to be gate valves installed in accordance with WSA 03 specifications. Isolation valves are to be located at a maximum 2 km apart as per WSAA guidelines for distribution mains (WSA 03-2011-3.1). Closer valve spacings may be required near road crossings or other points of interest. Isolation valves are to be located on the upstream and downstream sides of the Macleay Arm trenchless crossing.

6.5 Dunal disposal area

The effluent transfer pipeline is to discharge in the dunal disposal area on the eastern side of the Macleay Arm. A drone-based survey over the proposed dunal disposal area was undertaken by Diospatial on 20 September 2022. The data capture included aerial imagery, drone LiDAR and GNSS ground control survey. The Stuarts Point Survey Report from Diospatial is provided in Appendix D. This data was used to assist with the exit location of the trenchless section crossing the Macleay Arm.

Similar to the arrangement at South West Rocks, which Council has advised meets the required purpose, it is proposed that the effluent transfer pipeline will tee into two smaller lines with the disposal area to distribute the flow. These lines will then tee again to achieve 3 discharge points on each line (3 in total). A preliminary sketch of the arrangement from the South West Rocks site is provided in Figure 6.1.

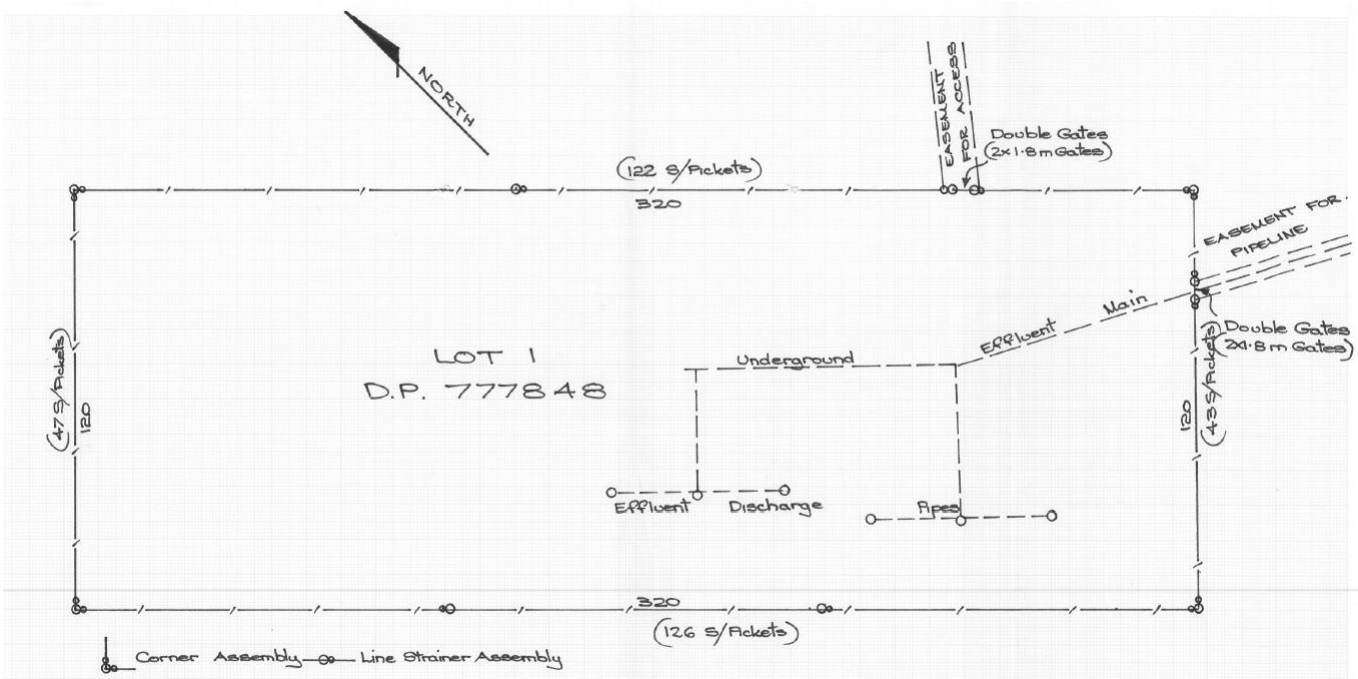

Figure 6.1 South West Rocks - Effluent Discharge System Arrangement

A short section of riser pipe will bring effluent to the surface where it discharges directly on a small area of riprap before flowing onto the ground. This discharge system is similar to the nearby existing South West Rocks effluent discharge area. The South West Rocks effluent discharge system is shown in Figure 6.2.

Figure 6.2 South West Rocks Effluent Discharge Pipe

Vehicle access to the dunal disposal site is from Stuarts Point beach. Vehicles can enter the beach via the access track off Reserve Road approximately 2.1km north of the proposed dunal disposal area. Pedestrian access to the site is available via the public footbridge. The footbridge is located approximately 700m south of the Macleay Arm pipeline crossing. On the eastern side of the footbridge, a walking track provides access to the beach which can be used to walk to the dunal disposal site to avoid walking through dense vegetation in the sand dunes.

Site security is achieved by fencing around the treated effluent discharge points. Similar to the South West Rocks site, fencing around the Stuarts Point treated effluent discharge point is to comprise of timber posts with plain connecting wires. A fenced area of approximately 8m x 12m is sufficient to ensure a minimum of 2m clearance from the discharge pipework and riser pipes to the fence line to allow for maintenance work. The size of this fenced area can be adjusted at the discretion of Council. A larger fenced area may be suitable if the design preference is for vehicles to be able to access all sides of the riser pipe and other discharge pipework. A double gate (2 x 1.8m) will provide access to the dunal discharge location from the access easement. Appropriate signage shall be installed along the fence line to indicate that no unauthorised access to the dunal disposal point is permitted.

Vegetation clearing will be required to establish the construction site and develop an access track from Stuarts Point beach. The construction contractor is to minimise vegetation clearing to just the construction boundary at the dunal disposal point. Post construction, routine clearing of the access track will be required to ensure the site can be access at all times by Council vehicles for maintenance of the discharge pipework and valving.

7. Hydraulics

7.1 Hydraulic grade line

A hydraulic grade line was developed for the effluent transfer pipeline using the proposed pipeline alignment. For the purpose of this calculation, it was assumed the pipeline remains at the minimum 600 mm below the existing surface level along the entire alignment as per WSAA requirements for trafficable carriage ways and verges of sealed roads.

It is noted that the vertical alignment will not follow the surface level and minimum cover depth for the entire alignment however for the purpose of simplicity at the concept design level this profile has been adopted for the pipeline in the hydraulic calculations. Greater pipeline depths than are shown are likely required for the crossing of the Macleay arm however this has also not been considered for the hydraulic grade line development noting that this does not affect the elevation at the discharge location. The hydraulic grade line for the effluent transfer pipeline is provided in Figure 7.1.

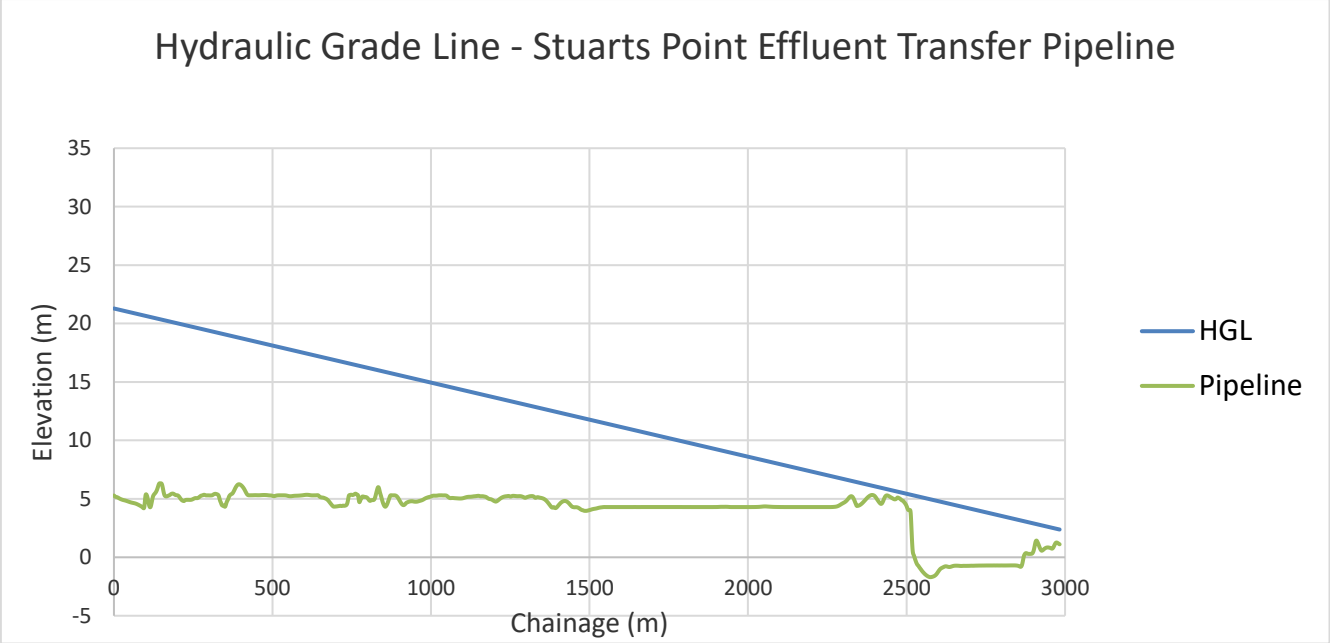

Figure 7.1 Hydraulic Grade Line

It was calculated that to provide a flowrate of 74L/s, approximately 22 m head is required to overcome static head and friction losses throughout the pipeline. Pressure head requirements for the effluent transfer pipeline system are subject to minor changes depending on the final location of the dunal disposal point at the discharge end of the pipeline.

7.2 System curves

A system curve for the proposed effluent transfer pipeline was developed by the design team to pressure head requirements at the design effluent disposal rate of 74L/s. For the purpose of the system curve development, it was assumed effluent would be stored in a small tank prior to pumping, with a difference between top and bottom water level of 2 m.

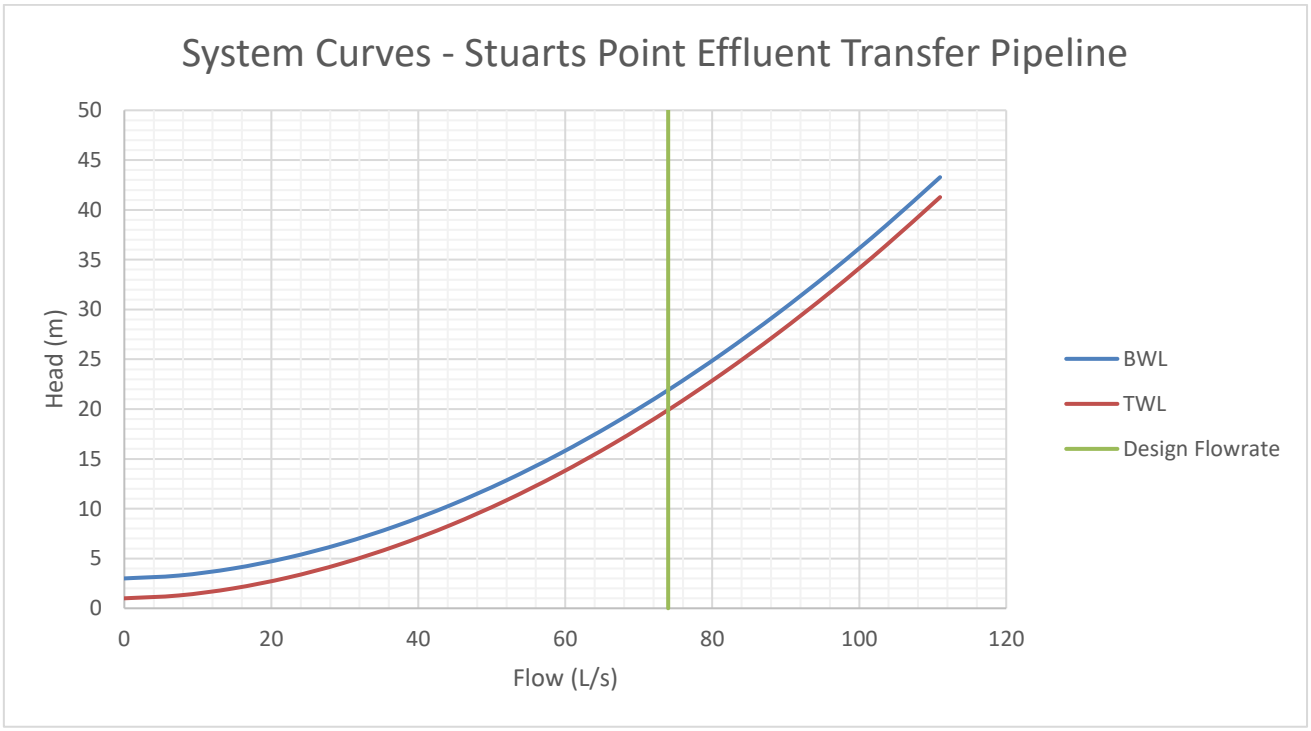

Figure 7.2 Stuarts Point Effluent Transfer Pipeline – System Curve

System curve calculations support the results of the hydraulic grade line development, with a pressure of approximately 22 m required to overcome static head and friction losses at a flowrate of 74L/s.

8. Safety in Design

Safety in design (SiD) was considered throughout the development of the Concept Design. Whilst the pipe installation (via trenching methods) is standard practice, the locations, site constraints and construction needs to be considered. It is anticipated that the following key issues will apply:

– Working adjacent to existing live services
– Trenched construction hazards
– Traffic Management, site traffic and turn off arrangements from small roads and road closures

The preliminary SiD register is included in Appendix E.

Appendices

Appendix A

Geotechnical Report

Stuarts Point Sewerage System – Effluent Transfer and Disposal Design

Geotechnical Report

Kempsey Shire Council

31 August 2022

→ **The Power of Commitment**

Project name		SPSS - Effluent transfer and disposal design and investigations					
Document title		Stuarts Point Sewerage System – Effluent Transfer and Disposal Design | Geotechnical Report					
Project number		12551313					
File name		12551313_REP-SPSS- Euffluent transfer and disposal design- Geotechnical Report.docx					
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Contents

Table index

Figure index

Appendices

1. Introduction

GHD was engaged by Kempsey Shire Council (KSC) to undertake a conceptual design, environmental assessment and geotechnical/geophysical investigation for the proposed effluent transfer infrastructure and dunal discharge at Stuarts Point, NSW. The work was commissioned on the basis of GHD's proposal dated June 2022 (ref. 12551313-FEE_1_SPSS Effluent Transfer & Disposal Design and Investigation_Cost Estimate-Jun2022).

The proposed transfer infrastructure is understood to comprise a pipeline crossing of the Macleay Arm to a disposal area located on the vegetated dunes adjacent to Stuarts Point Beach. The pipeline is proposed to be installed using trenchless technology.

This report presents the results of the geotechnical investigation and geophysical survey that were undertaken to assess the subsurface conditions along the proposed trenchless crossing alignment and provide information to assist the concept design.

This report should be read in conjunction with the General Notes provided in Appendix B.

1.1 Assumptions and limitations

This report has been prepared by GHD for Kempsey Shire Council and may only be used and relied on by Kempsey Shire Council for the purpose agreed between GHD and Kempsey Shire Council as set out in Section 1of this report.

GHD otherwise disclaims responsibility to any person other than Kempsey Shire Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on:

– Conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.
– Assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.
– Information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Site setting

2.1 Site description

The proposed transfer pipeline site is located on the NSW Mid North Coast approximately 10 km north-west of South West Rocks.

The proposed development and site surrounds comprise:

– An effluent transfer pipeline launch site located on the corner of Kimpton Street and Marine Parade that consists of a relatively small, cleared area bound by dense vegetation to the north and the Macleay Arm to the east.
– An approximate east-west aligned, 450 m long transfer pipeline beneath the Macleay Arm. At the pipeline location, the Macleay Arm comprises a relatively shallow (up to 4.5 m deep) brackish water body approximately 350 m wide.
– A thickly vegetated dunal discharge area located between the Macleay Arm and Stuarts Point Beach.

Refer to Figure 2.1 below for the site location and Figure 1 in Appendix A for the proposed transfer pipeline alignment.

Figure 2.1 Site location (source: Google Earth)

2.2 Regional geology

Reference to the NSW seamless geology mapping (minview.geoscience.nsw.gov.au, version 2022.8.3) shows the launch site and Macleay Arm are underlain by Holocene aged 'coastal deposits – beach ridge' (QP_br) and 'estuarine channel deposits' (QH_ecw) which are described to typically comprise fine to coarse grained quartz-lithic-carbonate marine deposited sand, with shell and shell-fragment-rich beds and polymictic gravel. The disposal area is underlain by a 'coastal deposits - dune facies' (QH_bd) which comprise reworked sand dunes. An excerpt of the mapped geology with the proposed pipeline alignment overlaid is shown in Figure 2.2.

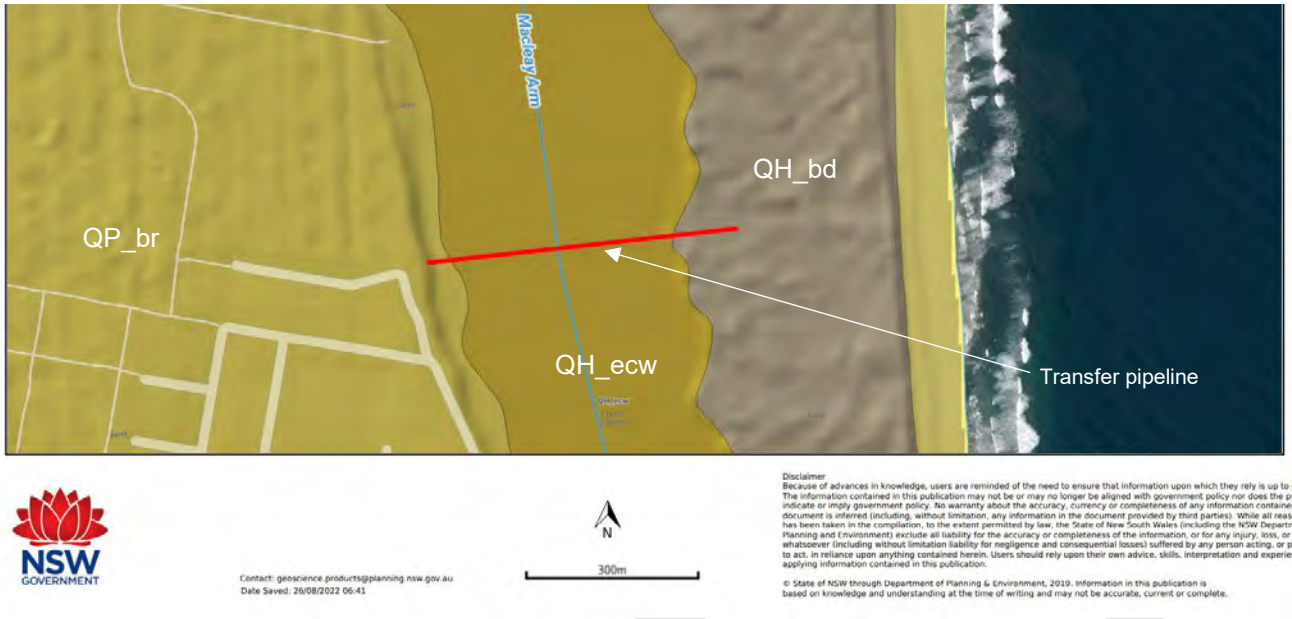


Figure 2.2 NSW seamless geology (source Minview)

2.3 Acid sulfate soil

Reference to the acid sulfate soil (ASS) mapping accessed via eSpade v2.2 (https://www.environment.nsw.gov.au/espade2webapp) shows the launch site and dunal disposal area sites have a low probability of occurrence of ASS materials.

The Macleay Arm is mapped with a high probability of occurrence of ASS materials at/near the ground surface or associated with bottom sediments.

3. Fieldwork methodology

3.1 Preliminaries

A 'Dial Before You Dig' buried services enquiry was made for the proposed site and obtained plans indicated the presence of underground utilities. To manage the risks of underground services, an accredited services locator was engaged to locate nearby services and clear the proposed borehole locations.

A Health, Safety and Environment (HSE) Plan, including a Job Safety and Environment Analysis (JSEA) and reviewed subcontractor Safe Work Method Statements (SWMS), was prepared and approved prior to conducting the fieldwork. All project site staff were inducted in to the HSE Plan prior to commencing fieldwork by the GHD supervisor, who also conducted daily pre-work safety assessments.

3.2 Geotechnical investigation

The geotechnical investigation fieldwork for the disposal area was undertaken on 26 May 2022 and 27 May 2022 and comprised the drilling of three (3) boreholes (BH01 to BH03) each to a depth of 6 m. Investigation of the launch site was undertaken on 7 June 2022 and comprised drilling one (1) borehole (BH04) to 20.28 m depth.

The boreholes were drilled with a track mounted geotechnical drilling rig using solid flight auger and rotary washbore drilling techniques. Standard Penetration Tests (SPTs) were undertaken at shallow depths less than 2.5 m in borehole BH01 to BH03 and regular depth intervals in BH04 to provide an assessment of the relative soil density. Boreholes BH01 to BH03 were supplemented with Dynamic Cone Penetrometer (DCP) tests (DCP01 to DCP03) completed to depths between 1.23 m and 2.4 m to provide additional assessment of the relative soil density.

At the completion of drilling, the boreholes were converted to groundwater piezometers. Piezometers were installed to 5.5 m depth in boreholes BH01 to BH03 and to 8.0 m depth in borehole BH04. A water level data logged was installed in the BH01 piezometer.

The fieldwork was supervised by an experienced GHD engineering geologist, who was responsible for locating the boreholes, logging the encountered strata, nominating in-situ testing and collecting representative samples for laboratory testing. The logging was carried out in accordance with Australian Standard *AS1726-2017, Geotechnical site investigations*.

The borehole log sheets are provided in Appendix C, while the DCP report sheets are provided in Appendix D. The logs and DCP report sheets should be read in conjunction with the attached Standard Sheets in Appendix B which explain the terms, abbreviations and symbols used together with the interpretations and limitations of the logging procedure.

3.3 Geophysical survey

The geophysical survey was undertaken between 12 July 2022 and 14 July 2022 by GBG Australia Pty Ltd and comprised a single marine seismic refraction survey line of 256 m length. Bathymetry data was collected along the survey line to aid in refraction processing. The survey comprised of:

– Single beam echosounder bathymetry
– Sub-bottom profiling
– Continuous marine refraction
– Transition zone refraction

The coverage of the survey is shown in Figure 3.1.

The geophysical report is provided in Appendix F.

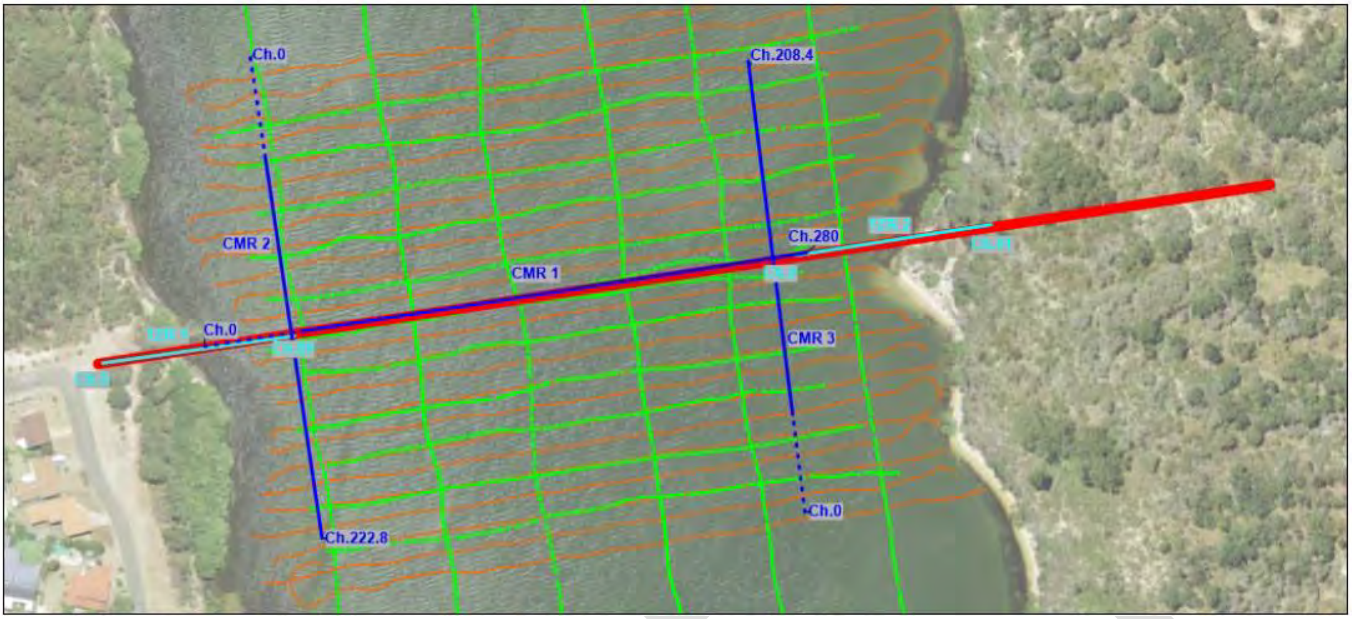


Figure 3.1 ***Coverage of the geophysical survey comprising sub-bottom profiling (green), single beam echosounder bathymetry (orange), continuous marine refraction (blue) and transition zone refraction (light blue) techniques. The proposed pipeline alignment is shown in red.***

3.4 Laboratory testing

Samples collected during the borehole drilling where sent to the NATA registered Macquarie Geotechnical laboratory for geotechnical testing and to NATA accredited Eurofins Environment Testing Australia for analytical testing.

The testing undertaken comprised:

- Seven (7) Particle size distribution tests
- Two (2) Soil aggressivity (pH, electrical conductivity, sulfate, chloride) tests
- Ten (10) ASS field screening tests
- One (1) Chromium reducible sulfur test

4. Subsurface conditions

4.1 Subsurface profiles

Reference to the borehole logs (Appendix C) should be made for a more detailed description of the subsurface conditions encountered at each test location.

4.1.1 Dunal disposal area

In general terms, the proposed disposal area (boreholes BH01 to BH03) comprised poorly graded medium grained sand of aeolian origin.

The encountered sand profiles were of variable density and comprised:

– BH01 – loose to medium dense sand to 1.8 m depth, overlying very loose to loose sand.
– BH02 – loose sand to 0.8 m depth, overlying medium dense sand.
– BH03 – very loose to loose sand to 1.3 m depth, overlying medium dense sand.

4.1.2 Transfer pipeline launch and alignment

Subsurface conditions encountered at the proposed launch site (borehole BH04) comprised poorly graded medium grained sand of marine origin. In-situ testing indicated the sands were loose to medium dense to a depth of 7.0 m, below which sands were very dense.

Subsurface conditions interpreted along the proposed pipeline crossing of the Macleay Arm (based on the geophysical survey) include:

– Medium dense sand to around RL -5 m AHD (about 2 m to 5 m below the floor of the Macleay Arm); overlying,
– Dense or better sand.

Based on geophysical sub-bottom profiling (SBP) survey, a reflector was noted between RL -18 m and -24 m AHD (approximately 23 m to 29 m below the ground surface of BH04), coinciding with seismic refraction velocities of 1800 m/s to 2200 m/s which are typically associated with rock materials. However, this seismic refraction velocity range reduces in level to around RL -11 m AHD (about 16 m depth below the ground surface at BH04) near the proposed launch site and based on the logged BH04 profile, both the seismic reflector and high velocities are inferred to correlate with very dense sand.

4.2 Groundwater

At the time of drilling groundwater was encountered at 0.8 m in each of the dunal discharge boreholes (BH01 to BH03), while drilling techniques prevented groundwater conditions from being observed in borehole BH04 located at the launch site.

Upon completion of drilling, groundwater piezometers were installed in each borehole. A groundwater level logger was installed in BH01 on 1 July 2022 (approximately one month after drilling) to measure changes in groundwater level over time. Recorded groundwater levels are shown in Figure 4.1 to have fluctuated between about 0.1 m and 0.8 m depth over the month of July 2022.

The weather station at Nambucca Heads recorded 222 mm of rainfall between 6 July 2022 and 7 July 2022 and then periods of relatively minor rainfall (i.e. < 20 mm) on several occasions up to the end of the month that align with increases in groundwater level. Logger data also indicates a minor tidal influence on groundwater levels of approximately 10 mm (low to high tide).

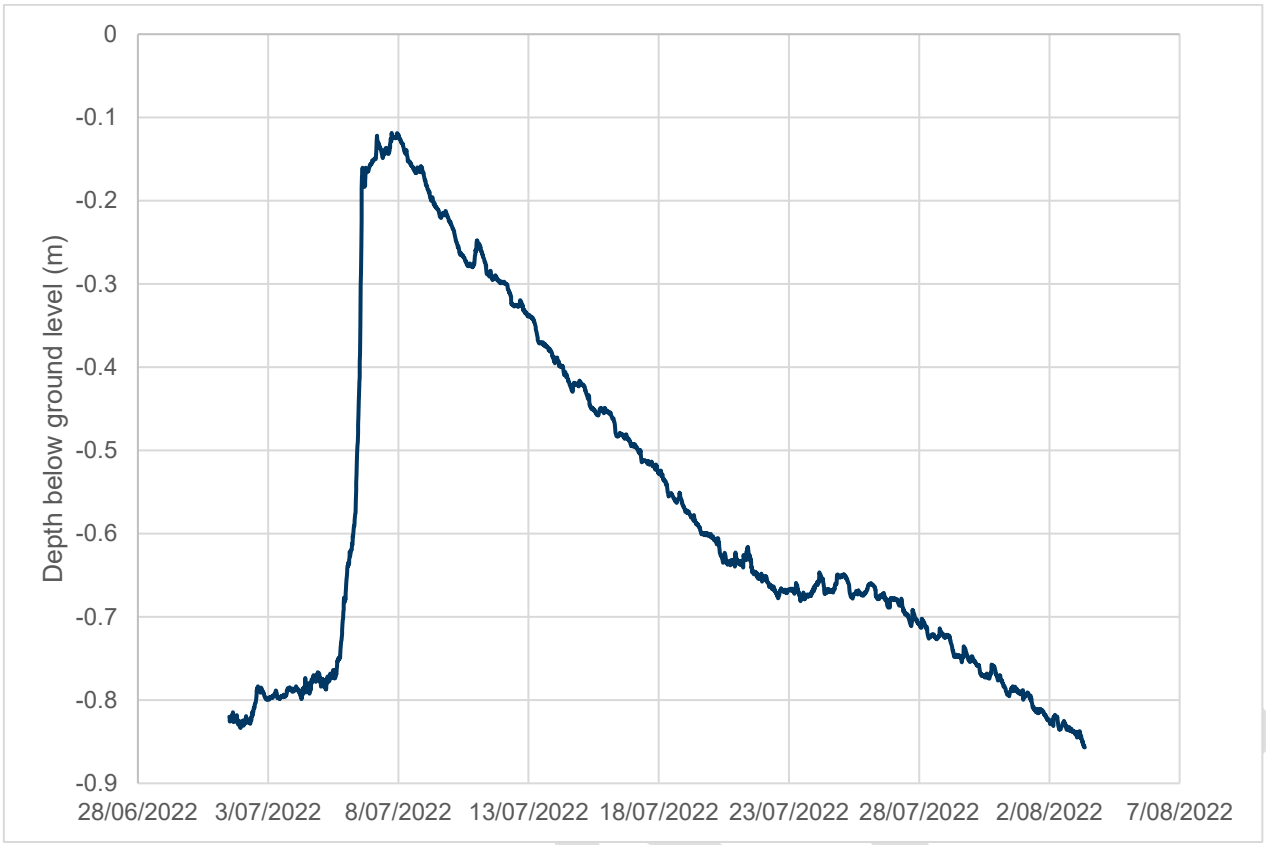


Figure 4.1 BH01 groundwater levels

5. Laboratory test results

Laboratory classification and characterisation testing was undertaken on selected soil samples recovered from the boreholes. The laboratory test reports are presented in Appendix E and the test results are summarised in the following sub-sections.

5.1 Geotechnical classification tests

Particle size distribution tests were undertaken on selected samples, the results of which are summarised in Table 5.1

Table 5.1 Summary of particle size distribution test results

Sample location	Sample depth (m)	Material description	Fines (% < 0.075 mm)	Sand (% 0.075–2.36 mm)	Gravel (%>2.36 mm)
BH01	1.0-1.45	SAND, aeolian	4	96	0
BH01	4.50-4.95	SAND, aeolian	8	92	0
BH02	1.0-1.45	SAND, aeolian	3	97	0
BH02	4.5-4.95	SAND, aeolian	7	93	0
BH03	4.5-4.95	SAND, aeolian	4	96	0
BH04	1.0-1.45	SAND, marine	1	99	0
BH04	4.0-4.5	SAND, marine	1	99	0

Particle size distribution results indicate that sand deposits comprise predominantly medium grained sand sized particles with trace amount of silt/clay.

5.2 Soil aggressivity tests

Two samples were submitted to Eurofins for a suite of soil aggressivity tests. The results are summarised in Table 5.2.

Table 5.2 Soil aggressivity test results

Sample location	Sample depth (m)	Material description	pH	Resistivity (Ohm.cm)	Chloride (mg/kg)	Sulfate (mg/kg)
BH01	1.0	SAND, aeolian	8.1	17000	<10	<30
BH02	4.5	SAND, aeolian	7.9	7800	<10	<30

Discussion relating to these soil aggression test results and associated exposure classifications is provided in Section 6.2.

5.3 Acid sulfate soils test results

Initial screening for actual and potential ASS using methods contained in the *Acid Sulfate Soils Management Advisory Committee (ASSMAC) Assessment Guidelines* (1998) was undertaken on selected soil samples. The ASS screening test results are summarised below in Table 5.3.

Table 5.3 Acid sulfate soil field indicator test results

Sample location	Sample depth (m)	Material description	pH $_F$	pH $_{FOX}$	Reaction rate
BH01	0.5	SAND, aeolian	6.0	3.6	2
BH01	2.0	SAND, aeolian	9.4	7.9	4
BH02	1.0	SAND, aeolian	6.5	3.0	3
BH02	3.0	SAND, aeolian	9.4	7.6	2
BH02	6.0	SAND, aeolian	9.3	7.7	2
BH03	0.0	SAND, aeolian	5.9	3.4	2
BH03	3.0	SAND, aeolian	9.2	7.5	1
BH03	6.0	SAND, aeolian	9.0	7.5	2
BH04	1.0	SAND, marine	5.6	3.2	1
BH04	2.5	SAND, marine	6.4	4.9	1

Where laboratory assessed reaction rate values correspond to the following:
1. "No reaction to slight"
2. "Moderate reaction"
3. "Strong reaction with persistent froth"
4. "Extreme reaction"

Positive indicators for the above test method include:

– pH $_F$ readings of =< 4, which suggest the presence of Actual Acid Sulfate Soils (AASS). pH values > 4 and < 5.5 suggest acidic soils but are not confirmatory of AASS.
– pH $_{FOX}$ < 3.5, which suggests the presence of potential acid sulfate soil (PASS). Other indicators for PASS from the oxidation component of the tests include a significant reaction rate (e.g. effervescence) and a lowering of pH from pH $_F$ following oxidation by more than one unit.

From the above results:

– None of the tested samples suggest the presence of AASS.
– All of the samples tested may be considered PASS, with three samples recording a pH $_{FOX}$ < 3.5 and the samples recorded a lowering of pH from pH $_F$ between 1.5 and 3.5. Further, seven (7) of the ten (10) samples were noted as having a moderate or greater reaction when exposed to hydrogen peroxide.

To confirm the presence of acid sulfate soils, chromium reducible sulfur (SCr) laboratory testing was conducted on the sample from BH01 at 0.5 m due to the depth of sample in relation to the proposed dunal discharge development, and the high recorded drop in pH between field and oxidised results. The results of this testing is shown below in Table 5.4.

Table 5.4 Chromium reducible sulfur test results

Sample location	Sample depth (m)	Material description	Chromium reducible sulfur (% S)	a-chromium reducible sulfur (mol H+/t)	Approximate Liming rate (kg/t)
BH01	0.5	SAND: aeolian	<0.02	<10	<1

Further discussion relating to ASS is provided in Section 6.3.

6. Discussion

6.1 Trenchless crossing

6.1.1 Trenchless elevation profile

The trenchless method and vertical alignment should be designed by an experienced trenchless contractor to ensure grades can be achieved, practical set up areas and setback distances are available, bore lengths are suitable, an appropriate overburden depth is achieved and clearance to underground utilities can be maintained. From a geotechnical perspective, the following constraints are noted:

- The Macleay Arm crossing comprises horizontal beds of sand that generally increase in strength with depth, including interpreted medium dense material at the surface (corresponding with a seismic velocity from 700 m/s) and dense to very dense material from around RL -5 m AHD (corresponding with seismic velocities greater than 1,500 m/s).
- The apparent horizontal layering becomes slightly less uniform towards both the eastern and western margin of the Macleay Arm, potentially indicating the presence of bar deposits or shell beds.
- The profile encountered in borehole BH04 indicates the interpreted rock levels in the GBG report (refer to Appendix F) may represent a velocity contrast between very dense sands and less dense material
- Sands that generally increase in density with depth are expected to be encountered where the proposed trenchless section is shallower than about RL -18 m AHD. Very dense sands or possibly rock are expected to be encountered below this level.
- Bores in sand will collapse if unsupported. For this reason, a suitable trenchless technique that includes bore support (e.g. casing) should be adopted.
- Sand may flow into the bore during construction. If this were to occur, the volume of sand removed from the bore could exceed the bore volume by many times in a particular location, leading to creation of a void which could migrate toward the Macleay Arm bed resulting in a blow-out of drilling mud into the water body.
- Based on the geophysical interpretation, a pocket of dense to very dense sand between about -1.4 m AHD and -4.9 m AHD may be expected beneath the eastern bank.

6.1.2 Entry and exit pit locations

The entry and exit pits are generally expected to be short trenches up to about 1 m deep to transition from the surface into the underbore. Temporary excavations should satisfy the requirements of relevant workplace health and safety legislation, including the Safe Work Australia, *Excavation Work – Code of Practice*, January 2020 or latest version. As such, people and equipment would not be in the pits.

The entry (west) and exit (east) pits are expected to be predominantly in loose medium grained sand. Groundwater was encountered at 0.8. m depth around the proposed exit pit and is expected to be approximately sea level at the proposed entry pit. Higher groundwater levels are expected in response to rainfall and to a lesser extent ides as indicated with the groundwater data logging in BH01.

Excavation at the pit locations is expected to be achievable using conventional earthmoving equipment such as excavators. Given the subsurface conditions comprise cohesionless sand, excavation faces are unlikely to be self-supporting above the water table for any reliable duration and collapsing/flowing sand soils are likely beneath the water table. Excavation of pits below groundwater or to depths to which groundwater could rise must take into consideration excavation stability and the need for dewatering and shoring. As the trenchless pits are expected to be less than 1 m deep, recommendations for dewatering and shoring are not provided.

Based on the presence of very loose and loose near surface conditions at and around the dunal disposal area, poor trafficability may be expected and suitable plant should be selected and / or temporary access measures (e.g. bog mats) should be considered for works proposed in this area.

6.2 Exposure classification for buried concrete and steel

Exposure classifications for buried steel and concrete elements based on the test results were assessed in accordance with Australian Standard *AS2159-2009, Piling – Design and Installation*.

The laboratory test results correspond to an exposure classification of 'mild' for buried concrete and 'non-aggressive' for buried steel elements based on Table 6.4.2(C) and Table 6.5.2(C) of *AS2159-2009*.

Buried steel or concrete exposed to seawater should be designed for a 'severe' exposure classification.

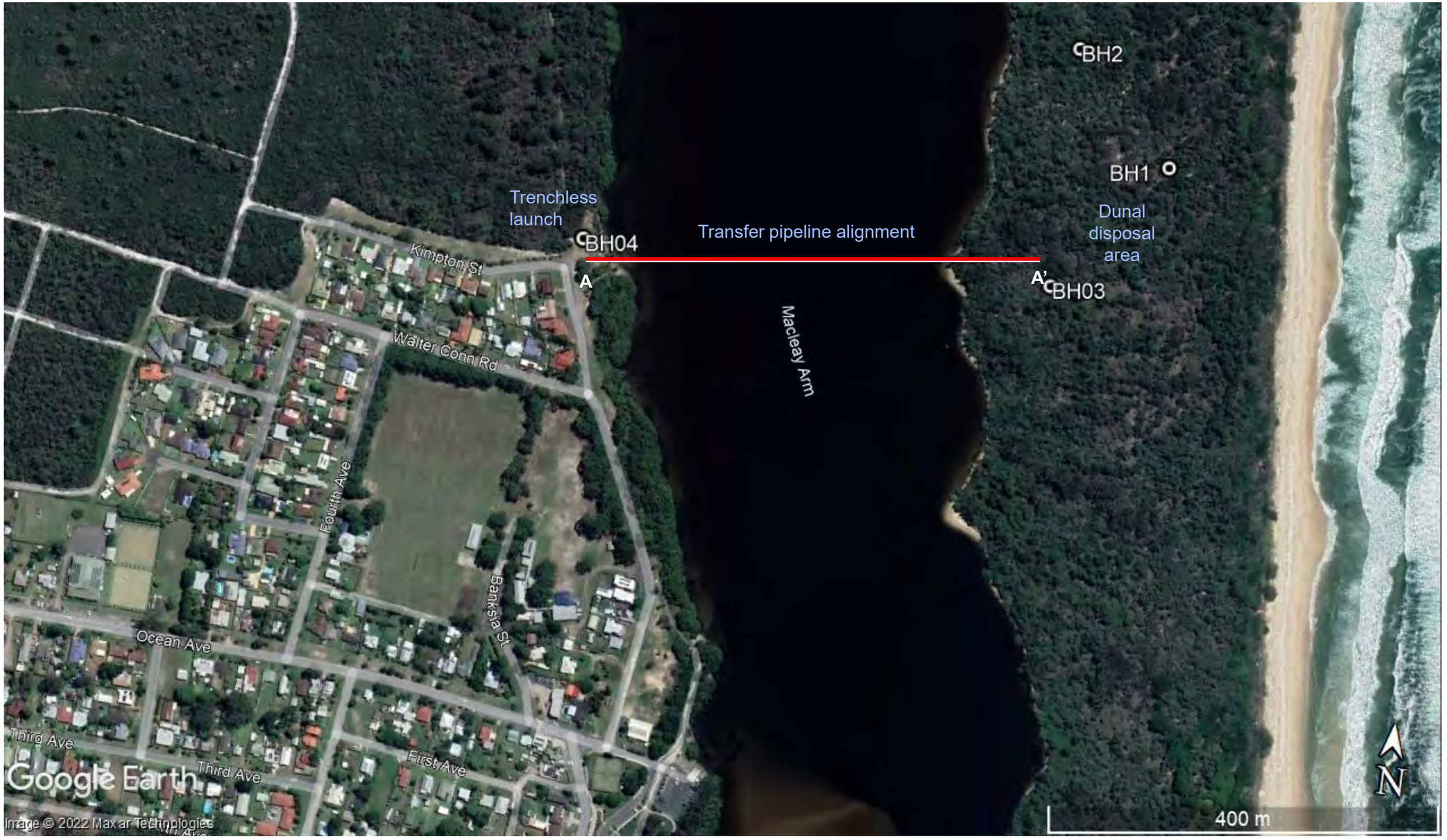
6.3 Management of acid sulfate soils

Acid sulfate soils encountered by the underbore will be buffered by the bentonite drilling muds used and so are not expected to require consideration in an ASS management plan. This expectation should be confirmed with the trenchless contractor.

Based on the ASS chromium reducible sulfur laboratory test result from BH03, the ASSMAC criteria has not been exceeded indicating an ASS management plan will not be required for other areas of the project. However, as the project area is in an area indicative of ASS, it is recommended that mitigation measures such as developing sampling and testing requirements for excavations be considered where soils of estuarine, aeolian or marine origin are encountered.

Appendix A

Figures



Kempsey Shire Council
Stuarts Point Transfer Pipeline Geotechnical Investigation
Borehole Location Plan

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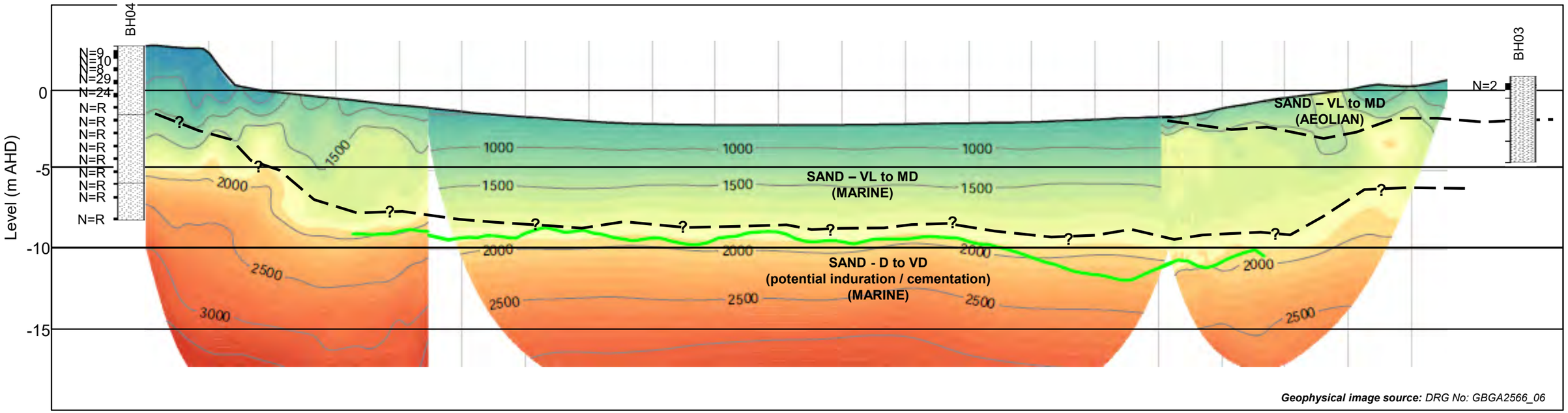
Figure 1

W E



LEGEND

BH04 — Geotechnical borehole

Sand

Interpreted SBP reflector

N=8 — SPT N number

Inferred boundary

P-Wave Velocity (m/s): 3600, 3400, 3200, 3000, 2800, 2600, 2400, 2200, 2000, 1800, 1600, 1400, 1200, 1000, 800, 600, 400, 200, 0

DISCLAIMER

This long –section includes inferred unit boundaries. These are interpretations and highly uncertain and may not represent actual sub-surface conditions

Kempsey Shire Council

Stuarts Point Transfer Pipeline Geotechnical Investigation

Geological Long Section A – A'

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Figure 2

Appendix B

Standard sheets

GENERAL NOTES

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The report contains the results of a geotechnical investigation or study conducted for a specific purpose and client. The results may not be used or relied on by other parties, or used for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the report are excluded unless they are expressly stated to apply in the report.

TEST HOLE LOGGING

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information. Moreover, the location of test holes should be considered approximate, unless noted otherwise (refer report). Reference should also be made to the relevant standard sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc.).

GROUNDWATER

Unless otherwise indicated, the water depths presented on the test hole logs are the depths of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater depth may differ from this recorded depth depending on material permeabilities (i.e. depending on response time of the measuring instrument). Further, variations of this depth could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities such as a change is ground surface level. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate surveys, instrumentation techniques and monitoring programmes.

INTERPRETATION OF RESULTS

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data, often with only approximate locations (e.g. GPS). Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in ground conditions do occur in the natural environment, particularly between discrete test hole locations or available observation sites. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural processes.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to GHD for appropriate assessment and comment.

GEOTECHNICAL VERIFICATION

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system and/or to conduct monitoring as a result of this natural variability. Allowance for verification by appropriate geotechnical personnel must be recognised and programmed for construction.

FOUNDATIONS

Where referred to in the report, the soil or rock quality, or the recommended depth of any foundation (piles, caissons, footings etc.) is an engineering estimate. The estimate is influenced, and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions must include at least all of the relevant test hole and test data, together with the appropriate Standard Description sheets and remarks made in the written report of a factual or descriptive nature.

Ref: DS5.5.1 Issue 0 Date: 05/10/2018

SOIL DESCRIPTION AND CLASSIFICATION

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Soil is described in general accordance with Australian Standard AS 1726-2017 (Geotechnical Site Investigations) in terms of visual and tactile properties, with potential refinement by laboratory testing. AS 1726 defines soil as particulate materials that occur in the ground and can be disaggregated or remoulded by hand in air or water without prior soaking. Classification of the soil is undertaken following description.

SOIL DESCRIPTION

The soil description includes a) Composition, b) Condition, c) Structure, d) Origin and e) Additional observations. 'FILL', 'TOPSOIL' or a 'MIXTURE OF SOIL AND COBBLES / BOULDERS' (with dominant fraction first) is denoted at the start of a soil description where applicable.

a) Soil Composition (soil name, colour, plasticity or particle characteristics, secondary and then minor components)

Soil Name: A soil is termed a *coarse grained soil* where the dry mass of sand and gravel particles exceeds 65% of the total. Soils with more than 35% fines (silt or clay particles) are termed *fine grained soils*. The soil name is made up of the primary soil component (in BLOCK letters), prefixed by applicable secondary component qualifiers. Minor components are applied as a qualifiers to the soil name (using the words 'with' or 'trace').

Particles are differentiated on the basis of size. 'Boulders' and 'cobbles' are outside the soil particle range, though their presence (and proportions) is noted. While individual particles may be designated as silt or clay based on grain size, fine grained soils are characterised as silt or clay based on tactile behaviour or Atterberg Limits, and not the relative composition of silt or clay sized particles.

Colour: The prominent colour is noted, followed by (spotted, mottled, streaked etc.) then secondary colours as applicable. Roughly equally proportioned colours are prefixed by (spotted, mottled, streaked etc.). Colour is described in its moist condition, though both wet and dry colours may also be provided if appropriate.

Plasticity: Fine grained soils are designated within standard ranges of plasticity based on tactile assessment or laboratory assessment of the Liquid Limit.

Particle Characteristics: The particle shape, particle distribution and particle size range within a coarse grained soil is described using standard terms. Particle composition may be described using rock or mineral names, with specific terms for carbonate soils.

Secondary and Minor Components: The primary soil is described and modified by secondary and minor components, with assessed ranges as tabulated.

Carbonate Soils: Carbonate content can be assessed by use of dilute '10%' HCl solution. Resulting clear sustained effervescence is interpreted as a *Carbonate soil* (approximately >50% carbonate), while weak or sporadic effervescence indicates *Calcareous soil* (< 50% carbonate). No effervescence is interpreted as a non-calcareous soil.

Organic and Peat Soils: Where identified, organic content is noted. *Organic soil* (2% to 25% organic matter) is usually identified by colour (usually dark grey/black) and odour (i.e. 'mouldy' or hydrogen sulphide odour). *Peat* (>25% organic matter) is identified by a spongy feel and fibrous texture. Peat soils' decomposition may be described as '*fibrous*' (little / no decomposition), '*pseudo-fibrous*' (moderate decomposition) or '*amorphous*' (full decomposition).

Fraction	Components		Particle Size (mm)
Oversize	BOULDERS		> 200
	COBBLES		63 - 200
Coarse grained soil particles	GRAVEL	Coarse	19 - 63
		Medium	6.7 -19
		Fine	2.36 - 6.7
	SAND	Coarse	0.6 - 2.36
		Medium	0.21 - 0.6
		Fine	0.075 - 0.21
Fine grained soil particles	SILT		0.002 - 0.075
	CLAY		< 0.002

Plasticity Terms (Fine Grained Soils)		Laboratory Liquid Limit Range
Silt	**Clay**	
N/A	N/A	(Non Plastic)
Low Plasticity	*Low Plasticity*	≤ 35%
	Medium Plasticity	> 35% and ≤ 50%
High Plasticity	*High Plasticity*	> 50%

Particle Distribution Terms (Coarse Grained Soils)	
Well graded	good representation of all particle sizes
Poorly graded	one or more intermediate sizes poorly represented
Gap graded	one or more intermediate sizes absent
Uniform	essentially of one size

Particle Shape Terms (Coarse Grained Soils)		
Rounded	*Sub-angular*	*Flaky or Platy*
Sub-rounded	*Angular*	*Elongated*

Secondary and Minor Components for Coarse Grained Soils			
Fines (%)	**Modifier** (as applicable)	**Accessory coarse (%)**	**Modifier** (as applicable)
≤ 5	*'trace silt / clay'*	≤ 15	*'trace sand / gravel'*
> 5, ≤ 12	*'with clay / silt'*	> 15, ≤ 30	*'with sand / gravel'*
> 12	*prefix 'silty / clayey'*	> 30	*prefix 'gravelly / sandy'*

Secondary and Minor Components for Fine Grained Soils	
% Coarse	**Modifier** (as applicable)
≤ 15	add *"trace sand / gravel"*
> 15, ≤ 30	add *"with sand / gravel"*
> 30	prefix soil *"sandy / gravelly"*

Ref: DS6.5.1.1 Rev 0 Date: 2/03/2018

SOIL DESCRIPTION AND CLASSIFICATION

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b) Soil Condition (moisture, relative density or consistency)

Moisture: Fine grained soils are described relative to plastic or liquid limits, while coarse grained soils are assessed based on appearance and feel. The observation of seepage or free water is noted on the test hole logs.

Moisture - Coarse Grained Soils		
Term		**Tactile Properties**
Dry	*('D')*	Non-cohesive, free running
Moist	*('M')*	Feels cool, darkened colour, tends to stick together
Wet	*('W')*	Feels cool, darkened colour, tends to stick together, free water forms when handling

Moisture - Fine Grained Soils		
Term		**Tactile Properties**
Moist, dry of plastic limit	*('w < PL')*	Hard and friable or powdery
Moist, near plastic limit	*('w ≈ PL')*	Can be moulded
Moist, wet of plastic limit	*('w > PL')*	Weakened, free water forms on hands with handling
Wet, near liquid limit	*('w ≈ LL')*	Highly weakened, tends to flow when tapped
Wet, wet of liquid limit	*('w > LL')*	Liquid consistency, soil flows

Relative Density (Non Cohesive Soils): The Density Index is inherently difficult to assess by visual or tactile means, and is normally assessed by penetration testing (e.g. SPT, DCP, PSP or CPT) with published correlations. Assessment may be affected by moisture and *in situ* stress conditions. Density Index assessment may be refined by combination of *in situ* density testing and laboratory reference maximum and minimum density ranges.

Consistency (Cohesive Soils): May be assessed by direct measurement (shear vane, CPT etc.), or approximate tactile correlations. Cohesive soils include fine grained soils, and coarse grained soils with sufficient fine grained components to induce cohesive behaviour. A 'design shear strength' must consider the mode of testing, the *in situ* moisture content and potential for variations of moisture which may affect the shear strength.

Relative Density (Non-Cohesive Soils)		
Term and (Symbol)		**Density Index (%)**
Very Loose	*(VL)*	≤ 15
Loose	*(L)*	> 15 and ≤ 35
Medium Dense	*(MD)*	> 35 and ≤ 65
Dense	*(D)*	> 65 and ≤ 85
Very Dense	*(VD)*	> 85

Consistency assessment can be influenced by moisture variation.

Consistency (Cohesive Soils)			
Term and (Symbol)		**Tactile Properties**	**Undrained Shear Strength**
Very Soft	*(VS)*	Extrudes between fingers when squeezed	< 12 kPa
Soft	*(S)*	Can be moulded by light finger pressure	12 - 25 kPa
Firm	*(F)*	Can be moulded by strong finger pressure	25 - 50 kPa
Stiff	*(St)*	Cannot be moulded by fingers	50 - 100 kPa
Very Stiff	*(VSt)*	Can be indented by thumb nail	100 - 200 kPa
Hard	*(H)*	Can be indented with difficulty by thumb nail	> 200 kPa
Friable	*(Fr)*	Easily crumbled or broken into small pieces by hand	-

c) Structure (zoning, defects, cementing)

Zoning: The *in situ* zoning is described using the terms below. *'Intermixed'* may be used for an irregular arrangement.

'layer' (a continuous zone across the exposed sample)

'lens' (a discontinuous layer with lenticular shape)

'pocket' (an irregular inclusion of different material).

'interbedded' or *"interlaminated'* (alternating soil types)

Defects: Described using terms below, with dimension orientation and spacing described where practical.

'parting' (an open or closed surface or crack sub parallel to layering with little / no tensile strength - open or closed)

'fissure' (as per a parting, though not parallel or sub parallel to layering – may include desiccation cracks)

'sheared seam' (zone of sub parallel near planar closely spaced intersecting smooth or slickensided fissures dividing the mass into lenticular or wedge shaped blocks)

'sheared surface' (a near planar, curved or undulating smooth, polished or slickensided surface, indicative of displacement)

'softened zone' (in clayey soils, usually adjacent to a defect with associated higher moisture content)

'tube' (tubular cavity, singly or one of a large number, often formed from root holes, animal burrows or tunnel erosion)

'tube cast' (an infilled tube – infill may vary from uncemented through to cemented or have rock properties)

'infilled seam' (sheet like soil body cutting through the soil mass, formed by infilling of open defects)

Cementation: Soils may be cemented by various substances (e.g. iron oxides and hydroxides, silica, calcium carbonate, gypsum), and the cementing agent shall be identified if practical. Cemented soils are described as:

'weakly cemented'	easily disaggregated by hand in air or water
'moderately cemented'	effort required to disaggregate the soil by hand in air or water

Materials extending beyond '*moderately cemented'* are encompassed within the rock strength range. Where consistent cementation throughout a soil mass is identified as a duricrust, it is described in accordance with duricrust rock descriptors. Where alternate descriptors of cementation development are applied for consistency with regional practices or geology, or client requirements, these are outlined separately.

SOIL DESCRIPTION AND CLASSIFICATION

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d) Origin

An interpretation is provided based on observations of landform, geology and fabric, and may further include assignment of a stratigraphic unit. The use of terms 'possibly' or 'probably' indicates a higher degree of uncertainty regarding the assessed origin or stratigraphic unit. Typical origin descriptors include:

Residual	Formed directly from in situ weathering with no visible structure or fabric of the parent soil or rock.
Extremely weathered	Formed directly from in situ weathering, with remnant and/or fabric from the parent rock.
Alluvial	Deposited by streams and rivers (may be applied more generically as transported by water).
Estuarine	Deposited in coastal estuaries, including sediments from inflowing rivers, streams, and tidal currents.
Marine	Deposited in a marine environment.
Lacustrine	Deposited in freshwater lakes.
Aeolian	Transported by wind.
Colluvial and Slopewash	Soil and rock debris transported down slopes by gravity (with or without assistance of water). Colluvium is typically applied to thicker / localised deposits, and slopewash for thinner / widespread deposits.
TOPSOIL	Surficial soil, typically with high levels of organic material. Topsoils buried by other transported soils are termed *'remnant topsoil'*. Tree roots within otherwise unaltered soil does not characterise topsoil.
FILL	Any material which has been placed by anthropogenic processes (i.e. human activity).

e) Additional Observations

Additional observations may be included to supplement the soil description. Additional observations may consist of notations relating to soil characteristics (odour, contamination, colour changes with time), inferred geology (with delineation of soil horizons or geological time scale) or notes on sampling and testing application (including the reliability, recovery, representativeness, or condition of samples or test conditions and limitations). If the material is assessed to be not representative, terms such as 'poor recovery', 'non-intact', 'recovered as' or 'probably' are applied.

SOIL CLASSIFICATION

Classification allocates the material within distinct soil groups assigned a two character Group Symbol:

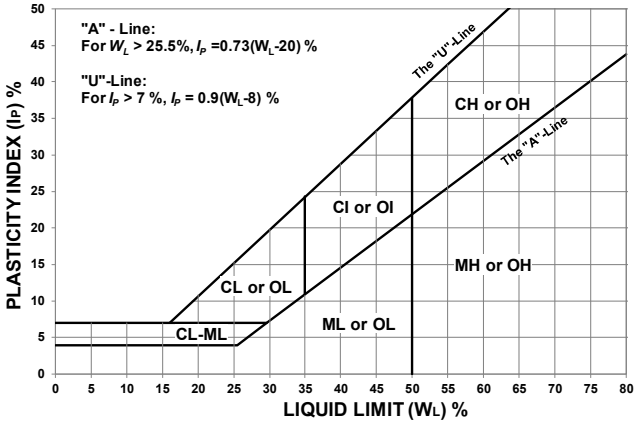
Coarse Grained Soils (sand and gravel: more than 65% of soil coarser than 0.075 mm)		
Major Division	**Group Symbol**	**Soil Group**
GRAVEL (more than half of the coarse fraction is > 2.36 mm)	GW	GRAVEL, well graded
	GP	GRAVEL, poorly graded
	GM	Silty GRAVEL
	GC	Clayey GRAVEL
SAND (more than half of the coarse fraction is < 2.36 mm)	SW	SAND, well graded
	SP	SAND, poorly graded
	SM	Silty SAND
	SC	Clayey SAND

Fine Grained Soils (silt and clay: more than 35% of soil finer than 0.075 mm)		
Major division	**Group Symbol**	**Soil Group**
SILT and CLAY (low to medium plasticity)	ML	SILT, low plasticity
	CL	CLAY, low plasticity
	CI	CLAY, medium plasticity
	OL	Organic SILT
SILT and CLAY (high plasticity)	MH	SILT, high plasticity
	CH	CLAY, high plasticity
	OH	Organic CLAY / SILT
Highly Organic	Pt	PEAT

Coarse grained soils with fines contents between 5% and 12% are provided a dual classification comprising the two group symbols separated by a dash, e.g. for a poorly graded gravel with between 5% and 12% silt fines (poorly graded 'GRAVEL with silt'), the classification is GP-GM.

For the purpose of classification, *poorly graded, uniform,* or *gap graded* soils are all designated as poorly graded. Soils that are dominated by boulders or cobbles are described separately and are not classified.

Classification is routinely undertaken based on tactile assessment with the soil description. Refinement of soil classification may be applied using laboratory assessment, including particle size distribution and Atterberg Limits. Atterberg Limits testing is applied to the sample portion finer than 0.425 mm. Fine grained soil components are assessed on the basis of regions defined within the Modified Casagrande Chart.



LABORATORY TESTING

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GENERAL

Samples extracted during the fieldwork stage of a site investigation may be “disturbed” or “undisturbed” (as generally indicated on the test hole logs) depending upon the nature and purpose of the sample as well as the method of extraction, transportation, extrusion and testing. This aspect should be taken into account when assessing test results, which must of necessity, reflect the effects of such disturbance.

All soil properties (as measured by laboratory testing) exhibit inherent variability and thus a certain statistical number of tests is required in order to predict an average property with any degree of confidence. The site variability of soil strata, future changes in moisture and other conditions and the discrete sampling positions must also be considered when assessing the representative nature of the laboratory programme.

Certain laboratory test results provide interpreted soil properties as derived by conventional mathematical procedures. The applicability of such properties to engineering design must be assessed with due regard to the site, sample condition, procedure and project in hand.

TESTING

Laboratory testing is normally carried out in accordance with Australian Standard AS 1289 as amended, or in NSW, Roads and Maritime Services (RMS) standards when specified. The routine Australian Standard tests are as follows:

Moisture Content	AS1289 2.1.1	
Liquid Limit	AS1289 3.1.1	collectively known as Atterberg Limits
Plastic Limit	AS1289 3.2.1	
Plasticity Index	AS1289 3.3.1	
Linear Shrinkage	AS1289 3.4.1	
Particle Density	AS1289 3.5.1	
Particle Size Distribution	AS1289 3.6.1, 3.6.2 and 3.6.3	
Emerson Class Number	AS1289 3.8.1	collectively, Dispersive Classification
Percent Dispersion	AS1289 3.8.2	
Pinhole Dispersion Classification	AS1289 3.8.3	
Hole Erosion (HE)	GHD Method	
No Erosion Filter (NEF)	GHD Method	
Organic Matter	AS1289 4.1.1	
Sulphate Content	AS1289 4.2.1	
pH Value	AS1289 4.3.1	
Resistivity	AS1289 4.4.1	
Standard Compaction	AS1289 5.1.1	
Modified Compaction	AS1289 5.2.1	
Dry Density Ratio	AS1289 5.4.1	
Minimum Density	AS1289 5.5.1	
Density Index	AS1289 5.6.1	
California Bearing Ratio	AS1289 6.1.1 and 6.1.2	
Shear Box	AS1289 6.2.2	
Undrained Triaxial Shear	AS1289 6.4.1 and 6.4.2	
One Dimensional Consolidation	AS1289 6.6.1	
Permeability Testing	AS1289 6.7.1, 6.7.2 and 6.7.3	

Where tests are used which are not covered by appropriate standard procedures, details are given in the report.

LABORATORIES

Our Australian laboratories are NATA accredited to AS ISO / IEC17025 for the listed tests.

The oedometer, triaxial and shear box equipment are fully automated for continuous operation using computer controlled data acquisition, processing and plotting systems.

Ref: DS5.5.2 Issue 0 Date: 05/10/2018

Appendix C

Borehole logs

BOREHOLE LOG SHEET

Client : Kempsey Shire Council

Project : Stuarts Point Sewerage System - Effluent Transfer and Disposal Design

Location : Stuarts Point, NSW

HOLE No. BH01

SHEET 1 OF 1

Position : 499942.0 E 6590908.0 N	**Surface RL:** 1.50m	**Angle from Horiz. :** -90°	**Processed :** E.D
Rig Type : Geoprobe	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** N.B	**Checked :** B.S*
Date Started : 26/5/2022	**Date Completed :** 26/5/2022	**Logged by :** E.D	**Date:** 31/08/22

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL							BOREHOLE	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth/(RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	BOREHOLE Log	Components
0	Solid Flight Auger (TC-bit)	Nil	(26/05/22)				SP	SAND: medium grained, white-grey, trace shell fragments (aeolian). 0.3 m, yellow.	M	L-MD	0.0m, ASS sample.		Bentonite Plug
											0.5m, ASS sample.		
1				SPT 2/6/4 N=10					W		1.0m, ASS sample.		Sand Backfill
													Solid PVC Casing
2				SPT 0/0/0 N=0						VL-L	2.0m, ASS sample.		
3													
													Slotted PVC Casing
4				D							4.5m, ASS sample.		
5								5.2 m, grey.					
				D									End of Well
													Sand Backfill
6					6.00 (7.50)			End of borehole at 6.00 metres. Target Depth. Standpipe piezometer installed at completion			6.0m, ASS sample.		
7													
8													

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 12551313

BOREHOLE LOG SHEET

Client : Kempsey Shire Council

Project : Stuarts Point Sewerage System - Effluent Transfer and Disposal Design

Location : Stuarts Point, NSW

HOLE No. BH02

SHEET 1 OF 1

Position : 499837.0 E 6591017.0 N	**Surface RL:** 1.50m	**Angle from Horiz. :** -90°	**Processed :** E.D
Rig Type : Geoprobe	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** N.B	**Checked :** B.S*
Date Started : 26/5/2022	**Date Completed :** 26/5/0202	**Logged by :** E.D	**Date:** 31/08/22

DRILLING					MATERIAL								Note: * indicates signatures on original issue of log or last revision of log BOREHOLE	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth/(RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	BOREHOLE Log	Components
0	Solid Flight Auger (TC-bit)	Nil	(26/05/22) ▽				SP	SAND: medium grained, yellow, trace shell fragments (aeolian).	M	L	0.0m, ASS sample.		Bentonite Plug
											0.5m, ASS sample.		
1				SPT 3/7/12 N=19					W	MD	1.0m, ASS sample.		Sand Backfill
													Solid PVC Casing
2											2.0m, ASS sample.		
3				D							3.0m, ASS sample.		Slotted PVC Casing
4													
				D							4.5m, ASS sample.		
5													End of Well
													Sand Backfill
6				D	6.00 (7.50)			End of borehole at 6.00 metres. Target Depth. Standpipe piezometer installed at completion			6.0m, ASS sample.		
7													
8													

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BOREHOLE LOG SHEET

Client : Kempsey Shire Council

Project : Stuarts Point Sewerage System - Effluent Transfer and Disposal Design

Location : Stuarts Point, NSW

HOLE No. BH03

SHEET 1 OF 1

Position : 499837.0 E 6590774.0 N	**Surface RL:** 1.50m	**Angle from Horiz. :** -90°	**Processed :** E.D
Rig Type : Geoprobe	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** N.B	**Checked :** B.S*
Date Started : 27/5/2022	**Date Completed :** 27/5/2022	**Logged by :** E.D	**Date:** 31/08/22

DRILLING					MATERIAL								Note: * indicates signatures on original issue of log or last revision of log BOREHOLE	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth/(RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	BOREHOLE Log	Components
0	Solid Flight Auger (TC-bit)	Nil	▽ (27/05/22)	SPT 1/1/1 N=2			SP	SAND: medium grained, yellow-white, trace coarse sand sized grains of black organic matter (aeolian).	M	VL-L	0.0m, ASS sample.		Bentonite Plug
											0.5m, ASS sample.		
1								0.65m, yellow, trace shell fragments.	W				Sand Backfill
													Solid PVC Casing
				D						MD	1.5m, ASS sample.		
2													
3				D							3.0m, ASS sample.		Slotted PVC Casing
4								4.0m, dark grey.					
				D							4.5m, ASS sample.		
5													End of Well
													Sand Backfill
6				D	6.00 (7.50)			End of borehole at 6.00 metres. Target Depth. Standpipe piezometer installed at completion			6.0m, ASS sample.		
7													
8													

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BOREHOLE LOG SHEET

Client : Kempsey Shire Council

Project : Stuarts Point Sewerage System - Effluent Transfer and Disposal Design

Location : Stuarts Point, NSW

HOLE No. BH04

SHEET 1 OF 3

Position : 499359.0 E 6590764.0 N		**Surface RL:** 5.00m		**Angle from Horiz. :** -90°	**Processed :** C.V
Rig Type : Hanjin	**Mounting:** Track	**Contractor :** Total Drilling Pty Ltd		**Driller :** M.T	**Checked :** B.S*
Date Started : 7/6/2022		**Date Completed :** 7/6/2022		**Logged by :** E.D	**Date:** 31/08/22

DRILLING					MATERIAL								
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth/(RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	BOREHOLE Log	Components
0	Solid Flight Auger (TC-bit)	HW casing	Not observed during augering	D			SP	SAND: medium grained, grey, trace clay (marine).	M	L-MD	0.0 m, ASS sample.		Cement
				SPT 3/4/5 N=9				0.5 m, grey-brown.			0.5 m, ASS sample.		Sand Backfill
1				SPT 3/3/7 N=10				0.8 m, brown.			1.0 m, ASS sample.		Bentonite Plug
2													Solid PVC Casing
	Rotary Wash Boring (Blade-bit)							2.6 m, yellow.			2.5 m, ASS sample.		Sand Backfill
3				SPT 3/3/5 N=8									
4				SPT 8/13/16 N=29						MD	4.0 m, ASS sample.		
5													Slotted PVC Casing
				SPT 7/11/13 N=24				5.5 m, grey.			5.5 m, ASS sample.		
6													
7		Nil		SPT 20/25 for 120mm N=ref						VD	7.0 m, ASS sample.		
8					8.00								End of Well

Note: * indicates signatures on original issue of log or last revision of log

BOREHOLE

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BOREHOLE LOG SHEET

GEO_BOREHOLE_AS1726 2017 12551313_LOGS.GPJ GHD_GEO_TEMPLATE 2.00.GDT 31/8/22

Client : Kempsey Shire Council

Project : Stuarts Point Sewerage System - Effluent Transfer and Disposal Design

Location : Stuarts Point, NSW

HOLE No. BH04

SHEET 2 OF 3

Position : 499359.0 E 6590764.0 N		**Surface RL:** 5.00m		**Angle from Horiz. :** -90°	**Processed :** C.V
Rig Type : Hanjin	**Mounting:** Track	**Contractor :** Total Drilling Pty Ltd		**Driller :** M.T	**Checked :** B.S*
Date Started : 7/6/2022		**Date Completed :** 7/6/2022		**Logged by :** E.D	**Date:** 31/08/22

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL							BOREHOLE	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth/(RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	BOREHOLE Log	Components
9	Rotary Wash Boring (Blade-bit)	Nil		SPT 17/25 for 120mm N=ref	(13.00)		SP	SAND: as previous.	M	VD			
								8.5 m, with shell fragments.			8.5 m, ASS sample.		
10				SPT 21/25 for 130mm N=ref							10.0 m, ASS sample.		
11													
12				SPT 21/25 for 120mm N=ref									Sand Backfill
13				SPT 21/25 for 120mm N=ref									
14													
15				SPT 24/25 for 110mm N=ref									
16					16.00								

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BOREHOLE LOG SHEET

GEO_BOREHOLE_AS1726 2017 12551313_LOGS.GPJ GHD_GEO_TEMPLATE 2.00.GDT 31/8/22

Client : Kempsey Shire Council

Project : Stuarts Point Sewerage System - Effluent Transfer and Disposal Design

Location : Stuarts Point, NSW

HOLE No. BH04

SHEET 3 OF 3

Position : 499359.0 E 6590764.0 N		**Surface RL:** 5.00m		**Angle from Horiz. :** -90°	**Processed :** C.V
Rig Type : Hanjin	**Mounting:** Track	**Contractor :** Total Drilling Pty Ltd		**Driller :** M.T	**Checked :** B.S*
Date Started : 7/6/2022		**Date Completed :** 7/6/2022		**Logged by :** E.D	**Date:** 31/08/22

DRILLING					MATERIAL								Note: * indicates signatures on original issue of log or last revision of log
												BOREHOLE	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth/(RL) metres	Graphic Log	USC Symbol	**Description** [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	BOREHOLE Log	Components
17	Rotary Wash Boring (Blade-bit)	Nil		SPT 25 for 140mm N=ref	(21.00)		SP	SAND: as previous.	M	VD			
18				SPT 24/25 for 85mm N=ref									◄ Sand Backfill
19													
20				SPT 18/25 for 130mm N=ref	20.28 (25.28)			End of borehole at 20.28 metres. Target Depth. Standpipe piezometer installed at completion					
21													
22													
23													
24													

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Appendix D

DCP report sheets

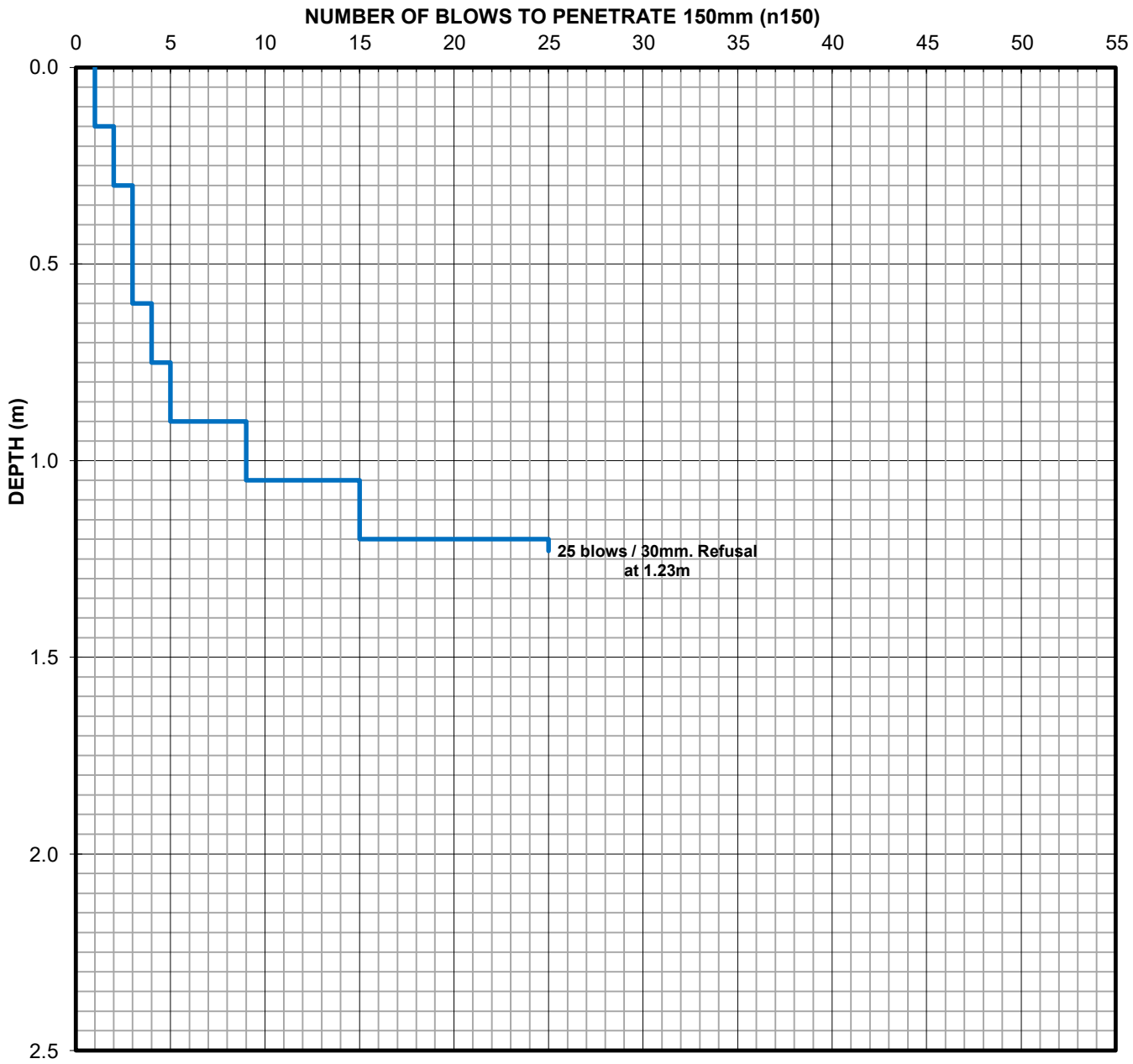
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Kempsey Shire Council
Project: Stuarts Point - Effluent Transfer and Disposal Design
Location: Stuarts Point, NSW

PROBE: DCP01

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	499942 E 6590908 N	**Chainage:**	-	**Operator:**	ED
Elevation:	-	**Offset:**	-	**Date:**	26/05/2022
Adjacent Test Hole / Pit:	BH01			**Checked:**	
Position Relative to Test Hole / Pit:	Adjacent			**Date:**	



Comments:

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Job No. **12551313**

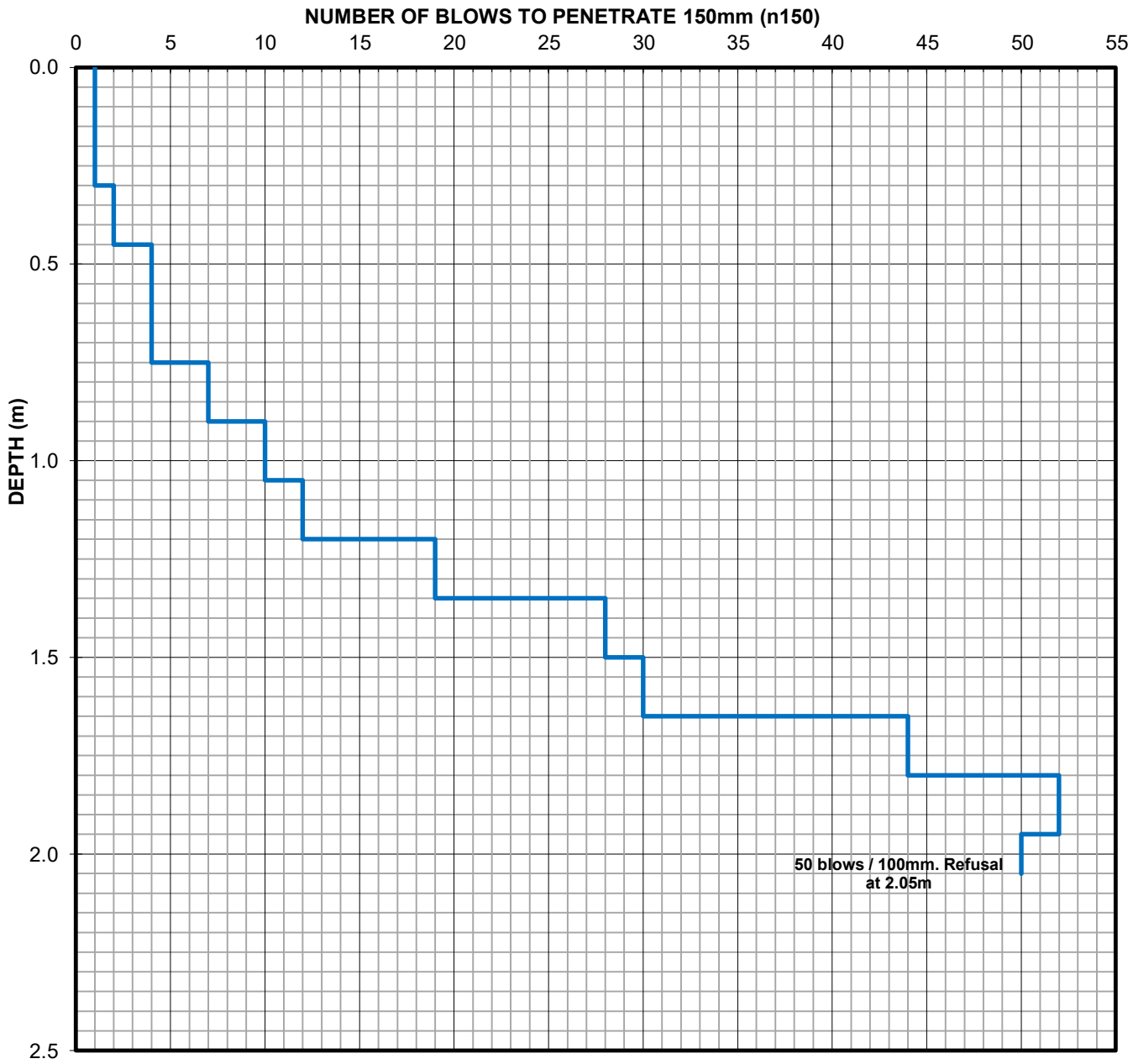
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Kempsey Shire Council
Project: Stuarts Point - Effluent Transfer and Disposal Design
Location: Stuarts Point, NSW

PROBE: DCP02

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	499837 E 6591017 N	**Chainage:**	-	**Operator:**	ED
Elevation:	-	**Offset:**	-	**Date:**	26/05/2022
Adjacent Test Hole / Pit:	BH02			**Checked:**	
Position Relative to Test Hole / Pit:	Adjacent			**Date:**	



Comments:

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Job No.
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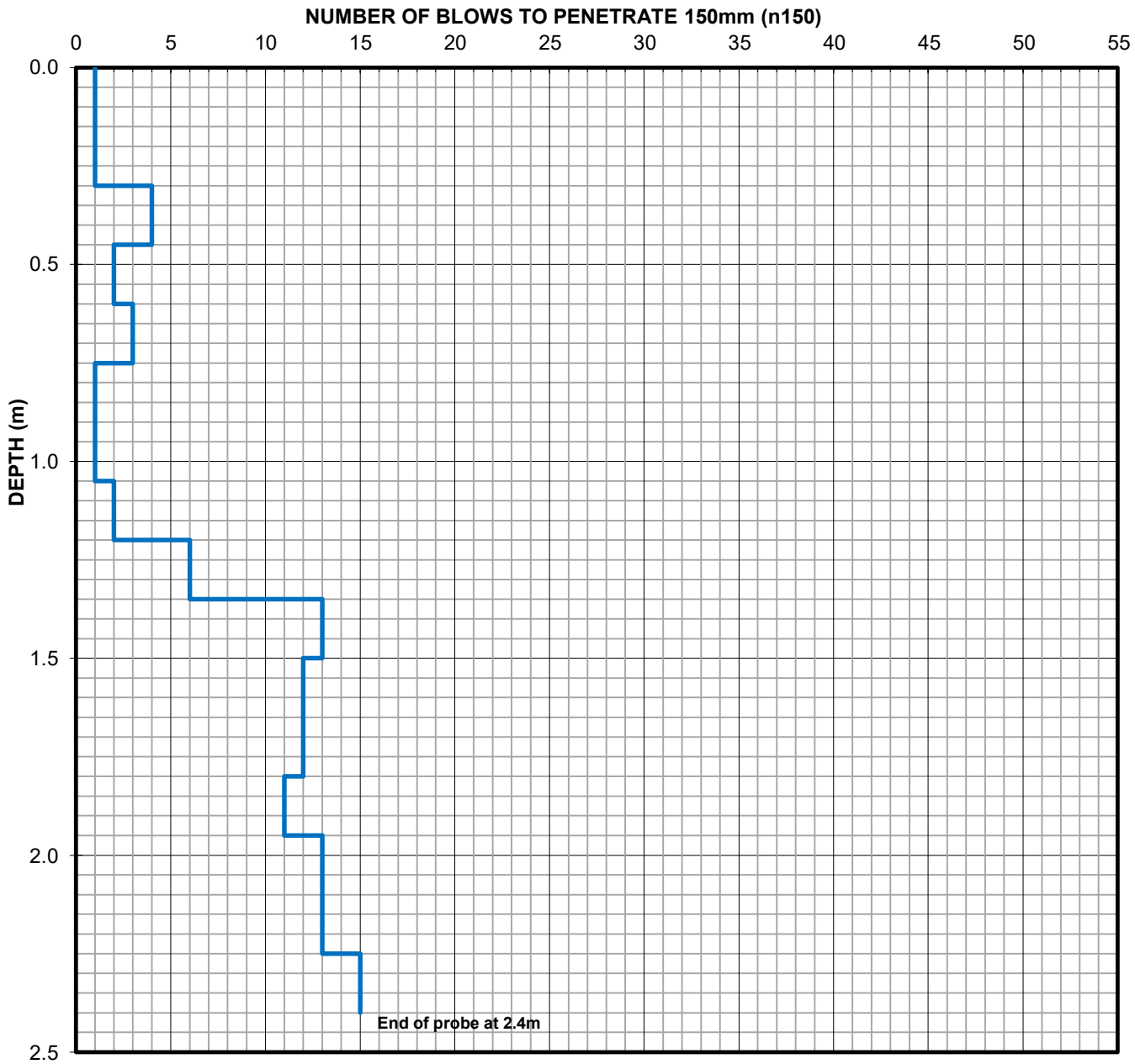
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Kempsey Shire Council
Project: Stuarts Point - Effluent Transfer and Disposal Design
Location: Stuarts Point, NSW

PROBE: DCP03

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	499837 E 6590774 N	**Chainage:**	-	**Operator:**	ED
Elevation:	-	**Offset:**	-	**Date:**	27/05/2022
Adjacent Test Hole / Pit:	BH03			**Checked:**	
Position Relative to Test Hole / Pit:	Adjacent			**Date:**	



Comments:

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GHD GEOTECHNICS

Job No.
12551313

Appendix E

Laboratory results

Sydney Laboratory
Unit 5/43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Material Test Report

Report No: SYD2201394
Issue No: 1

Client: Kempsey Shire Council
PO Box 78
West Kempsey NSW 2240

Project: 12551313

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: D.P Brooke

Date of Issue: 8/07/2022

Sample Details

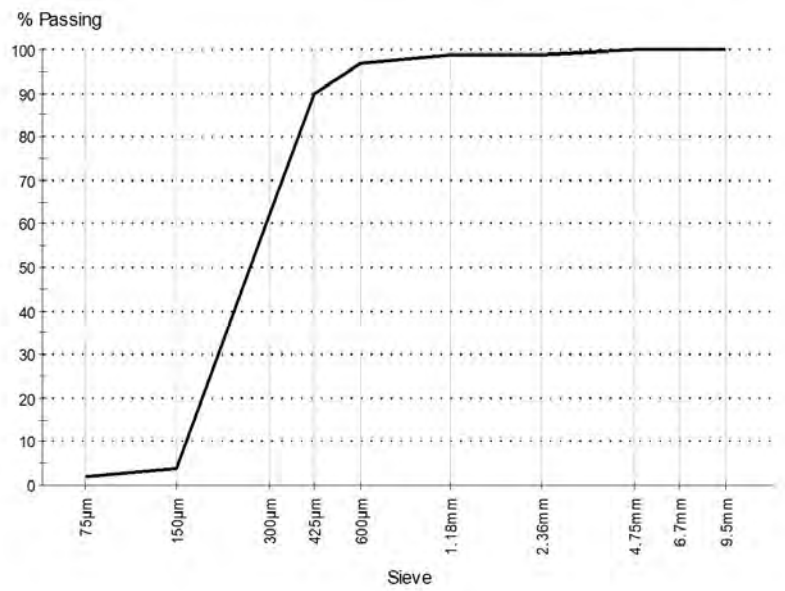
GHD Sample No	SYD22-0285-01
Sampled By	Sampled by GHD Geotechnical
Client Location	SPSS Effluent Transfer & Disposal Design Stuarts Point NSW
BH / TP No.	BH01
Depth (m)	1.0-1.45
Soil Classification	SAND (SP) yellow/brown as per AS1726 tables 9 & 10

Other Test Results

Description	Method	Result	Limits
Curvature Coefficient	AS 1289.3.6.1	0.89	
Uniformity Coefficient		1.82	

Particle Size Distribution

AS 1289.3.6.1



Drying by: Oven
Date Tested: 4/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	100	
2.36mm	99	
1.18mm	99	
600µm	97	
425µm	90	
300µm	62	
150µm	4	
75µm	2	

Comments

N/A

Sydney Laboratory
Unit 5/43 Herbert St
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Material Test Report

Report No: SYD2201395
Issue No: 1

Client: Kempsey Shire Council
PO Box 78
West Kempsey NSW 2240

Project: 12551313

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: D.P Brooke

Date of Issue: 8/07/2022

Sample Details

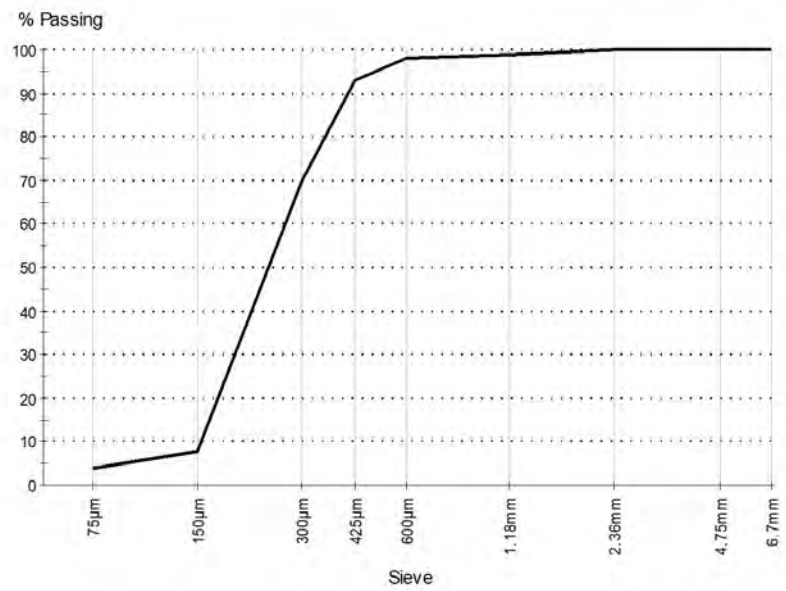
GHD Sample No	SYD22-0285-02
Sampled By	Sampled by GHD Geotechnical
Client Location	SPSS Effluent Transfer & Disposal Design Stuarts Point NSW
BH / TP No.	BH01
Depth (m)	4.5
Soil Classification	SAND (SP) yellow/brown as per AS1726 tables 9 & 10

Other Test Results

Description	Method	Result	Limits
Curvature Coefficient	AS 1289.3.6.1	0.89	
Uniformity Coefficient		1.75	

Particle Size Distribution

AS 1289.3.6.1



Drying by: Oven
Date Tested: 4/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
6.7mm	100	
4.75mm	100	
2.36mm	100	
1.18mm	99	
600µm	98	
425µm	93	
300µm	70	
150µm	8	
75µm	4	

Comments

N/A

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Material Test Report

Report No: SYD2201396
Issue No: 1

Client: Kempsey Shire Council
PO Box 78
West Kempsey NSW 2240

Project: 12551313

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: D.P Brooke

Date of Issue: 8/07/2022

Sample Details

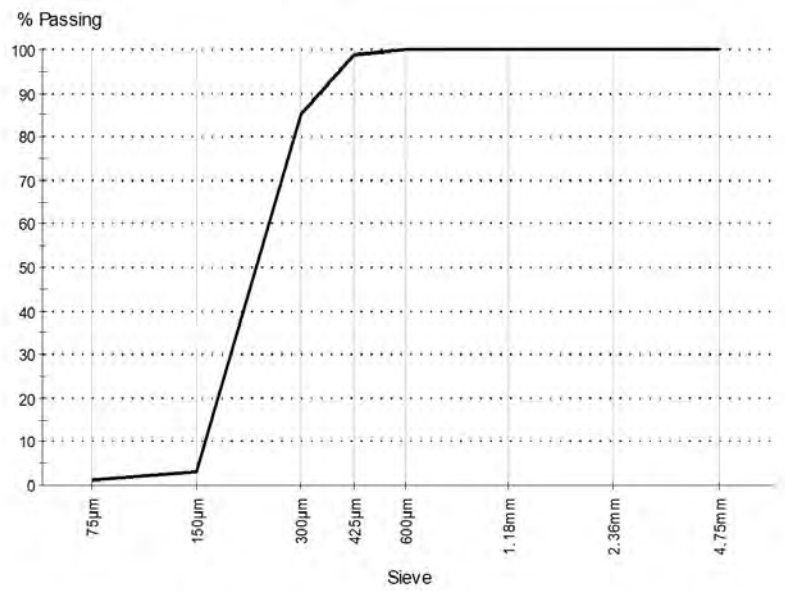
GHD Sample No	SYD22-0285-03
Sampled By	Sampled by GHD Geotechnical
Client Location	SPSS Effluent Transfer & Disposal Design Stuarts Point NSW
BH / TP No.	BH02
Depth (m)	1.0 - 1.45
Soil Classification	SAND (SP) yellow brown as per AS1726 tables 9 & 10

Other Test Results

Description	Method	Result	Limits
Curvature Coefficient	AS 1289.3.6.1	0.92	
Uniformity Coefficient		1.53	

Particle Size Distribution

AS 1289.3.6.1



Drying by: Oven
Date Tested: 4/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	100	
1.18mm	100	
600µm	100	
425µm	99	
300µm	85	
150µm	3	
75µm	1	

Comments

N/A

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Material Test Report

Report No: SYD2201397
Issue No: 1

Client: Kempsey Shire Council
PO Box 78
West Kempsey NSW 2240

Project: 12551313

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: D.P Brooke

Date of Issue: 8/07/2022

Sample Details

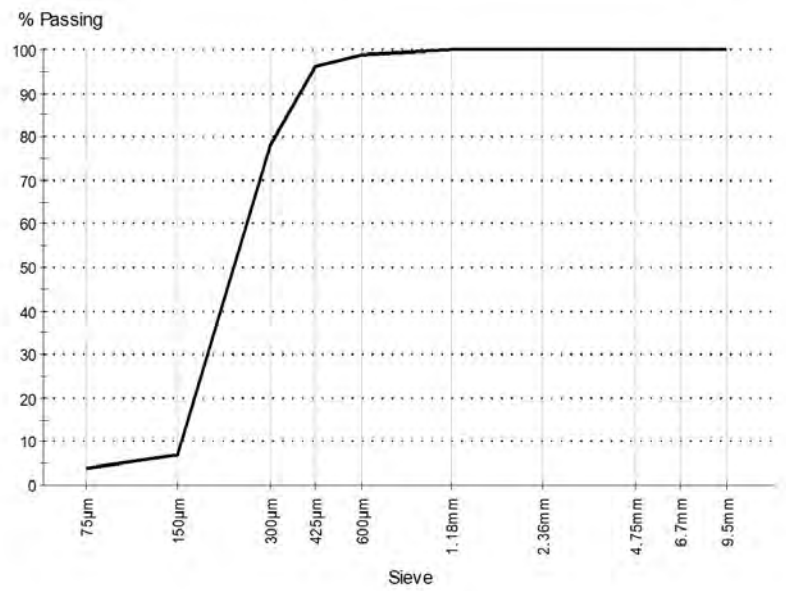
GHD Sample No	SYD22-0285-04
Sampled By	Sampled by GHD Geotechnical
Client Location	SPSS Effluent Transfer & Disposal Design Stuarts Point NSW
BH / TP No.	BH02
Depth (m)	4.5
Soil Classification	SAND (SP) yellow brown as per AS1726 tables 9 & 10

Other Test Results

Description	Method	Result	Limits
Curvature Coefficient	AS 1289.3.6.1	0.91	
Uniformity Coefficient		1.63	

Particle Size Distribution

AS 1289.3.6.1



Drying by: Oven
Date Tested: 4/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	100	
2.36mm	100	
1.18mm	100	
600µm	99	
425µm	96	
300µm	78	
150µm	7	
75µm	4	

Comments

N/A

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Material Test Report

Report No: SYD2201398
Issue No: 1

Client: Kempsey Shire Council
PO Box 78
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Project: 12551313

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: D.P Brooke

Date of Issue: 8/07/2022

Sample Details

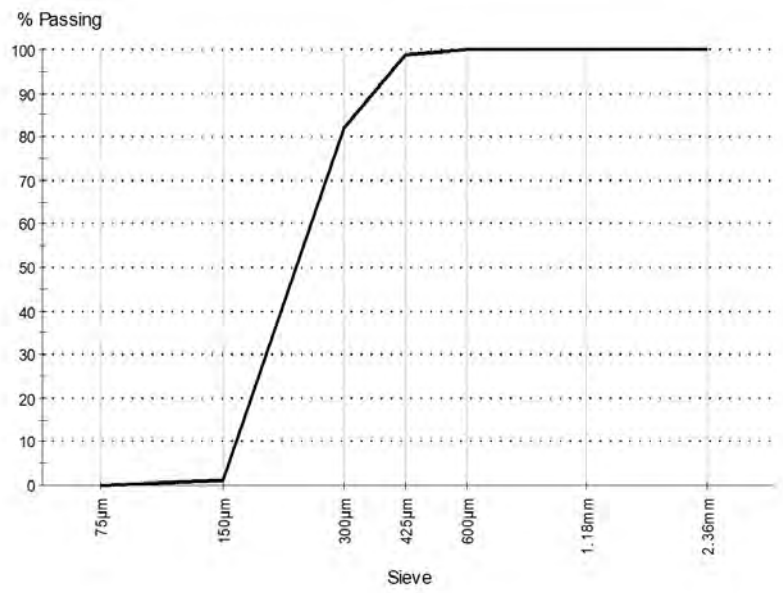
GHD Sample No	SYD22-0285-05
Sampled By	Sampled by GHD Geotechnical
Client Location	SPSS Effluent Transfer & Disposal Design Stuarts Point NSW
BH / TP No.	BH03
Depth (m)	0.5 - 0.95
Soil Classification	SAND (SP) yellow brown as per AS1726 tables 9 & 10

Other Test Results

Description	Method	Result	Limits
Curvature Coefficient	AS 1289.3.6.1	0.92	
Uniformity Coefficient		1.53	

Particle Size Distribution

AS 1289.3.6.1



Drying by: Oven
Date Tested: 4/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	100	
600µm	100	
425µm	99	
300µm	82	
150µm	1	
75µm	0	

Comments

N/A

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Material Test Report

Report No: SYD2201399
Issue No: 1

Client: Kempsey Shire Council
PO Box 78
West Kempsey NSW 2240

Project: 12551313

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: D.P Brooke

Date of Issue: 8/07/2022

Sample Details

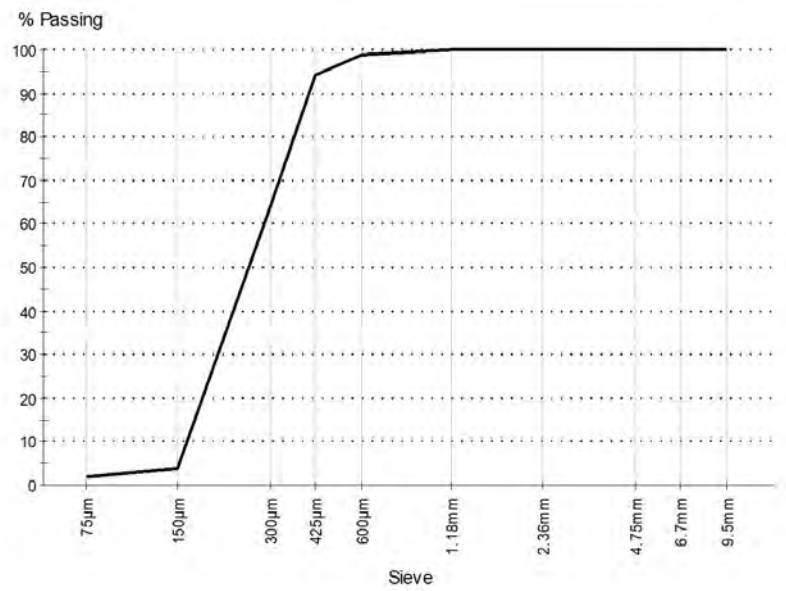
GHD Sample No	SYD22-0285-06
Sampled By	Sampled by GHD Geotechnical
Client Location	SPSS Effluent Transfer & Disposal Design Stuarts Point NSW
BH / TP No.	BH03
Depth (m)	4.5
Soil Classification	SAND (SP) yellow brown as per AS1726 tables 9 & 10

Other Test Results

Description	Method	Result	Limits
Curvature Coefficient	AS 1289.3.6.1	0.89	
Uniformity Coefficient		1.78	

Particle Size Distribution

AS 1289.3.6.1



Drying by: Oven
Date Tested: 4/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	100	
2.36mm	100	
1.18mm	100	
600µm	99	
425µm	94	
300µm	64	
150µm	4	
75µm	2	

Comments

N/A

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Material Test Report

Report No: SYD2201400
Issue No: 1

Client: Kempsey Shire Council
PO Box 78
West Kempsey NSW 2240

Project: 12551313

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: D.P Brooke

Date of Issue: 8/07/2022

Sample Details

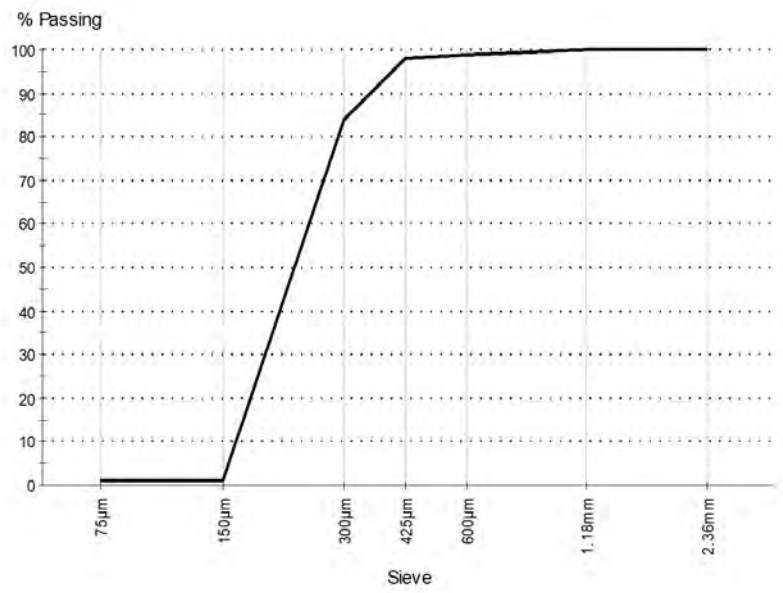
GHD Sample No	SYD22-0285-07
Sampled By	Sampled by GHD Geotechnical
Client Location	SPSS Effluent Transfer & Disposal Design Stuarts Point NSW
BH / TP No.	BH04
Depth (m)	1.0 - 1.45
Soil Classification	SAND (SP) Brown as per AS1726 tables 9 & 10

Other Test Results

Description	Method	Result	Limits
Curvature Coefficient	AS 1289.3.6.1	0.92	
Uniformity Coefficient		1.52	

Particle Size Distribution

AS 1289.3.6.1



Drying by: Oven
Date Tested:

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	100	
600µm	99	
425µm	98	
300µm	84	
150µm	1	
75µm	1	

Comments

N/A

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Material Test Report

Report No: SYD2201401
Issue No: 1

Client: Kempsey Shire Council
PO Box 78
West Kempsey NSW 2240

Project: 12551313

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: D.P Brooke

Date of Issue: 8/07/2022

Sample Details

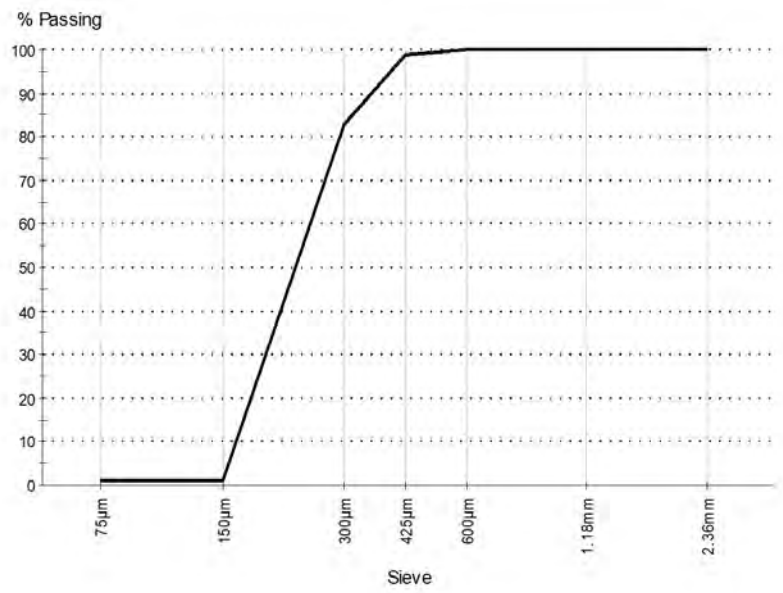
GHD Sample No	SYD22-0285-08
Sampled By	Sampled by GHD Geotechnical
Client Location	SPSS Effluent Transfer & Disposal Design Stuarts Point NSW
BH / TP No.	BH04
Depth (m)	4.0 - 4.45
Soil Classification	SAND (SP) yellow brown as per AS1726 tables 9 & 10

Other Test Results

Description	Method	Result	Limits
Curvature Coefficient	AS 1289.3.6.1	0.92	
Uniformity Coefficient		1.53	

Particle Size Distribution

AS 1289.3.6.1



Drying by: Oven
Date Tested: 4/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	100	
600µm	100	
425µm	99	
300µm	83	
150µm	1	
75µm	1	

Comments

N/A

GHD Pty Ltd
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Newcastle
NSW 2300

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Amylia Fletcher**

Report **900203-S**
Project name SPSS - ETDD
Project ID 12551313
Received Date Jun 17, 2022

Client Sample ID			**BH01 0.5M**	**BH01 1M**	**BH01 2M**	**BH02 1M**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**B22-Jn0054038**	**B22-Jn0054039**	**B22-Jn0054040**	**B22-Jn0054041**
Date Sampled			**May 26, 2022**	**May 26, 2022**	**May 26, 2022**	**May 26, 2022**
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.0	-	9.4	6.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.6	-	7.9	3.0
Reaction Ratings*[S05]	0	-	2.0	-	4.0	3.0
Chloride	5	mg/kg	-	< 5	-	-
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	-	59	-	-
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	-	8.1	-	-
Resistivity*	0.5	ohm.m	-	170	-	-
Sulphate (as SO4)	30	mg/kg	-	< 30	-	-
% Moisture	1	%	-	18	-	-

Client Sample ID			**BH02 3M**	**BH02 4.5M**	**BH02 6M**	**BH03 SURFACE**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**B22-Jn0054042**	**B22-Jn0054043**	**B22-Jn0054044**	**B22-Jn0054045**
Date Sampled			**May 26, 2022**	**May 26, 2022**	**May 26, 2022**	**May 27, 2022**
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	9.4	-	9.3	5.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	7.6	-	7.7	3.4
Reaction Ratings*[S05]	0	-	2.0	-	2.0	2.0
Chloride	5	mg/kg	-	7.8	-	-
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	-	130	-	-
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	-	7.9	-	-
Resistivity*	0.5	ohm.m	-	78	-	-
Sulphate (as SO4)	30	mg/kg	-	< 30	-	-
% Moisture	1	%	-	16	-	-

Client Sample ID			BH03 3M	BH03 6M
Sample Matrix			Soil	Soil
Eurofins Sample No.			B22-Jn0054046	B22-Jn0054047
Date Sampled			May 27, 2022	May 27, 2022
Test/Reference	LOR	Unit		
Acid Sulfate Soils Field pH Test				
pH-F (Field pH test)*	0.1	pH Units	9.2	9.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	7.5	7.5
Reaction Ratings*[S05]	0	-	1.0	2.0

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Acid Sulfate Soils Field pH Test	Brisbane	Jun 27, 2022	7 Days
- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests			
Chloride	Melbourne	Jun 27, 2022	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Melbourne	Jun 27, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Melbourne	Jun 27, 2022	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Melbourne	Jun 27, 2022	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
% Moisture	Melbourne	Jun 24, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

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Sydney
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Girraween NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Newcastle
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NATA # 1261 Site # 25079

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IANZ # 1290

Company Name: GHD Pty Ltd NEWCASTLE
Address: 3/24 Honeysuckle Dve
Newcastle
NSW 2300

Project Name: SPSS - ETDD
Project ID: 12551313

Order No.: 12551313
Report #: 900203
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Jun 22, 2022 9:15 AM
Due: Jun 29, 2022
Priority: 5 Day
Contact Name: Amylia Fletcher

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						HOLD	Acid Sulfate Soils Field pH Test	Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254								X	X
Sydney Laboratory - NATA # 1261 Site # 18217									
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X		
Mayfield Laboratory - NATA # 1261 Site # 25079									
Perth Laboratory - NATA # 2377 Site # 2370									
External Laboratory									
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
1	BH01 0.5M	May 26, 2022		Soil	B22-Jn0054038		X		
2	BH01 1M	May 26, 2022		Soil	B22-Jn0054039			X	X
3	BH01 2M	May 26, 2022		Soil	B22-Jn0054040		X		
4	BH02 1M	May 26, 2022		Soil	B22-Jn0054041		X		
5	BH02 3M	May 26, 2022		Soil	B22-Jn0054042		X		
6	BH02 4.5M	May 26, 2022		Soil	B22-			X	X

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NATA # 1261 Site # 18217

Brisbane
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NATA # 2377 Site # 2370

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Rolleston, Christchurch 7675
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Company Name: GHD Pty Ltd NEWCASTLE
Address: 3/24 Honeysuckle Dve
Newcastle
NSW 2300

Project Name: SPSS - ETDD
Project ID: 12551313

Order No.: 12551313
Report #: 900203
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Jun 22, 2022 9:15 AM
Due: Jun 29, 2022
Priority: 5 Day
Contact Name: Amylia Fletcher

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						HOLD	Acid Sulfate Soils Field pH Test	Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254								X	X
Sydney Laboratory - NATA # 1261 Site # 18217									
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X		
Mayfield Laboratory - NATA # 1261 Site # 25079									
Perth Laboratory - NATA # 2377 Site # 2370									
External Laboratory									
					Jn0054043				
7	BH02 6M	May 26, 2022		Soil	B22-Jn0054044		X		
8	BH03 SURFACE	May 27, 2022		Soil	B22-Jn0054045		X		
9	BH03 3M	May 27, 2022		Soil	B22-Jn0054046		X		
10	BH03 6M	May 27, 2022		Soil	B22-Jn0054047		X		
11	BH01 SURFACE	May 26, 2022		Soil	B22-Jn0054048	X			
12	BH01 4.5M	May 26, 2022		Soil	B22-Jn0054049	X			

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Phone : 0800 856 450
IANZ # 1290

Company Name: GHD Pty Ltd NEWCASTLE
Address: 3/24 Honeysuckle Dve
Newcastle
NSW 2300

Project Name: SPSS - ETDD
Project ID: 12551313

Order No.: 12551313
Report #: 900203
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Jun 22, 2022 9:15 AM
Due: Jun 29, 2022
Priority: 5 Day
Contact Name: Amylia Fletcher

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						HOLD	Acid Sulfate Soils Field pH Test	Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254								X	X
Sydney Laboratory - NATA # 1261 Site # 18217									
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X		
Mayfield Laboratory - NATA # 1261 Site # 25079									
Perth Laboratory - NATA # 2377 Site # 2370									
External Laboratory									
13	BH01 6M	May 26, 2022		Soil	B22-Jn0054050	X			
14	BH02 SURFACE	May 26, 2022		Soil	B22-Jn0054051	X			
15	BH02 0.5M	May 26, 2022		Soil	B22-Jn0054052	X			
16	BH02 2M	May 26, 2022		Soil	B22-Jn0054053	X			
17	BH03 0.5M	May 27, 2022		Soil	B22-Jn0054054	X			
18	BH03 1.5M	May 27, 2022		Soil	B22-Jn0054055	X			
19	BH03 4.5M	May 27, 2022		Soil	B22-	X			

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IANZ # 1290

Company Name: GHD Pty Ltd NEWCASTLE
Address: 3/24 Honeysuckle Dve
Newcastle
NSW 2300

Project Name: SPSS - ETDD
Project ID: 12551313

Order No.: 12551313
Report #: 900203
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Jun 22, 2022 9:15 AM
Due: Jun 29, 2022
Priority: 5 Day
Contact Name: Amylia Fletcher

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						HOLD	Acid Sulfate Soils Field pH Test	Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254								X	X
Sydney Laboratory - NATA # 1261 Site # 18217									
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X		
Mayfield Laboratory - NATA # 1261 Site # 25079									
Perth Laboratory - NATA # 2377 Site # 2370									
External Laboratory									
					Jn0054056				
20	BH04 0.0	Not Provided		Soil	B22-Jn0054057	X			
21	BH04 1	Not Provided		Soil	B22-Jn0054059	X			
22	BH04 2.5	Not Provided		Soil	B22-Jn0054060	X			
23	BH04 7	Not Provided		Soil	B22-Jn0054061	X			
24	BH04 4	Not Provided		Soil	B22-Jn0054062	X			
25	BH04 5.5	Not Provided		Soil	B22-Jn0054063	X			

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Brisbane Laboratory - NATA # 1261 Site # 20794						X	X		
Mayfield Laboratory - NATA # 1261 Site # 25079									
Perth Laboratory - NATA # 2377 Site # 2370									
External Laboratory									
26	BH04 8.5	Not Provided		Soil	B22-Jn0054064	X			
27	BH04 10	Not Provided		Soil	B22-Jn0054065	X			
28	BH04 11.5	Not Provided		Soil	B22-Jn0054090	X			
29	BH04 13	Not Provided		Soil	B22-Jn0054091	X			
30	BH04 14.5	Not Provided		Soil	B22-Jn0054092	X			
31	BH04 16	Not Provided		Soil	B22-Jn0054093	X			
32	BH04 17.5	Not Provided		Soil	B22-	X			

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Sydney Laboratory - NATA # 1261 Site # 18217									
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X		
Mayfield Laboratory - NATA # 1261 Site # 25079									
Perth Laboratory - NATA # 2377 Site # 2370									
External Laboratory									
					Jn0054094				
33	BH04 20	Not Provided		Soil	B22-Jn0054095	X			
Test Counts						23	8	2	2

Internal Quality Control Review and Glossary

General

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2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
Chloride			mg/kg	< 5			5	Pass	
Sulphate (as SO4)			mg/kg	< 30			30	Pass	
LCS - % Recovery									
Chloride			%	111			70-130	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)			%	94			70-130	Pass	
Sulphate (as SO4)			%	108			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Chloride	M22-Jn0060172	NCP	%	114			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B22-Jn0054038	CP	pH Units	6.0	5.9	pass	20%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Chloride	M22-Jn0060169	NCP	mg/kg	910	940	19	30%	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	M22-Jn0057292	NCP	uS/cm	140	140	<1	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	M22-Jn0060708	NCP	pH Units	8.8	8.9	pass	30%	Pass	
Resistivity*	M22-Jn0057292	NCP	ohm.m	71	70	<1	30%	Pass	
Sulphate (as SO4)	M22-Jn0060169	NCP	mg/kg	480	490	34	30%	Fail	Q02
% Moisture	M22-Jn0054455	NCP	%	11	11	1.0	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B22-Jn0054044	CP	pH Units	9.3	9.4	pass	20%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	N/A
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
Q02	The duplicate %RPD is outside the recommended acceptance criteria. Further analysis indicates sample heterogeneity as the cause
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised by:

Andrew Black	Analytical Services Manager
Caitlin Breeze	Senior Analyst-Inorganic
Linda Chouman	Senior Analyst-Sample Properties
Myles Clark	Senior Analyst-SPOCAS

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

GHD Pty Ltd
3/24 Honeysuckle Dve
Newcastle
NSW 2300

Attention: **James Petersen**

Report **909762-S**
Project name SPSS - ETDD REBATCH
Project ID 12551313
Received Date Jul 28, 2022

Client Sample ID			**BH04 1.0**	**BH04 2.5**	**BH01 0.5**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**B22-JI0059744**	**B22-JI0059745**	**B22-JI0059746**
Date Sampled			**Not Provided**[I12]	**Not Provided**[I12]	**May 26, 2022**
Test/Reference	LOR	Unit			
Acid Sulfate Soils Field pH Test					
pH-F (Field pH test)*	0.1	pH Units	5.6	6.4	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.2	4.9	-
Reaction Ratings*[S05]	0	-	1.0	1.0	-
Actual Acidity (NLM-3.2)					
pH-KCL (NLM-3.1)	0.1	pH Units	-	-	5.6
Titratable Actual Acidity (NLM-3.2)	0.003	% pyrite S	-	-	< 0.003
Titratable Actual Acidity (NLM-3.2)	2	mol H+/t	-	-	< 2
Potential Acidity - Chromium Reducible Sulfur					
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)[S04]	0.005	% S	-	-	< 0.005
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	3	mol H+/t	-	-	< 3
Extractable Sulfur					
Sulfur - KCl Extractable	0.005	% S	-	-	N/A
HCl Extractable Sulfur	0.005	% S	-	-	N/A
Retained Acidity (S-NAS)					
Net Acid soluble sulfur (SNAS) NLM-4.1	0.02	% S	-	-	N/A
Net Acid soluble sulfur (s-SNAS) NLM-4.1[S02]	0.02	% S	-	-	N/A
Net Acid soluble sulfur (a-SNAS) NLM-4.1	10	mol H+/t	-	-	N/A
HCl Extractable Sulfur Correction Factor	1	factor	-	-	2.0
Acid Neutralising Capacity (ANCbt)					
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	0.01	% CaCO3	-	-	N/A
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)[S03]	0.02	% S	-	-	N/A
Acid Neutralising Capacity - (a-ANCbt) (NLM-5.2)	2	mol H+/t	-	-	N/A
ANC Fineness Factor		factor	-	-	1.5
Net Acidity (Including ANC)					
CRS Suite - Net Acidity - NASSG (Including ANC)	0.02	% S	-	-	< 0.02
CRS Suite - Net Acidity - NASSG (Including ANC)	10	mol H+/t	-	-	< 10
CRS Suite - Liming Rate - NASSG (Including ANC)[S01]	1	kg CaCO3/t	-	-	< 1
Extraneous Material					
<2mm Fraction	0.005	g	-	-	250
>2mm Fraction	0.005	g	-	-	< 0.005
Analysed Material	0.1	%	-	-	100
Extraneous Material	0.1	%	-	-	< 0.1
% Moisture	1	%	-	-	9.0

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Acid Sulfate Soils Field pH Test	Brisbane	Aug 02, 2022	7 Days
- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests			
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	Aug 01, 2022	6 Week
- Method: LTM-GEN-7070 Chromium Reducible Sulfur Suite			
Extraneous Material	Brisbane	Aug 01, 2022	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Jul 29, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

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Project Name: SPSS - ETDD REBATCH
Project ID: 12551313

Order No.: 12551313
Report #: 909762
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Jul 28, 2022 2:37 PM
Due: Aug 4, 2022
Priority: 5 Day
Contact Name: Amylia Fletcher

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						HOLD	Acid Sulfate Soils Field pH Test	Chromium Reducible Sulfur Suite	Moisture Set
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X	X	X
External Laboratory									
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
1	BH04 1.0	Not Provided		Soil	B22-Jl0059744		X		
2	BH04 2.5	Not Provided		Soil	B22-Jl0059745		X		
3	BH01 0.5	May 26, 2022		Soil	B22-Jl0059746			X	X
4	BH04 0.5	Not Provided		Soil	B22-Jl0059747	X			
Test Counts						1	2	1	1

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NTU: Nephelometric Turbidity Units
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Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery							
Actual Acidity (NLM-3.2)							
pH-KCL (NLM-3.1)	%	97			80-120	Pass	
Titratable Actual Acidity (NLM-3.2)	%	94			80-120	Pass	
LCS - % Recovery							
Potential Acidity - Chromium Reducible Sulfur							
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)	%	100			80-120	Pass	
LCS - % Recovery							
Extractable Sulfur							
HCl Extractable Sulfur	%	106			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B22-JI0059610	NCP	pH Units	7.2	7.2	pass	20%	Pass	
Duplicate									
Actual Acidity (NLM-3.2)				Result 1	Result 2	RPD			
pH-KCL (NLM-3.1)	L22-JI0061212	NCP	pH Units	5.0	5.0	<1	20%	Pass	
Titratable Actual Acidity (NLM-3.2)	L22-JI0061212	NCP	% pyrite S	0.012	0.012	2.0	30%	Pass	
Titratable Actual Acidity (NLM-3.2)	L22-JI0061212	NCP	mol H+/t	7.3	7.2	2.0	20%	Pass	
Duplicate									
Potential Acidity - Chromium Reducible Sulfur				Result 1	Result 2	RPD			
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)	L22-JI0061212	NCP	% S	< 0.005	< 0.005	<1	20%	Pass	
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	L22-JI0061212	NCP	mol H+/t	< 3	< 3	<1	30%	Pass	
Duplicate									
Extractable Sulfur				Result 1	Result 2	RPD			
Sulfur - KCl Extractable	L22-JI0061212	NCP	% S	N/A	N/A	N/A	30%	Pass	
HCl Extractable Sulfur	L22-JI0061212	NCP	% S	N/A	N/A	N/A	20%	Pass	
Duplicate									
Retained Acidity (S-NAS)				Result 1	Result 2	RPD			
Net Acid soluble sulfur (SNAS) NLM-4.1	L22-JI0061212	NCP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur (s-SNAS) NLM-4.1	L22-JI0061212	NCP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur (a-SNAS) NLM-4.1	L22-JI0061212	NCP	mol H+/t	N/A	N/A	N/A	30%	Pass	
Duplicate									
Acid Neutralising Capacity (ANCbt)				Result 1	Result 2	RPD			
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	L22-JI0061212	NCP	% CaCO3	N/A	N/A	N/A	20%	Pass	
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)	L22-JI0061212	NCP	% S	N/A	N/A	N/A	30%	Pass	
ANC Fineness Factor	L22-JI0061212	NCP	factor	1.5	1.5	<1	30%	Pass	
Duplicate									
Net Acidity (Including ANC)				Result 1	Result 2	RPD			
CRS Suite - Net Acidity - NASSG (Including ANC)	L22-JI0061212	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
CRS Suite - Net Acidity - NASSG (Including ANC)	L22-JI0061212	NCP	mol H+/t	< 10	< 10	<1	30%	Pass	
CRS Suite - Liming Rate - NASSG (Including ANC)	L22-JI0061212	NCP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B22-JI0059495	NCP	%	5.9	6.2	5.1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	N/A
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
I12	Where sampling date has not been provided, Eurofins | Environment Testing is not able to determine whether analysis has been performed within recommended holding times.
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised by:

Andrew Black	Analytical Services Manager
Jonathon Angell	Senior Analyst-Sample Properties
Myles Clark	Senior Analyst-SPOCAS

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Appendix F

Geophysical survey report

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Report

MACLEAY ARM HDD – MARINE GEOPHYSICAL INVESTIGATION

Date: 28 July 2022

Job Number: GBGA2566

SHALLOW

GEOPHYSICAL

INVESTIGATIONS

DETAILS

Project Number:	GBGA2566
Document Title:	Macleay Arm HDD – Marine Geophysical Investigation
Site Address:	Macleay Arm – Stuarts Point
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DOCUMENT HISTORY

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2			
3			

DISTRIBUTION

Revision	Paper	Paper	Issued to	Date issued
Draft	1	0	Amylia Fletcher, GHD	28/07/2022
1				
2				
3				

Contents

Table of Figures

List of Tables

1 INTRODUCTION

At the request of GHD, GBG Australia Pty Ltd (part of GBG Group) carried out a marine geophysical investigation. The investigation was required as part of the planning phase for a Horizontal Direction Drill (HDD) across Macleay Arm at Stuarts Point.

The investigation included Single Beam Echosounder (SBES), Sub-Bottom Profiling (SBP) and Marine Seismic Refraction in both Transition Zone and Continuous configurations.

2 GEOPHYSICAL INVESTIGATION SITE

The investigation area is located at Stuarts Point NSW with the planned HDD alignment crossing Macleay Arm. The supplied coordinates of the alignment shown in table 1.

Table 1. Supplied HDD alignment coordinates. Coordinates supplied in GDA2020 MGA 56.

Point	Easting	Northing
Entry	499355.6	6590738
Exit	499894.3	6590821

Figure 1 shows the alignment (red) overlaid on a satellite image. The other lines represent the extent of the data collection for the survey methodologies discussed further in this report. To the east, dense vegetation precluded data collection beyond what is shown by the cyan line. A detailed site plan can be found in Appendix A (GBGA2566_01 – Site Plan).

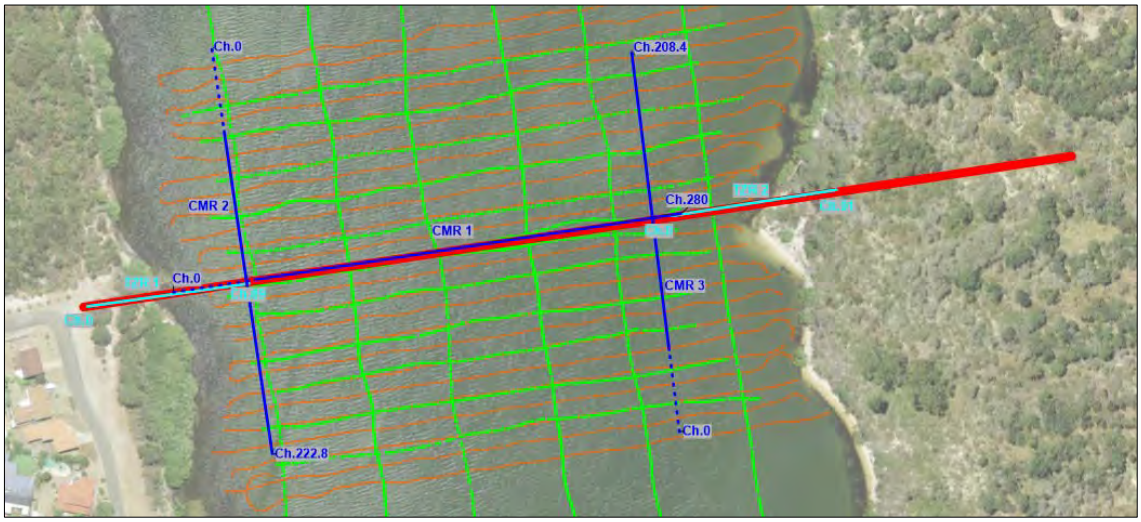

Figure 1. Satellite image with supplied HDD alignment (red) and data collection extents overlaid.

2.1.1 Positioning

All GNSS data presented in this report is given in MGA2020 zone 56 (GDA2020) and AHD (AusGeoid2020).

The coordinates of the land refraction component (of the Transition Zone Refraction (TZR) geophones and shot locations were measured using an Emlid Reach RS2 multi-band, RTK-enabled GNSS receiver. RTK corrections were streamed from the nearest AUSCORS reference station. The recorded horizontal and vertical RMS errors were 0.012 m and 0.012 m respectively.

Positioning of overwater data was done using a Trimble GNSS receiver with RTK corrections. The Trimble receiver was affixed to the survey vessel and where appropriate offset and layback distances were programmed to account for the offsets of the equipment from the GNSS receiver. The SmartNetAus DGNSS Corrections (Fixed Base) was utilised for provision of RTK corrections. A check on the accuracy of the corrections were undertaken.

3 DATA ACQUISITION

Data acquisition was completed over 3 days between Tuesday 12th July and Thursday 14th July.

GBG engaged Astute Surveying Pty Ltd for the Single Beam Echosounder (SBES) survey and for vessel and operator hire. All methods utilised Astute's vessel, Coastal Explorer (Figure 2).

Figure 2. Coastal explorer on the east side of the HDD alignment. Picture taken looking west from the bank.

3.1 SINGLE BEAM ECHOSOUNDER (SBES) – BATHYMETRY

The bathymetric mapping was undertaken by Astute Surveying Pty Ltd. The survey was conducted by Mr Ben Grey, an AHSCP Certified Practitioner (Hydrography) Level 1, from Astute Surveying's survey vessel "Coastal Explorer" with the following equipment installed:

- CEE HydroSystems – CEE ECHO (SBES)
- Trimble SPS855 RTK GNS
- Hydrographic Survey Software (Hypack 2022)
- Sound velocity profiler

Prior to testing a sound velocity cast was undertaken to correct for differences between depth and the sound velocity.

Lines were conducted at ~ 10m intervals in an east-west orientation out to 120m north and south of the HDD alignment.

3.2 SUB-BOTTOM PROFILING

SBP is a seismic reflection method whereby acoustic pulses from the source are reflected off interfaces where there is significant variation in acoustic impedance. This occurs primarily at the water-seabed interface and the sediment-rock interface. Sedimentary reflectors are also often observed. At a travel speed of 3 kn and a pulse rate of 0.333 s, the resulting data resolution along the survey line is ~0.5 m which allows for capturing of small-scale variations in the bedrock profile.

SBP data was acquired using an Applied Acoustic Boomer system. The system is comprised of a boomer plate source, similar to the source shown in Figure 3 and a 20-component, single channel hydrophone array. Both the boomer plate source and hydrophone array were towed 10 m behind the vessel and offset laterally from each other. The hydrophone array was shifted outside the turbulence of the motor using an extendable pole to ensure optimal signal quality.

Figure 3. Applied Acoustic Boomer SBP source.

The boomer source was set to an energy of 100 Joules at a pulse rate of 0.333 seconds (s). A record length of 60 milliseconds (ms) was utilised to ensure adequate depth coverage. The resulting theoretical maximum depth of investigation was 45 m (@1520m/s velocity). The sample frequency was set to 10 KHz.

Data was recorded using SonarWiz (V7.08.01, Chesapeake Technology Inc., 2021).

Lines were completed in an East-West direction at ~ 20 m intervals. Lines in the North-South direction were completed at ~50 m intervals. Coverage was completed as close as safely possible to shore.

3.3 MARINE SEISMIC REFRACTION (MSR)

Seismic refraction is a seismic method that relies on measured travel times over known distances of seismic waves generated from a seismic source. At an interface where there is a significant density contrast, the seismic wave will refract along the interface and return to the surface. The 'first arrival' time of the signal returning to the receivers (hydrophones or geophones) having travelled from the source through the sub-surface materials is picked at each receiver. Given the known distance from the source to the receivers and the arrival time of the returning signal, a velocity can be calculated. Seismic refraction measures compressional wave (P-wave) velocity. This process is repeated across multiple shot locations allowing for a P-wave distribution profile of varying sub-surface layers (refractors) to be resolved.

For this investigation, MSR was completed in both static Transition Zone Refraction (TZR) and Continuous Marine Refraction (CMR) configurations.

TZR was completed on the west and east side of the Macleay Arm. CMR was completed through the middle. An additional two CMR profiles were completed in a north-south orientation.

Both configurations mostly utilise the same equipment which is summarised below:

- The receiving array was a 24 channel, 4 m spaced receiver array (92 m). This array length was the longest practical length that could be utilised on site. The length of the array is related to the maximum achievable depth of the method and was selected to increase the likelihood of capturing the bedrock refractor.
- Two seismic sources were utilised. The marine seismic source was a 20 cubic inch Bolt Airgun which uses compressed nitrogen that is released from a chamber by a solenoid-activated piston. The land seismic source was a sledgehammer impacting a metal plate.
- Geometrics Geode digital seismograph
- RTK GNSS
- Airgun source triggering system
- Panasonic Toughbook
- 1 vessel
- GISCO radio wireless triggering system (TZR marine shots only)

Table 1 below summarises the MSR line coordinates, lengths, and configurations.

Table 2. Summary of MSR lines. Coordinates provided in GDA2020 MGA 56.

Line	Chainage	Easting	Northing	Configuration
TZR1	0	499357.6	6590738.6	TZR
	89*	499445.9	6590751.2	
TZR2	0	499676.1	6590787.8	TZR
	91*	499766.1	6590802.3	
CMR1	0	499404.5	6590746.3	CMR
	280	499681.3	6590789.3	
CMR2	0	499425.5	6590879.0	CMR
	223	499458.6	6590658.3	
CM3	0	499680.5	6590670.4	CMR
	209	499654.4	6590877.2	

N.B * *TZR chainages are presented as horizontal distance and therefore with topography considered the total distance will be less than the 92m array length.*

The data collection methodology for each configuration is described in the subheadings below.

3.3.1 Transition Zone Refraction (TZR)

For each side of Macleay Arm TZR was utilised. This involved firstly marking out the orientation of the alignment. The land component of the array was first laid out. The remainder of the array was then laid out from Coastal Explorer with a float then attached to the last hydrophone in the water to denote its location (also for retrieval). Hydrophones that were on the land were then substituted for spiked geophones. The seismic array therefore comprised of a combination of geophones and hydrophones.

The receiving equipment was setup on the land side. The airgun was setup on Coastal Explorer. Figure 4 shows the land equipment setup on the east side. Coastal Explorer is moving into position for the first air gun shot.

Figure 4. Seismic receiving equipment setup on the east side of the alignment. Picture taken looking west.

Seismic shots were then taken in the water, with the air gun lowered to the seabed and fired. The source firing is triggered and simultaneously, utilising the wireless trigger system, triggers the recording equipment close to zero time of the energy pulse. A GPS location was taken of the shot position for positioning during processing. This was repeated until the water was too shallow. At this point, land shots were completed as close to the waterline as practicable. This was repeated moving inland at suitable increments measured using a tape that was laid along the alignment. Offset shots were conducted on the west side but were not possible on the east due to impenetrable vegetation along the alignment.

3.3.2 Continuous Marine Refraction (CMR)

For the CMR, floats were attached at intervals along the array to ensure it stays just below the water surface under tow. All equipment for this configuration was loaded onto Coastal Explorer.

For CMR1, the tail end of the array was held on the western bank and released once the boat was underway. This ensured data was recorded as close in as possible.

For all CMR lines, the airgun was offset from Coastal Explorer by 5 m and suspended in the water by a large buoy. The airgun was offset from the array by 20 m. Therefore, the total distance of equipment from the back of the vessel was 117 m. This larger offset was chosen as it was observed on site during TZR data collection that the bedrock may be deep particularly on the eastern side.

Data collection involves deploying the airgun and array well before the commencement of the line. Once at the start of the line, the air gun is triggered at 3-5 second intervals whilst the vessel travels at ~3 knots. The shot triggering system triggers the seismograph directly at zero-time of the source. This is continued until the end of the line is reached.

4 GEOPHYSICAL DATA QUALITY AND PROCESSING

4.1 SBES

Bathymetry data was processed in Hypack to output an Isopac contour plan of depth in metres from AHD. No processing was required other than assessing positioning and height as part of the QA process. No tidal corrections were required as the corrections to AHD were undertaken during data collection using the Z axis output from the RTK corrected GNSS navigation stream.

The accuracy was determined to be ±0.15m @ 2 std dev.

4.2 SBP

Overall, the data quality of the SBP method was adequate. Several factors limited the achievable quality on site including:

- Compacted seabed sediments resulting in high amplitude reflections at near surface.
- Shallow water, further increasing the amplitude of near surface reflections as well as limiting the ability to increase the output energy of the source (which typically helps with penetration depth)
- Relatively deep interpreted bedrock reflector
- Interpreted bedrock reflector likely to be in different states of weathering and therefore the clarity of the response is variable.

Navigation files were exported from Sonar Wiz and utilised to produce a track plot.

SEG-Y files saved from Sonar Wiz were imported directly in to Reflex W. Within Reflex W several processing steps were applied including:

- Subtract-mean (Moves the bi polar signal over zero increasing the signal to noise)
- Bandpass Frequency Filter (to remove high frequency and low frequency noise)
- Running Average (to smooth the reflection horizons slightly to make data easier to interpret)
- Energy Decay Gain (to increase signal to noise with depth for each profile)

These steps were applied to reduce noise and amplify responses from meaningful reflectors to improve the accuracy of the picking process.

Once the processing steps were applied to the individual files, the following steps were taken:

- The interpreted reflectors were 'picked' which primarily consisted of the seabed, and the interpreted top of rock. These layers were assigned a velocity (m/s). Seabed was assigned 1525 m/s and 'sediment' assigned 1650 m/s. The velocity assignment is required to convert time into depth for the reflectors. A comparison of the result reflector depths was made against the MSR results.
- These layers were then exported from Reflex as CSV files and combined into a single file.
- The XYZ file was gridded using the Kriging interpolation algorithm in Surfer 22 (Golden Software 2021) to produce a thickness contour plot.
- The thickness contour plot was analysed for erroneous picks resulting in 'pinch' points from differing reflectors at intersection points of the survey grid. This was iteratively refined and compared with the marine seismic refraction results.
- The thickness grid file was then subtracted from the SBES data set to produce the interpreted top of rock depth contour in AHD.

4.3 MSR

Overall, the data quality of the MSR data was good. Shots collected utilising the airgun provided clear first arrivals to all receivers. Some land shots on each side utilising the hammer were of poorer quality. This was due to on the east, the large vertical height difference between the bank and the road. On the west it was due to the inability to supply sufficient energy on the vegetated, sand portion which provided an almost 'springy' mat absorbing significant amounts of energy. Stacking was performed to mitigate this as best as possible and was mostly able to be picked and utilised. In addition on this side, no offset

shots were able to be performed as beyond the end the receiving array, the vegetation became impenetrable along the alignment.

The following processing steps were applied to both continuous and static configurations:

- The acquired GPS information for shot locations was used to calculate distances between shot points for each line.
- Utilising Rayfract 3.35 (Intelligent Resources Inc.), spreads and shot geometry were transformed into an HDR file. The HDR file enables unique geometry to be input in a batch process and assigned to each file.
- First arrivals for each file were then picked.
- Elevation information
    - For TZR, as they are bottom laid, the SBES + Land elevation data grid was 'sliced' along the TZR line to generate a list of elevations and chainages. This dataset was utilised to populate a coordinate file (.COR) assigning elevations to stations and shot stations along the line. This is performed prior to modelling.
    - For CMR lines, as they are surface towed no elevation is input into the software prior to modelling. The resulting profile from the software is vertically shifted up or down to account for tide. A 'Blanking file' (.bln) in Surfer 22 (Golden Software 2021) is created from the SBES grid having been 'sliced' along the CMR line as with the TZR. The original resulting output from Rayfract is then 'blanked' to remove the water column and present data below the seabed.
- An initial layer model is generated from the picked data in Rayfract 3.35. This starting model is then utilised for Wavefront Eikonal Tomographic (WET) modelling which produces the grid files.
- Grid files are then imported into Surfer 22 for drafting and elevation correction for continuous lines.

5 RESULTS AND INTERPRETATION

The results of the geophysical investigation have been provided in the following drawings attached in Appendix A of this report:

- GBGA2566_01 – Site Plan
- GBGA2566_02 - SBES
- GBGA2566_03 - SBP
- GBGA2566_04 - TZR
- GBGA2566_05 - CMR
- GBGA2566_06 – Combined TZR & CMR

Drawing GBGA2566_01 presents the site plan. The CMR line is broken into solid and dotted and is described in the legend as ‘data extents’ and ‘collection extents’ respectively. This is done to show where the first receiver was placed from and where the data is presented from. The 45 m of dotted line from each CMR line, is due to the single offset nature of the CMR data collection and therefore when modelled, is only presented from 45 m.

Drawing GBGA2566_02 presents the results of the Single Beam Echosounder (SBES) survey. The SBES results have also been combined with the land GPS readings from the TZR lines to provide a continuous elevation model across the planned HDD alignment. TZR, and CMR lines have been overlaid for reference.

Drawing GBGA256_03 presents the results of the Sub-Bottom Profiling (SBP) survey. The contour presents the top of rock interpretation in metres AHD. As stated in the data quality statement in section 4.2, the clarity of the interpreted bedrock reflector was variable across the site which suggests variable states of weathering. Generally, the broad trend across the contour plan is the rock deepens toward the east which is expected given the barrier beach setting to the east. Across the HDD alignment, however, there appears to be a shallower isolated area in the east.

Throughout the SBP reflection profiles there is evidence of small hyperbolic reflectors in the sediment profile which may indicate the presence of buried boulders or rocks. Figure 5 shows an example of this. This may be of relevance to the HDD operations. In addition, figure 5 shows an example of how the interpreted top of rock reflector clarity reduces toward the right of the figure.

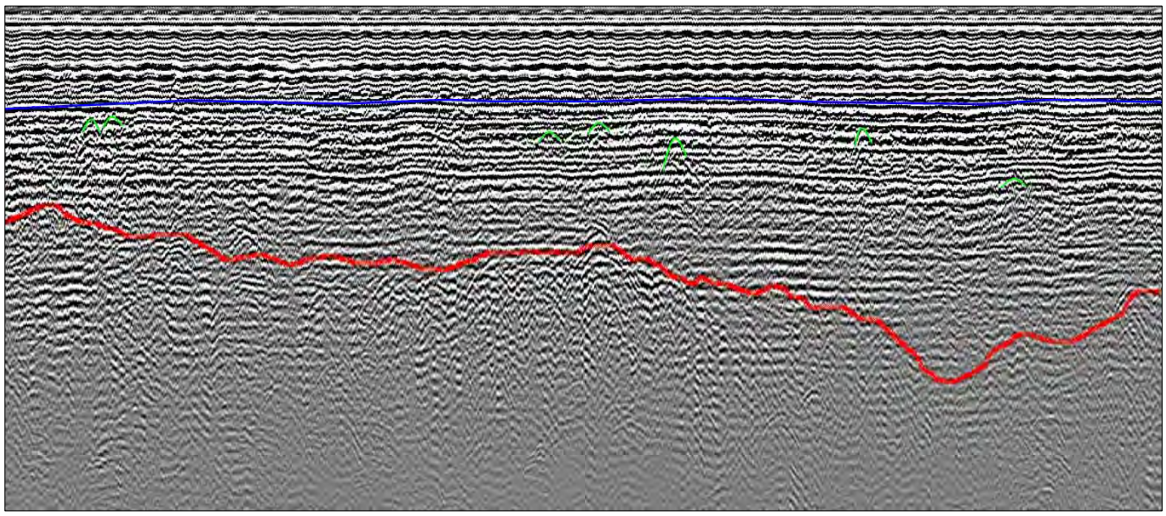

Figure 5. Example SBP profile. Blue line presents the seabed. Red line represents the top of rock interpretation. Green hyperbolas indicate possible rocks suspended in sediment.

Drawing GBGA2566_04 presents the Transition Zone Refraction (TZR) results. Both profiles are presented west to east and corrected for topography. The start and end coordinates of the lines have been added to each profile. Where the lines intersect the SBP grid, the SBP grid has been ‘sliced’ and overlaid as the green polyline on the profiles. This has partly

informed the top of rock interpretation of the refraction results at approximately 2000 m/s. At the 2000 m/s contour interval the correlation with the SBP is reasonable.

Drawing GBGA2566_05 presents the results of the Continuous Marine Refraction (CMR). Each profile is presented in the direction it was collected and noted on the top axis of each profile. The start and end coordinates of the lines have been added to each profile. Like the TZR results, the SBP contour has been 'sliced' and overlaid as the green polyline on the profiles. Like the TZR results, the 2000m/s contour is also reasonably consistent with the SBP.

Drawing GBGA2566_06 presents the combined results of the two TZR profiles and the CMR1 profile. This combination represents the collation of the 2D datasets along the planned HDD alignment. The start and end coordinates of the lines have been added. TZR profiles provide a higher-level detail due to the nature of this configuration whereby shots are taken throughout the spread, not just at a constant offset for the CMR profiles. The correlation between the datasets provides confidence in the interpretations made.

6 CONCLUSIONS

A marine geophysical investigation was conducted across a proposed HDD alignment spanning Macleay Arm at Stuarts Point.

The results have been interpreted to show a likely bedrock interface occurring between 10 and 20m AHD across the alignment. The rock broadly dips down toward the east with an isolated rise almost directly along the alignment in the east. Although there is a broad trend, there is variability in the interpreted rock level.

Within the SBP results there is evidence of isolated suspended harder material which may represent rock (boulders/cobbles). This may be of significance to the planned HDD activities.

For and on behalf of

GBG Australia

Taylor Willick. BSc Geophysics & Geology

Senior Geophysicist

APPENDIX A. DRAWINGS

SITE PLAN

LEGEND:

- Transition Zone Refraction (TZR) Line
- Continuous Marine Refraction (CMR) Line (Data Extents)
- Continuous Marine Refraction (CMR) Line (Collection Extents)
- Sub-Bottom Profiling (SBP) Track Plot
- Single Beam Echosounder (SBES) Track Plot
- **Ch.0** Chainage Label

CLIENT: GHD	DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION	SCALE: 1:2000	DRAWN: TW
	DRG No: GBGA2566_01	REV: DRAFT

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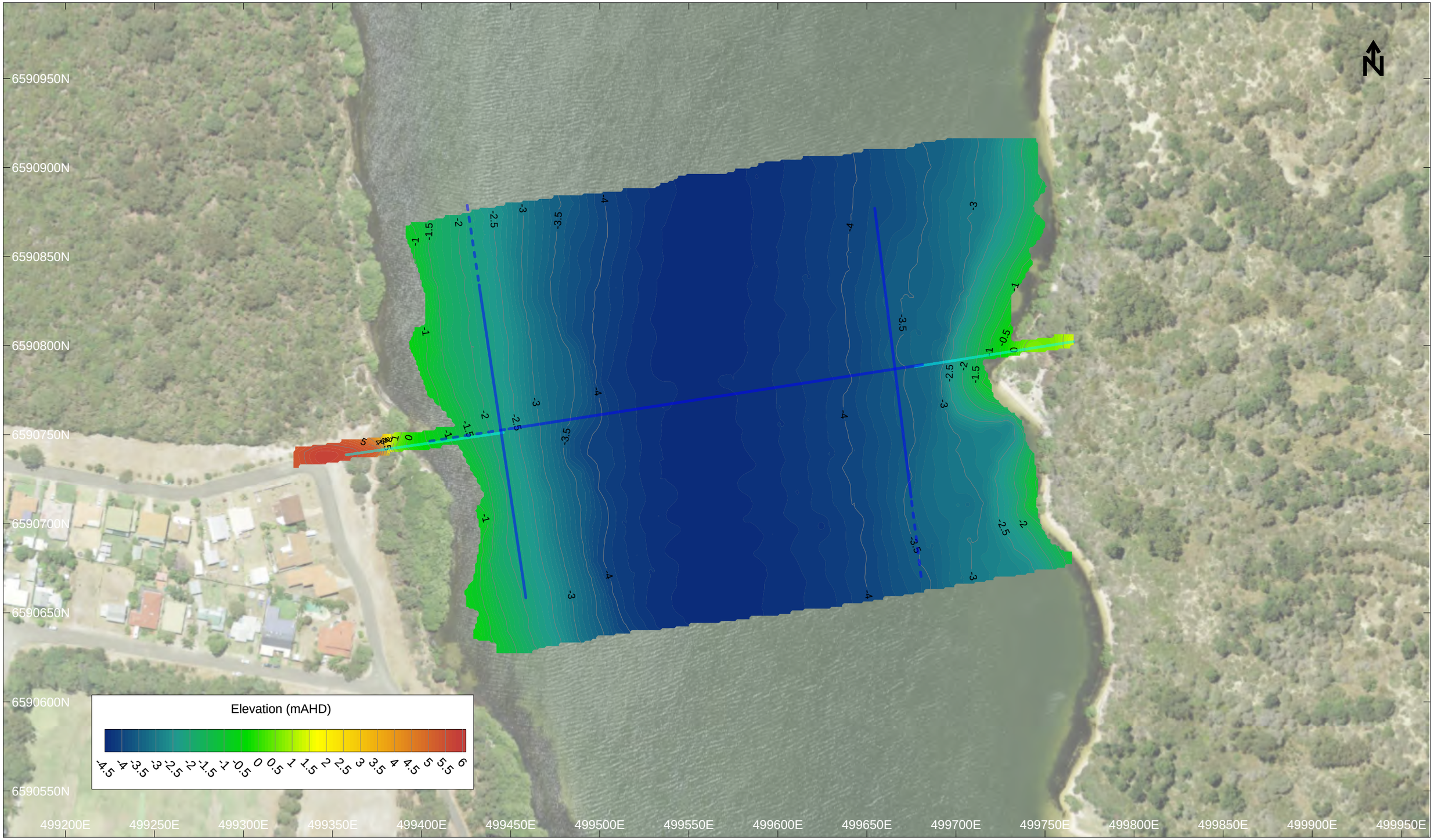
SINGLE BEAM ECHOSOUNDER (SBES) COMBINED WITH LAND HDD ALLIGNMENT CONTOUR



LEGEND:
- Transition Zone Refraction (TZR) Line
- Continuous Marine Refraction (CMR) Line (Data Extents)
- Continuous Marine Refraction (CMR) Line (Collection Extents)

CLIENT: GHD	DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION	SCALE: 1:2000	DRAWN: TW
	DRG No: GBGA2566_02	REV: DRAFT

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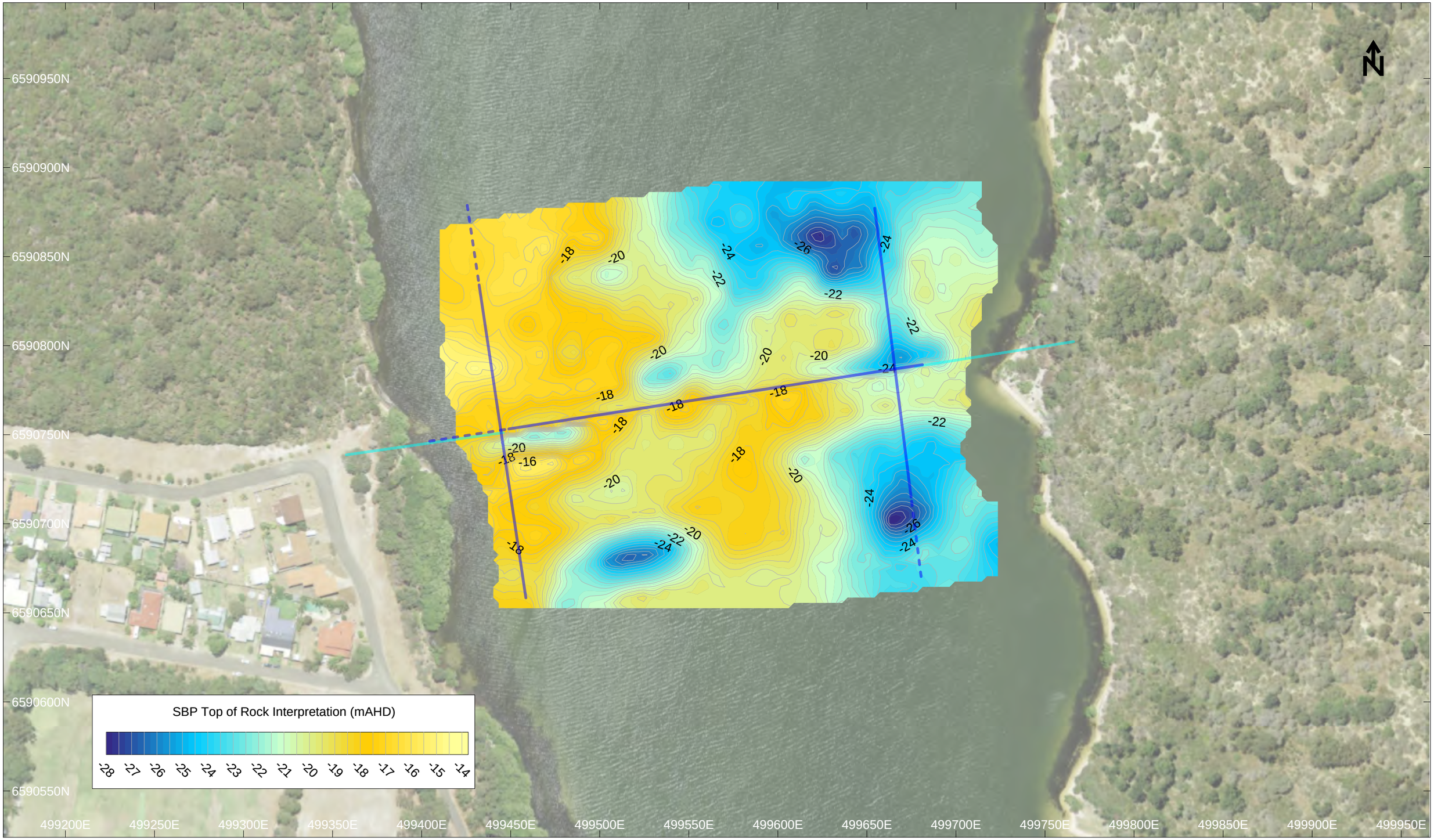
SUB-BOTTOM PROFILING (SBP) TOP OF ROCK INTERPRETATION



LEGEND:
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- Continuous Marine Refraction (CMR) Line (Data Extents)
- Continuous Marine Refraction (CMR) Line (Collection Extents)

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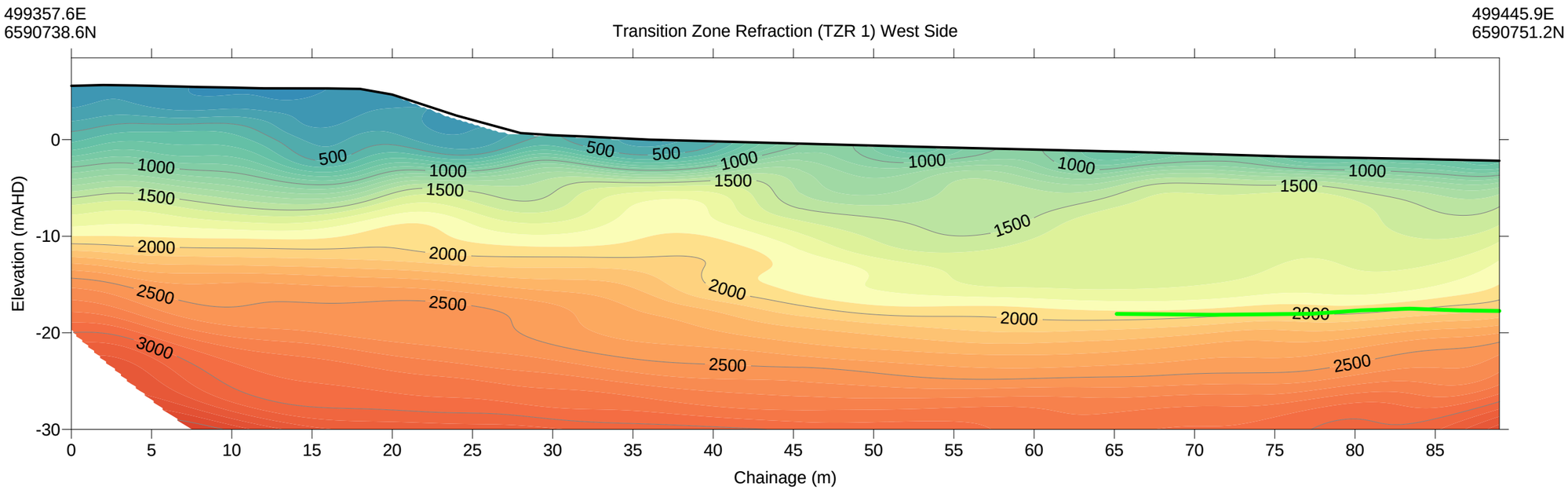
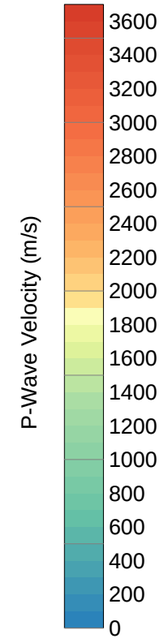
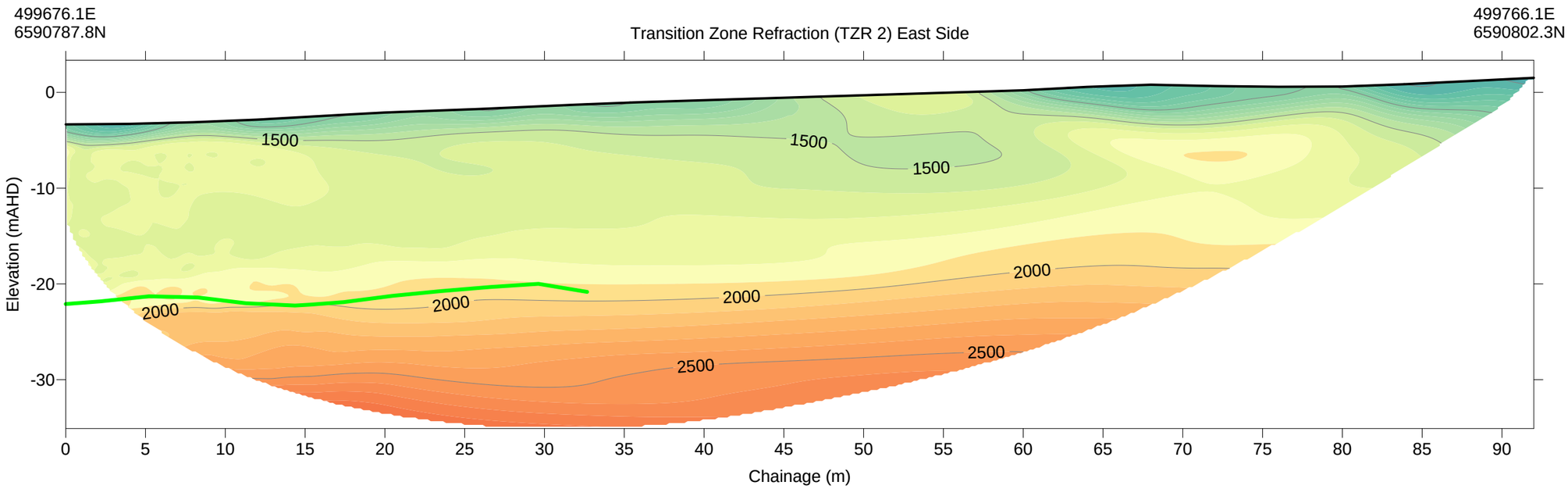
TRANSITION ZONE REFRACTION PROFILES







LEGEND:
- Elevation profile
- SBP 'Slice'

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		DRG No: GBGA2566_04	REV: DRAFT

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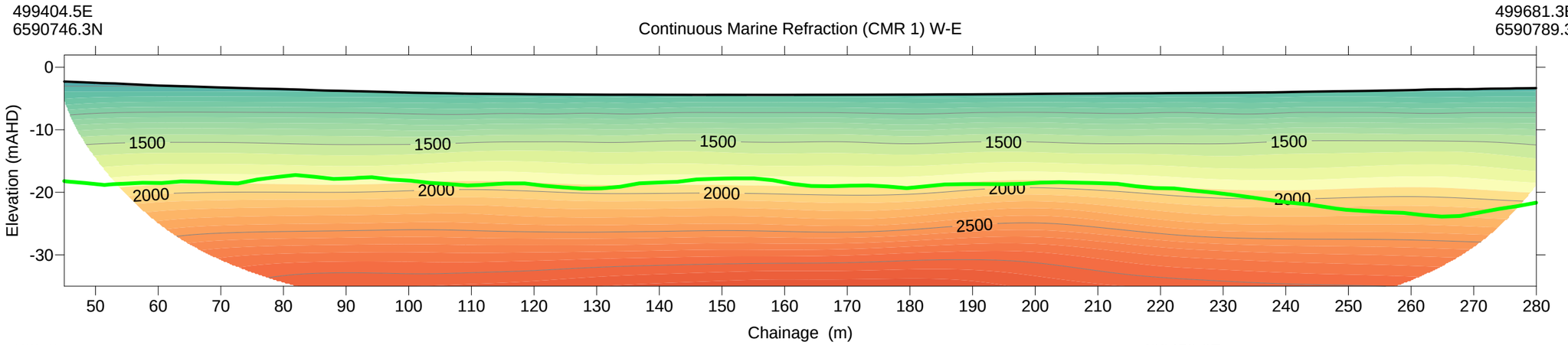
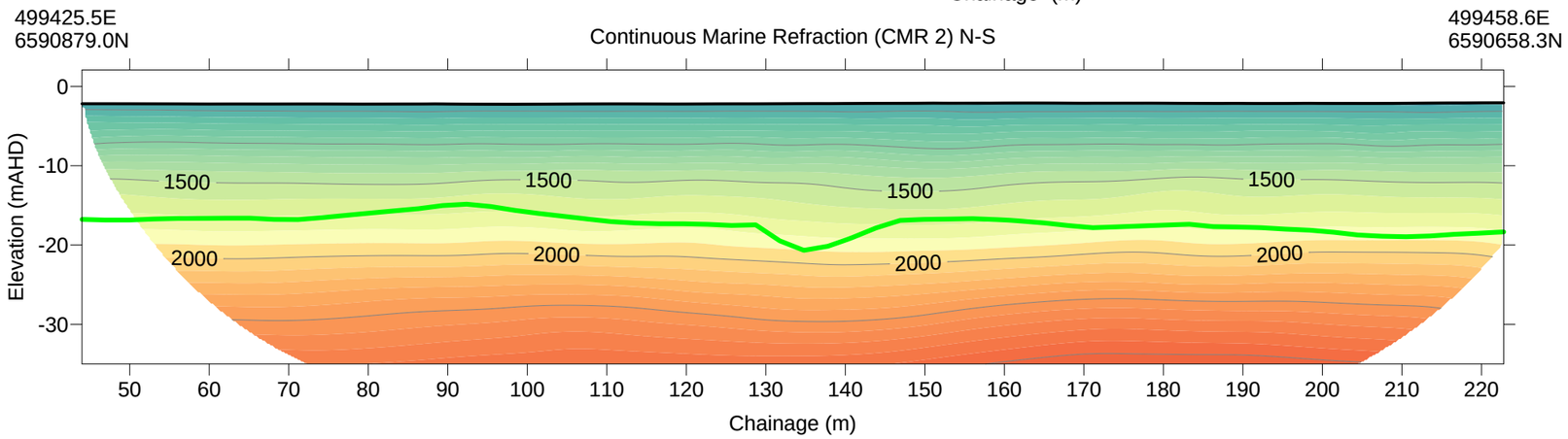
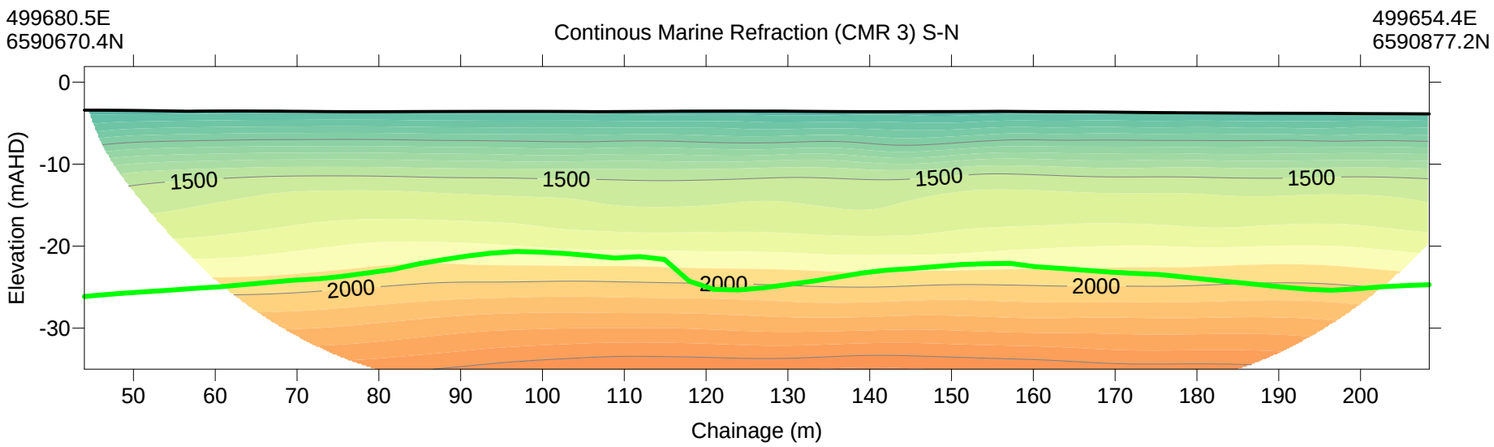
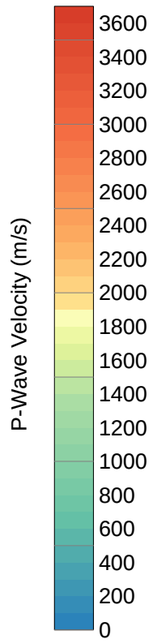
TRANSITION ZONE REFRACTION PROFILES









LEGEND:
- Elevation profile
- SBP 'Slice'

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		DRG No: GBGA2566_05	REV: DRAFT

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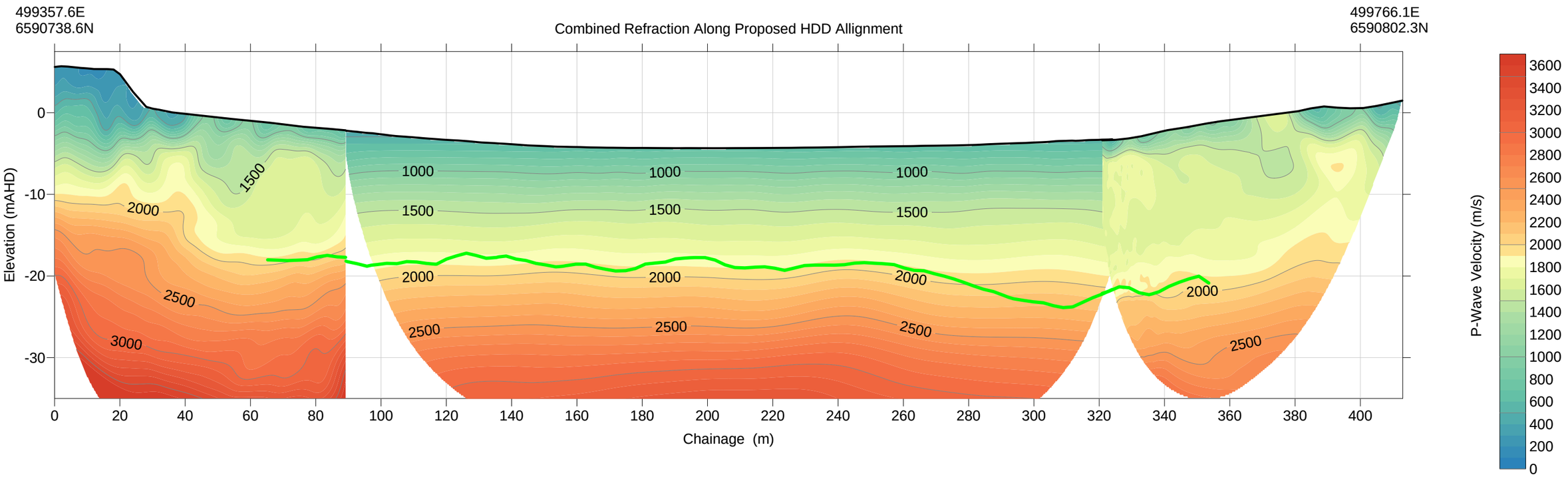
COMBINED TZR AND CMR REFRACTION PROFILES ALONG HDD ALLIGNMENT



LEGEND:

Elevation profile

SBP 'Slice'

CLIENT: GHD		DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION		SCALE: 1:750	DRAWN: TW
		DRG No: GBGA2566_06	REV: DRAFT

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Appendix B

Marine Geophysical Investigation Report

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Report

MACLEAY ARM HDD – MARINE GEOPHYSICAL INVESTIGATION

Date: 28 July 2022

Job Number: GBGA2566

SHALLOW

GEOPHYSICAL

INVESTIGATIONS

DETAILS

Project Number:	GBGA2566
Document Title:	Macleay Arm HDD – Marine Geophysical Investigation
Site Address:	Macleay Arm – Stuarts Point
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DOCUMENT HISTORY

Revision	Prepared by	Reviewed by	Date issued
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2			
3			

DISTRIBUTION

Revision	Paper	Paper	Issued to	Date issued
Draft	1	0	Amylia Fletcher, GHD	28/07/2022
1				
2				
3				

Contents

Table of Figures

List of Tables

1 INTRODUCTION

At the request of GHD, GBG Australia Pty Ltd (part of GBG Group) carried out a marine geophysical investigation. The investigation was required as part of the planning phase for a Horizontal Direction Drill (HDD) across Macleay Arm at Stuarts Point.

The investigation included Single Beam Echosounder (SBES), Sub-Bottom Profiling (SBP) and Marine Seismic Refraction in both Transition Zone and Continuous configurations.

2 GEOPHYSICAL INVESTIGATION SITE

The investigation area is located at Stuarts Point NSW with the planned HDD alignment crossing Macleay Arm. The supplied coordinates of the alignment shown in table 1.

Table 1. Supplied HDD alignment coordinates. Coordinates supplied in GDA2020 MGA 56.

Point	Easting	Northing
Entry	499355.6	6590738
Exit	499894.3	6590821

Figure 1 shows the alignment (red) overlaid on a satellite image. The other lines represent the extent of the data collection for the survey methodologies discussed further in this report. To the east, dense vegetation precluded data collection beyond what is shown by the cyan line. A detailed site plan can be found in Appendix A (GBGA2566_01 – Site Plan).

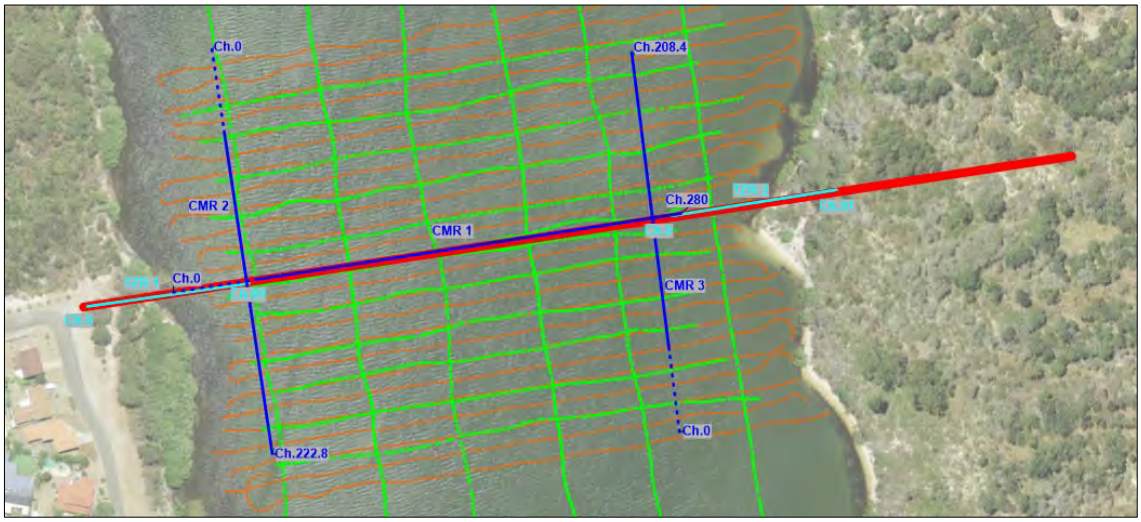

Figure 1. Satellite image with supplied HDD alignment (red) and data collection extents overlaid.

2.1.1 Positioning

All GNSS data presented in this report is given in MGA2020 zone 56 (GDA2020) and AHD (AusGeoid2020).

The coordinates of the land refraction component (of the Transition Zone Refraction (TZR) geophones and shot locations were measured using an Emlid Reach RS2 multi-band, RTK-enabled GNSS receiver. RTK corrections were streamed from the nearest AUSCORS reference station. The recorded horizontal and vertical RMS errors were 0.012 m and 0.012 m respectively.

Positioning of overwater data was done using a Trimble GNSS receiver with RTK corrections. The Trimble receiver was affixed to the survey vessel and where appropriate offset and layback distances were programmed to account for the offsets of the equipment from the GNSS receiver. The SmartNetAus DGNSS Corrections (Fixed Base) was utilised for provision of RTK corrections. A check on the accuracy of the corrections were undertaken.

3 DATA ACQUISITION

Data acquisition was completed over 3 days between Tuesday 12th July and Thursday 14th July.

GBG engaged Astute Surveying Pty Ltd for the Single Beam Echosounder (SBES) survey and for vessel and operator hire. All methods utilised Astute's vessel, Coastal Explorer (Figure 2).

Figure 2. Coastal explorer on the east side of the HDD alignment. Picture taken looking west from the bank.

3.1 SINGLE BEAM ECHOSOUNDER (SBES) – BATHYMETRY

The bathymetric mapping was undertaken by Astute Surveying Pty Ltd. The survey was conducted by Mr Ben Grey, an AHSCP Certified Practitioner (Hydrography) Level 1, from Astute Surveying's survey vessel "Coastal Explorer" with the following equipment installed:

- CEE HydroSystems – CEE ECHO (SBES)
- Trimble SPS855 RTK GNS
- Hydrographic Survey Software (Hypack 2022)
- Sound velocity profiler

Prior to testing a sound velocity cast was undertaken to correct for differences between depth and the sound velocity.

Lines were conducted at ~ 10m intervals in an east-west orientation out to 120m north and south of the HDD alignment.

3.2 SUB-BOTTOM PROFILING

SBP is a seismic reflection method whereby acoustic pulses from the source are reflected off interfaces where there is significant variation in acoustic impedance. This occurs primarily at the water-seabed interface and the sediment-rock interface. Sedimentary reflectors are also often observed. At a travel speed of 3 kn and a pulse rate of 0.333 s, the resulting data resolution along the survey line is ~0.5 m which allows for capturing of small-scale variations in the bedrock profile.

SBP data was acquired using an Applied Acoustic Boomer system. The system is comprised of a boomer plate source, similar to the source shown in Figure 3 and a 20-component, single channel hydrophone array. Both the boomer plate source and hydrophone array were towed 10 m behind the vessel and offset laterally from each other. The hydrophone array was shifted outside the turbulence of the motor using an extendable pole to ensure optimal signal quality.

Figure 3. Applied Acoustic Boomer SBP source.

The boomer source was set to an energy of 100 Joules at a pulse rate of 0.333 seconds (s). A record length of 60 milliseconds (ms) was utilised to ensure adequate depth coverage. The resulting theoretical maximum depth of investigation was 45 m (@1520m/s velocity). The sample frequency was set to 10 KHz.

Data was recorded using SonarWiz (V7.08.01, Chesapeake Technology Inc., 2021).

Lines were completed in an East-West direction at ~ 20 m intervals. Lines in the North-South direction were completed at ~50 m intervals. Coverage was completed as close as safely possible to shore.

3.3 MARINE SEISMIC REFRACTION (MSR)

Seismic refraction is a seismic method that relies on measured travel times over known distances of seismic waves generated from a seismic source. At an interface where there is a significant density contrast, the seismic wave will refract along the interface and return to the surface. The 'first arrival' time of the signal returning to the receivers (hydrophones or geophones) having travelled from the source through the sub-surface materials is picked at each receiver. Given the known distance from the source to the receivers and the arrival time of the returning signal, a velocity can be calculated. Seismic refraction measures compressional wave (P-wave) velocity. This process is repeated across multiple shot locations allowing for a P-wave distribution profile of varying sub-surface layers (refractors) to be resolved.

For this investigation, MSR was completed in both static Transition Zone Refraction (TZR) and Continuous Marine Refraction (CMR) configurations.

TZR was completed on the west and east side of the Macleay Arm. CMR was completed through the middle. An additional two CMR profiles were completed in a north-south orientation.

Both configurations mostly utilise the same equipment which is summarised below:

- The receiving array was a 24 channel, 4 m spaced receiver array (92 m). This array length was the longest practical length that could be utilised on site. The length of the array is related to the maximum achievable depth of the method and was selected to increase the likelihood of capturing the bedrock refractor.
- Two seismic sources were utilised. The marine seismic source was a 20 cubic inch Bolt Airgun which uses compressed nitrogen that is released from a chamber by a solenoid-activated piston. The land seismic source was a sledgehammer impacting a metal plate.
- Geometrics Geode digital seismograph
- RTK GNSS
- Airgun source triggering system
- Panasonic Toughbook
- 1 vessel
- GISCO radio wireless triggering system (TZR marine shots only)

Table 1 below summarises the MSR line coordinates, lengths, and configurations.

Table 2. Summary of MSR lines. Coordinates provided in GDA2020 MGA 56.

Line	Chainage	Easting	Northing	Configuration
TZR1	0	499357.6	6590738.6	TZR
	89*	499445.9	6590751.2	
TZR2	0	499676.1	6590787.8	TZR
	91*	499766.1	6590802.3	
CMR1	0	499404.5	6590746.3	CMR
	280	499681.3	6590789.3	
CMR2	0	499425.5	6590879.0	CMR
	223	499458.6	6590658.3	
CM3	0	499680.5	6590670.4	CMR
	209	499654.4	6590877.2	

N.B * *TZR chainages are presented as horizontal distance and therefore with topography considered the total distance will be less than the 92m array length.*

The data collection methodology for each configuration is described in the subheadings below.

3.3.1 Transition Zone Refraction (TZR)

For each side of Macleay Arm TZR was utilised. This involved firstly marking out the orientation of the alignment. The land component of the array was first laid out. The remainder of the array was then laid out from Coastal Explorer with a float then attached to the last hydrophone in the water to denote its location (also for retrieval). Hydrophones that were on the land were then substituted for spiked geophones. The seismic array therefore comprised of a combination of geophones and hydrophones.

The receiving equipment was setup on the land side. The airgun was setup on Coastal Explorer. Figure 4 shows the land equipment setup on the east side. Coastal Explorer is moving into position for the first air gun shot.

Figure 4. Seismic receiving equipment setup on the east side of the alignment. Picture taken looking west.

Seismic shots were then taken in the water, with the air gun lowered to the seabed and fired. The source firing is triggered and simultaneously, utilising the wireless trigger system, triggers the recording equipment close to zero time of the energy pulse. A GPS location was taken of the shot position for positioning during processing. This was repeated until the water was too shallow. At this point, land shots were completed as close to the waterline as practicable. This was repeated moving inland at suitable increments measured using a tape that was laid along the alignment. Offset shots were conducted on the west side but were not possible on the east due to impenetrable vegetation along the alignment.

3.3.2 Continuous Marine Refraction (CMR)

For the CMR, floats were attached at intervals along the array to ensure it stays just below the water surface under tow. All equipment for this configuration was loaded onto Coastal Explorer.

For CMR1, the tail end of the array was held on the western bank and released once the boat was underway. This ensured data was recorded as close in as possible.

For all CMR lines, the airgun was offset from Coastal Explorer by 5 m and suspended in the water by a large buoy. The airgun was offset from the array by 20 m. Therefore, the total distance of equipment from the back of the vessel was 117 m. This larger offset was chosen as it was observed on site during TZR data collection that the bedrock may be deep particularly on the eastern side.

Data collection involves deploying the airgun and array well before the commencement of the line. Once at the start of the line, the air gun is triggered at 3-5 second intervals whilst the vessel travels at ~3 knots. The shot triggering system triggers the seismograph directly at zero-time of the source. This is continued until the end of the line is reached.

4 GEOPHYSICAL DATA QUALITY AND PROCESSING

4.1 SBES

Bathymetry data was processed in Hypack to output an Isopac contour plan of depth in metres from AHD. No processing was required other than assessing positioning and height as part of the QA process. No tidal corrections were required as the corrections to AHD were undertaken during data collection using the Z axis output from the RTK corrected GNSS navigation stream.

The accuracy was determined to be ±0.15m @ 2 std dev.

4.2 SBP

Overall, the data quality of the SBP method was adequate. Several factors limited the achievable quality on site including:

- Compacted seabed sediments resulting in high amplitude reflections at near surface.
- Shallow water, further increasing the amplitude of near surface reflections as well as limiting the ability to increase the output energy of the source (which typically helps with penetration depth)
- Relatively deep interpreted bedrock reflector
- Interpreted bedrock reflector likely to be in different states of weathering and therefore the clarity of the response is variable.

Navigation files were exported from Sonar Wiz and utilised to produce a track plot.

SEG-Y files saved from Sonar Wiz were imported directly in to Reflex W. Within Reflex W several processing steps were applied including:

- Subtract-mean (Moves the bi polar signal over zero increasing the signal to noise)
- Bandpass Frequency Filter (to remove high frequency and low frequency noise)
- Running Average (to smooth the reflection horizons slightly to make data easier to interpret)
- Energy Decay Gain (to increase signal to noise with depth for each profile)

These steps were applied to reduce noise and amplify responses from meaningful reflectors to improve the accuracy of the picking process.

Once the processing steps were applied to the individual files, the following steps were taken:

- The interpreted reflectors were 'picked' which primarily consisted of the seabed, and the interpreted top of rock. These layers were assigned a velocity (m/s). Seabed was assigned 1525 m/s and 'sediment' assigned 1650 m/s. The velocity assignment is required to convert time into depth for the reflectors. A comparison of the result reflector depths was made against the MSR results.
- These layers were then exported from Reflex as CSV files and combined into a single file.
- The XYZ file was gridded using the Kriging interpolation algorithm in Surfer 22 (Golden Software 2021) to produce a thickness contour plot.
- The thickness contour plot was analysed for erroneous picks resulting in 'pinch' points from differing reflectors at intersection points of the survey grid. This was iteratively refined and compared with the marine seismic refraction results.
- The thickness grid file was then subtracted from the SBES data set to produce the interpreted top of rock depth contour in AHD.

4.3 MSR

Overall, the data quality of the MSR data was good. Shots collected utilising the airgun provided clear first arrivals to all receivers. Some land shots on each side utilising the hammer were of poorer quality. This was due to on the east, the large vertical height difference between the bank and the road. On the west it was due to the inability to supply sufficient energy on the vegetated, sand portion which provided an almost 'springy' mat absorbing significant amounts of energy. Stacking was performed to mitigate this as best as possible and was mostly able to be picked and utilised. In addition on this side, no offset

shots were able to be performed as beyond the end the receiving array, the vegetation became impenetrable along the alignment.

The following processing steps were applied to both continuous and static configurations:

- The acquired GPS information for shot locations was used to calculate distances between shot points for each line.
- Utilising Rayfract 3.35 (Intelligent Resources Inc.), spreads and shot geometry were transformed into an HDR file. The HDR file enables unique geometry to be input in a batch process and assigned to each file.
- First arrivals for each file were then picked.
- Elevation information
    - For TZR, as they are bottom laid, the SBES + Land elevation data grid was 'sliced' along the TZR line to generate a list of elevations and chainages. This dataset was utilised to populate a coordinate file (.COR) assigning elevations to stations and shot stations along the line. This is performed prior to modelling.
    - For CMR lines, as they are surface towed no elevation is input into the software prior to modelling. The resulting profile from the software is vertically shifted up or down to account for tide. A 'Blanking file' (.bln) in Surfer 22 (Golden Software 2021) is created from the SBES grid having been 'sliced' along the CMR line as with the TZR. The original resulting output from Rayfract is then 'blanked' to remove the water column and present data below the seabed.
- An initial layer model is generated from the picked data in Rayfract 3.35. This starting model is then utilised for Wavefront Eikonal Tomographic (WET) modelling which produces the grid files.
- Grid files are then imported into Surfer 22 for drafting and elevation correction for continuous lines.

5 RESULTS AND INTERPRETATION

The results of the geophysical investigation have been provided in the following drawings attached in Appendix A of this report:

- GBGA2566_01 – Site Plan
- GBGA2566_02 - SBES
- GBGA2566_03 - SBP
- GBGA2566_04 - TZR
- GBGA2566_05 - CMR
- GBGA2566_06 – Combined TZR & CMR

Drawing GBGA2566_01 presents the site plan. The CMR line is broken into solid and dotted and is described in the legend as ‘data extents’ and ‘collection extents’ respectively. This is done to show where the first receiver was placed from and where the data is presented from. The 45 m of dotted line from each CMR line, is due to the single offset nature of the CMR data collection and therefore when modelled, is only presented from 45 m.

Drawing GBGA2566_02 presents the results of the Single Beam Echosounder (SBES) survey. The SBES results have also been combined with the land GPS readings from the TZR lines to provide a continuous elevation model across the planned HDD alignment. TZR, and CMR lines have been overlaid for reference.

Drawing GBGA256_03 presents the results of the Sub-Bottom Profiling (SBP) survey. The contour presents the top of rock interpretation in metres AHD. As stated in the data quality statement in section 4.2, the clarity of the interpreted bedrock reflector was variable across the site which suggests variable states of weathering. Generally, the broad trend across the contour plan is the rock deepens toward the east which is expected given the barrier beach setting to the east. Across the HDD alignment, however, there appears to be a shallower isolated area in the east.

Throughout the SBP reflection profiles there is evidence of small hyperbolic reflectors in the sediment profile which may indicate the presence of buried boulders or rocks. Figure 5 shows an example of this. This may be of relevance to the HDD operations. In addition, figure 5 shows an example of how the interpreted top of rock reflector clarity reduces toward the right of the figure.

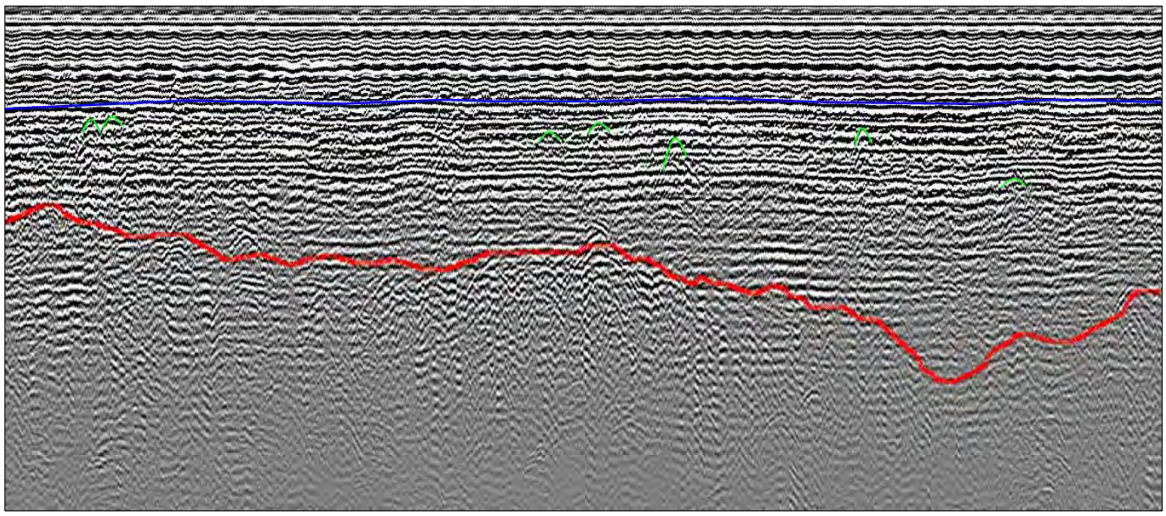

Figure 5. Example SBP profile. Blue line presents the seabed. Red line represents the top of rock interpretation. Green hyperbolas indicate possible rocks suspended in sediment.

Drawing GBGA2566_04 presents the Transition Zone Refraction (TZR) results. Both profiles are presented west to east and corrected for topography. The start and end coordinates of the lines have been added to each profile. Where the lines intersect the SBP grid, the SBP grid has been ‘sliced’ and overlaid as the green polyline on the profiles. This has partly

informed the top of rock interpretation of the refraction results at approximately 2000 m/s. At the 2000 m/s contour interval the correlation with the SBP is reasonable.

Drawing GBGA2566_05 presents the results of the Continuous Marine Refraction (CMR). Each profile is presented in the direction it was collected and noted on the top axis of each profile. The start and end coordinates of the lines have been added to each profile. Like the TZR results, the SBP contour has been 'sliced' and overlaid as the green polyline on the profiles. Like the TZR results, the 2000m/s contour is also reasonably consistent with the SBP.

Drawing GBGA2566_06 presents the combined results of the two TZR profiles and the CMR1 profile. This combination represents the collation of the 2D datasets along the planned HDD alignment. The start and end coordinates of the lines have been added. TZR profiles provide a higher-level detail due to the nature of this configuration whereby shots are taken throughout the spread, not just at a constant offset for the CMR profiles. The correlation between the datasets provides confidence in the interpretations made.

6 CONCLUSIONS

A marine geophysical investigation was conducted across a proposed HDD alignment spanning Macleay Arm at Stuarts Point.

The results have been interpreted to show a likely bedrock interface occurring between 10 and 20m AHD across the alignment. The rock broadly dips down toward the east with an isolated rise almost directly along the alignment in the east. Although there is a broad trend, there is variability in the interpreted rock level.

Within the SBP results there is evidence of isolated suspended harder material which may represent rock (boulders/cobbles). This may be of significance to the planned HDD activities.

For and on behalf of

GBG Australia

Taylor Willick. BSc Geophysics & Geology

Senior Geophysicist

APPENDIX A. DRAWINGS

SITE PLAN

LEGEND:

- Transition Zone Refraction (TZR) Line
- Continuous Marine Refraction (CMR) Line (Data Extents)
- Continuous Marine Refraction (CMR) Line (Collection Extents)
- Sub-Bottom Profiling (SBP) Track Plot
- Single Beam Echosounder (SBES) Track Plot
- **Ch.0** Chainage Label

CLIENT: GHD	DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION	SCALE: 1:2000	DRAWN: TW
	DRG No: GBGA2566_01	REV: DRAFT

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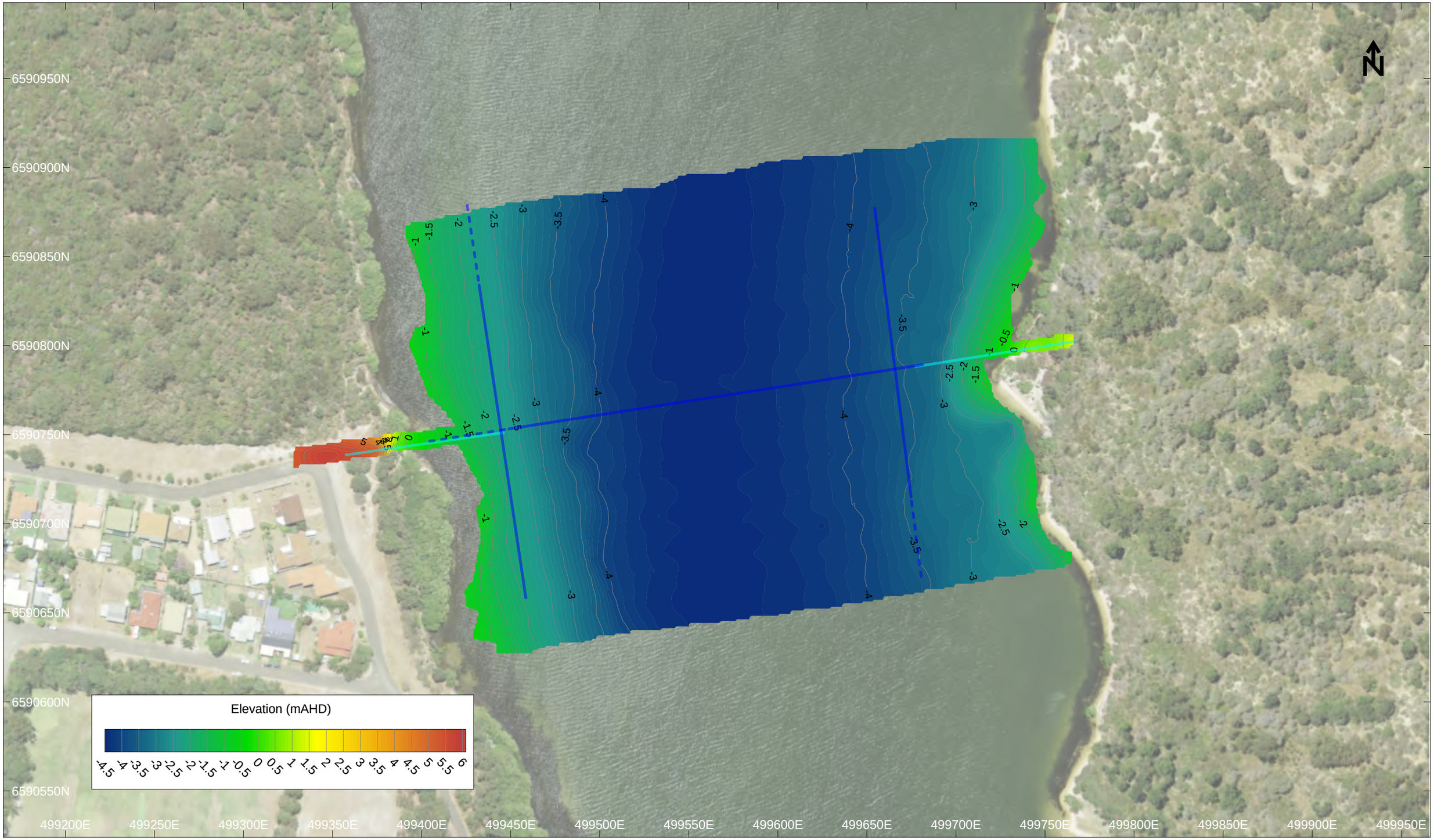
SINGLE BEAM ECHOSOUNDER (SBES) COMBINED WITH LAND HDD ALLIGNMENT CONTOUR



LEGEND:
- Transition Zone Refraction (TZR) Line
- Continuous Marine Refraction (CMR) Line (Data Extents)
- Continuous Marine Refraction (CMR) Line (Collection Extents)

CLIENT: GHD	DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION	SCALE: 1:2000	DRAWN: TW
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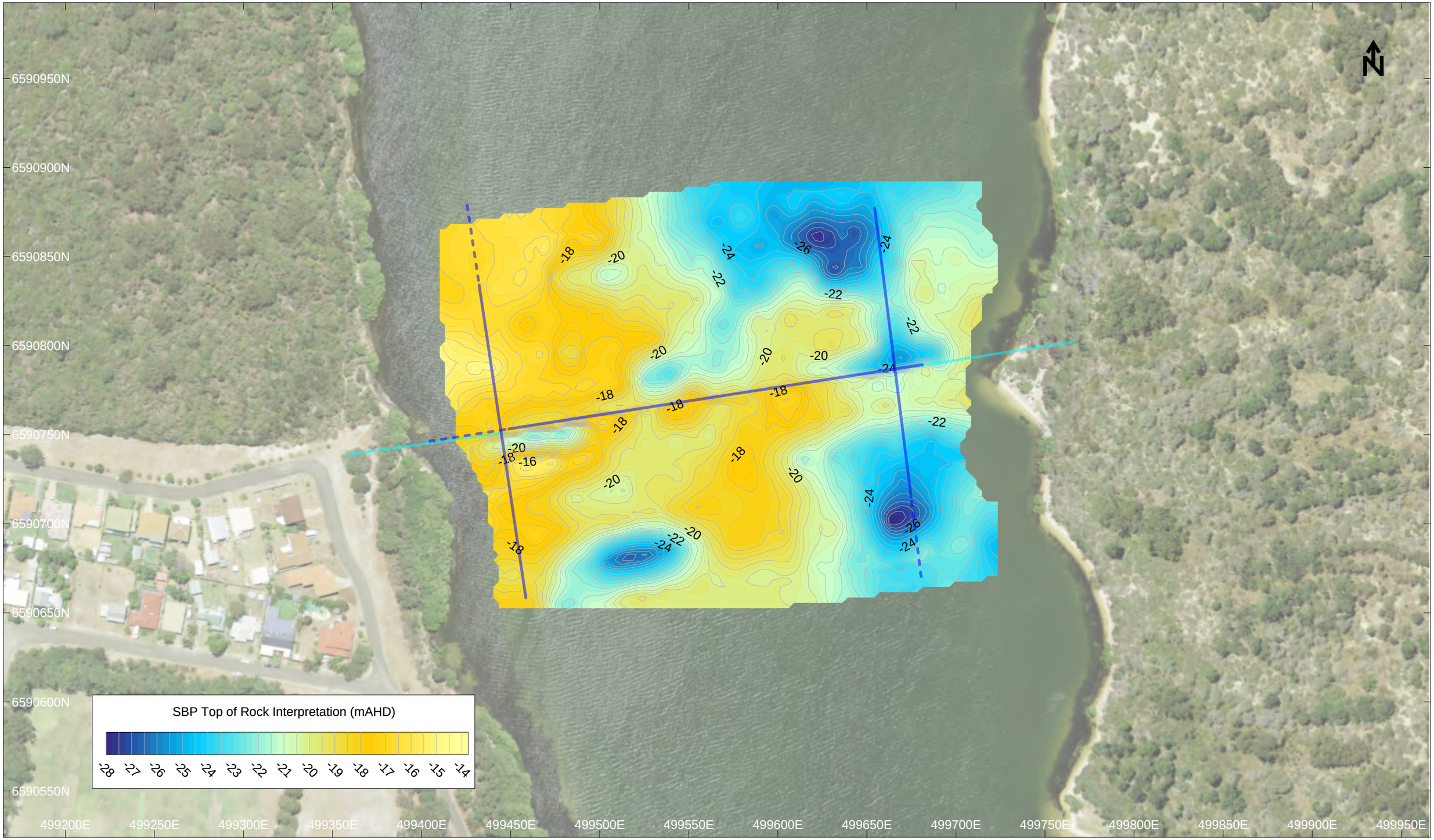
SUB-BOTTOM PROFILING (SBP) TOP OF ROCK INTERPRETATION

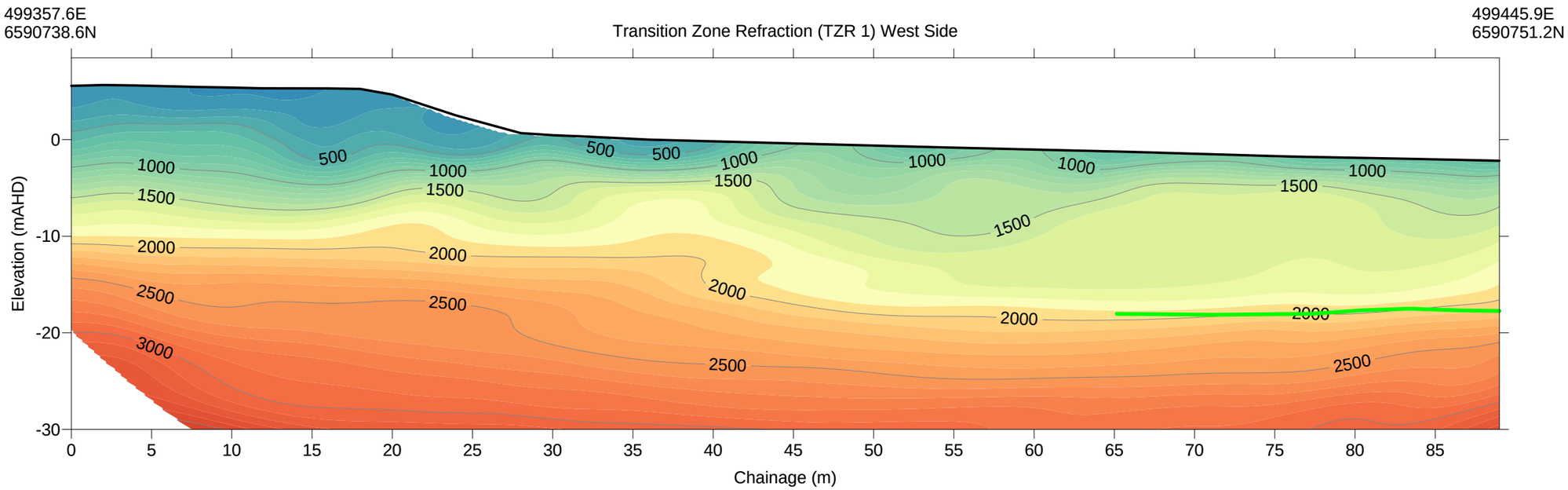


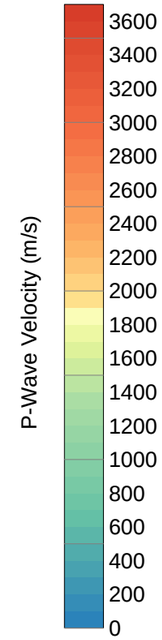
LEGEND:
- Transition Zone Refraction (TZR) Line
- Continuous Marine Refraction (CMR) Line (Data Extents)
- Continuous Marine Refraction (CMR) Line (Collection Extents)

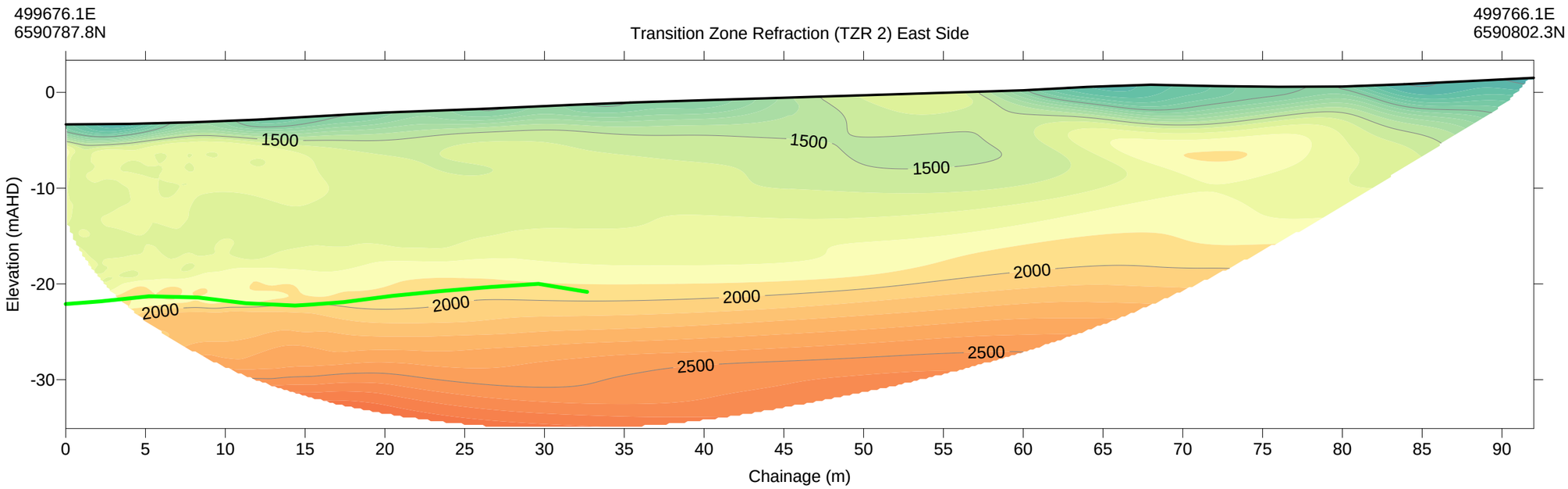
CLIENT: GHD		DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION		SCALE: 1:2000	DRAWN: TW
		DRG No: GBGA2566_03	REV: DRAFT

GBG Australia Pty. Ltd.
28/7 Salisbury Road,
Castle Hill, NSW 2154
Telephone: (02) 9890 2122
Email: info@gbgoz.com.au

TRANSITION ZONE REFRACTION PROFILES







LEGEND:
- Elevation profile
- SBP 'Slice'

CLIENT: GHD		DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION		SCALE: X-1:300 Y-1:500	DRAWN: TW
		DRG No: GBGA2566_04	REV: DRAFT

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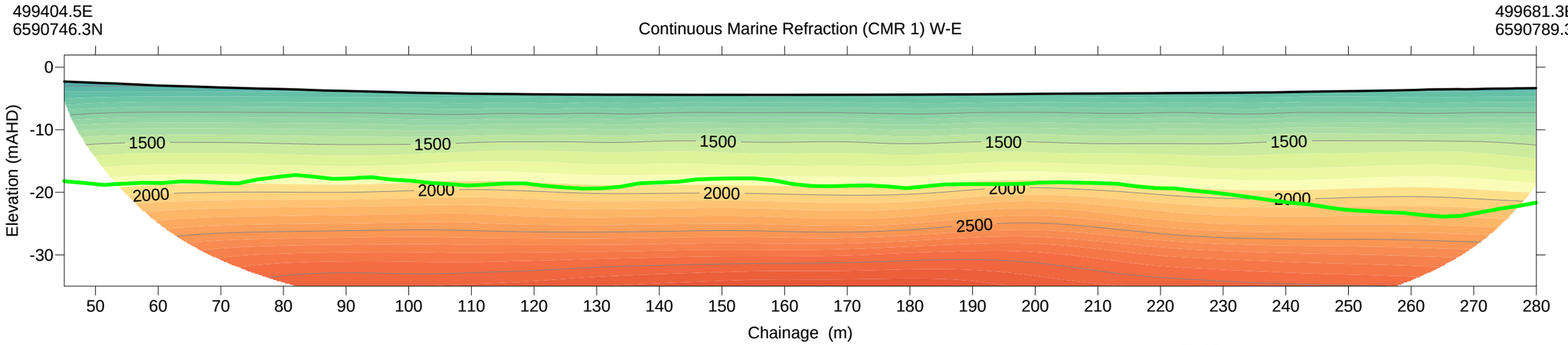
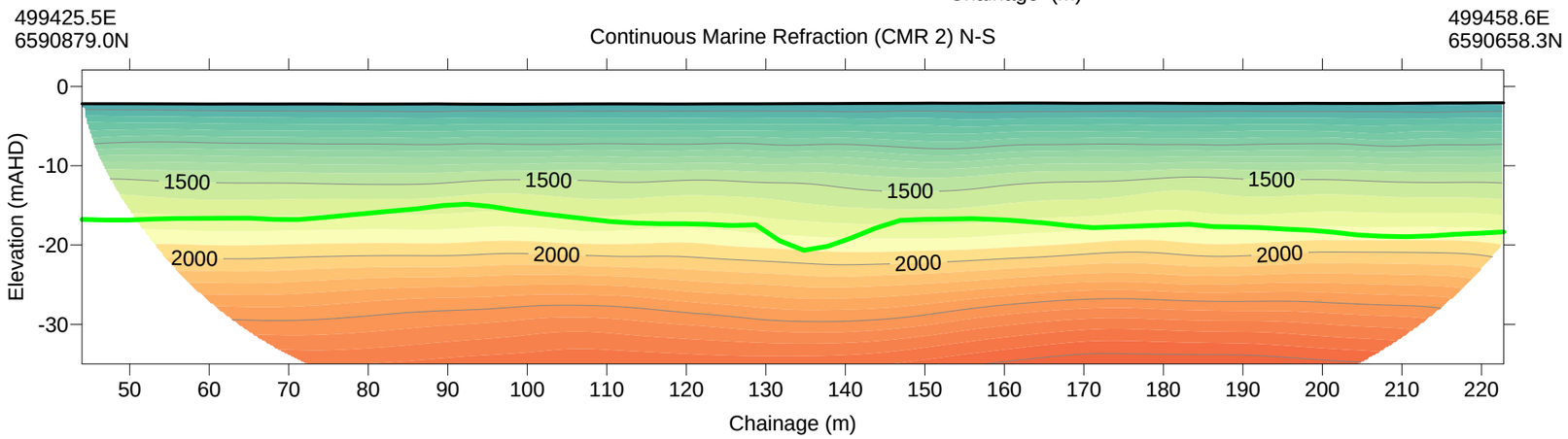
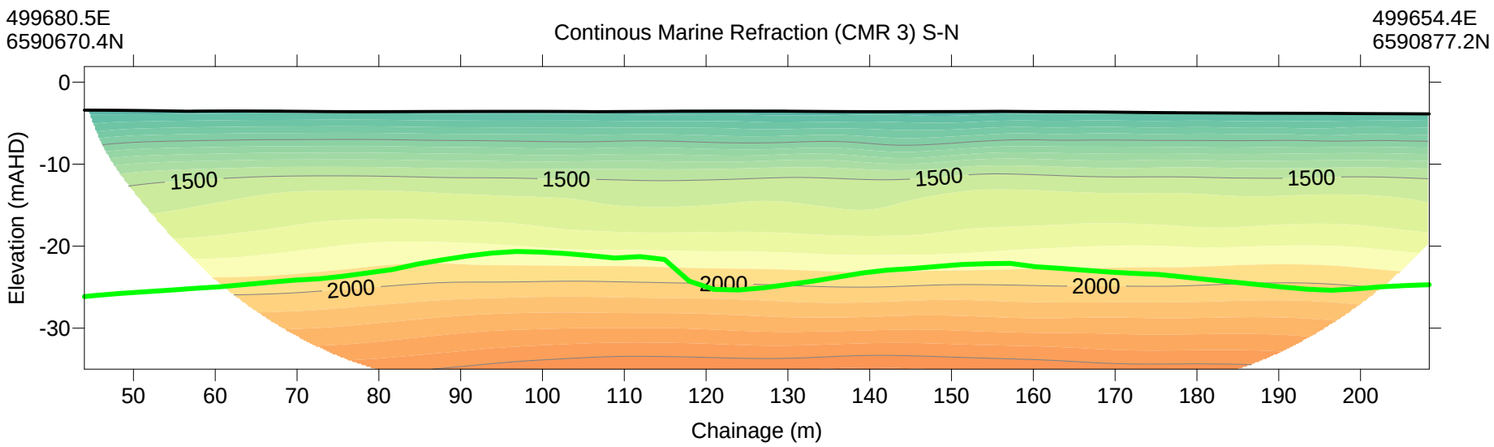
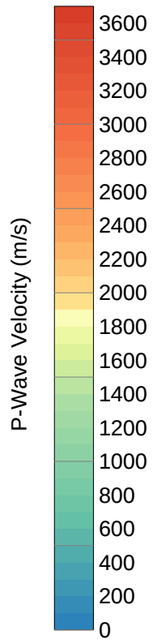
TRANSITION ZONE REFRACTION PROFILES









LEGEND:
- Elevation profile
- SBP 'Slice'

CLIENT: GHD		DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION		SCALE: 1:750	DRAWN: TW
		DRG No: GBGA2566_05	REV: DRAFT

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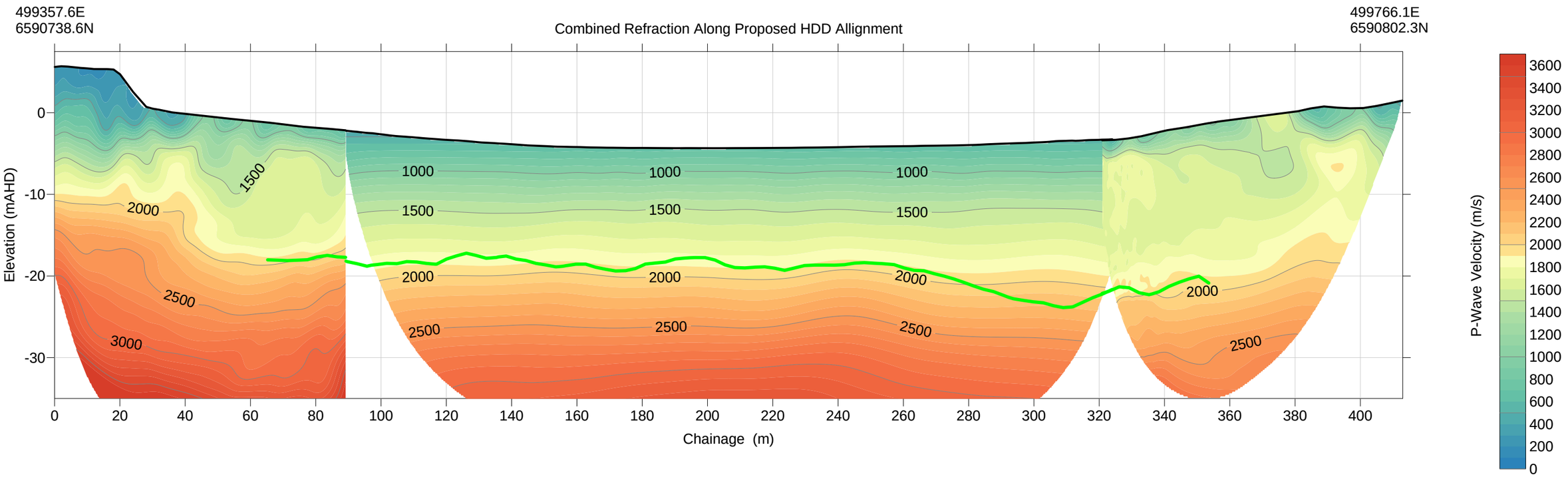
COMBINED TZR AND CMR REFRACTION PROFILES ALONG HDD ALLIGNMENT



LEGEND:

Elevation profile

SBP 'Slice'

CLIENT: GHD		DATE: 28/07/22	DATUM: GDA2020 MGA56
TITLE: STUARTS POINT - MACLEAY ARM HDD MARINE GEOPHYSICAL INVESTIGATION		SCALE: 1:750	DRAWN: TW
		DRG No: GBGA2566_06	REV: DRAFT

GBGGROUP

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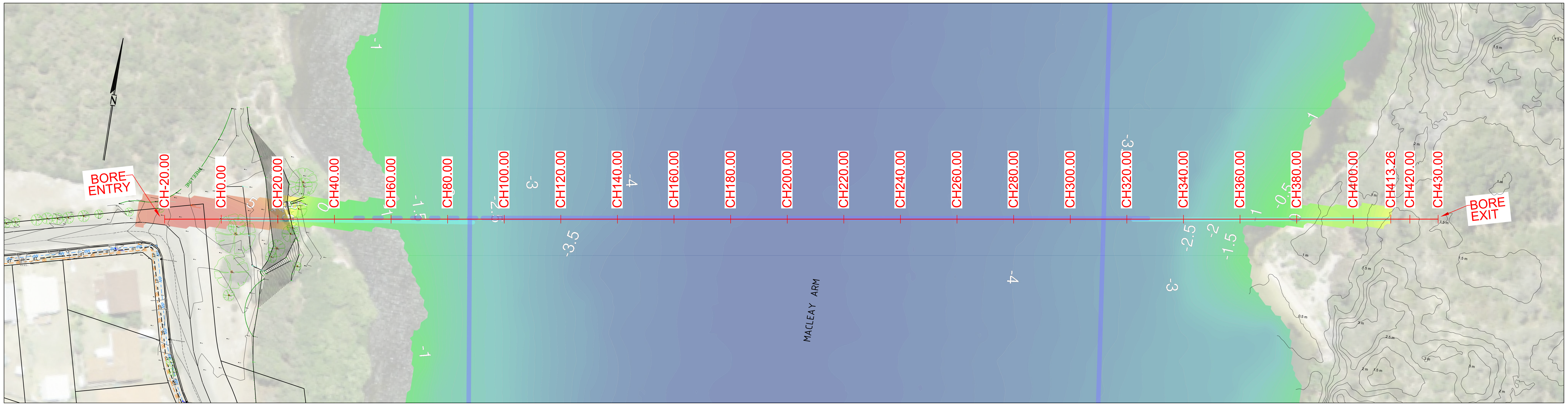
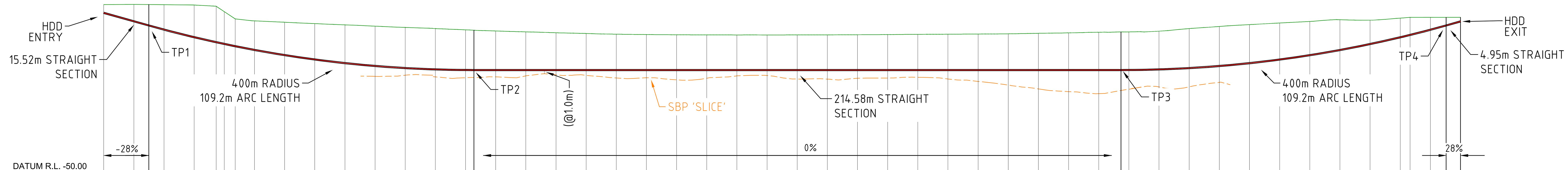
Appendix C

Macleay Arm Crossing HDD Analysis (Underbore Solutions)



ALIGNMENT PLAN
SCALE 1:800



HORIZONTAL CHAINAGE	NATURAL SURFACE	DEPTH TO BORE CENTRELINE	DESIGN LEVEL : CENTRE OF BORE
-20.00	5.73	2.73	3.00
-10.00	5.80		
-5.05	5.75	6.94	-1.19
0.00	5.70		
10.00	5.60		
17.30	5.20		
20.00	3.40		
23.60	1.00	9.08	-8.08
30.00	0.35		
40.00	-0.13		
50.00	-0.57	11.93	-12.50
60.00	-0.99		
70.00	-1.42 -18.09		
80.00	-1.84 -17.71		
90.00	-2.23 -18.27 -18.54		
100.00	-2.64		
102.80	-2.78	13.22	-16.00
110.00	-3.01 -18.27		
120.00	-3.32 -17.94		
130.00	-3.62 -17.58		
140.00	-3.86 -17.76		
150.00	-4.08 -18.62	11.92	-16.00
160.00	-4.20 -18.56		
170.00	-4.28 -19.26		
180.00	-4.31 -18.72		
190.00	-4.34 -17.93		
200.00	-4.34 -17.82	11.66	-16.00
210.00	-4.33 -18.99		
220.00	-4.31 -19.01		
230.00	-4.27 -18.71		
240.00	-4.22 -18.65		
250.00	-4.14 -18.41	11.86	-16.00
260.00	-4.10 -18.99		
270.00	-4.03 -19.77		
280.00	-3.96 -21.00		
290.00	-3.80 -22.27		
300.00	-3.65 -23.17 -23.84		
310.00	-3.44		
317.38	-3.34	12.66	-16.00
320.00	-3.32 -22.36		
330.00	-3.08 -21.61		
330.00	-2.22 -21.57		
350.00	-1.53 -20.08		
360.00	-0.90		
370.00	-0.38	12.14	-12.52
380.00	0.14		
390.00	0.73		
400.00	0.57		
410.00	1.25		
413.26	1.52		
420.00	1.50		
425.23	1.50	2.68	-1.18
430.00	1.50	1.35	0.15

LONGSECTION PLAN
SCALE HORIZONTAL 1:800 VERTICAL 1:800

16m 0 16m 32m 48m
SCALE - 1:800

450mm BOREHOLE
315mm PE PN16 CONDUIT
BORE SECTION
NOT TO SCALE

CLIENT:

www.dialbeforeyoudig.com.au
DIAL 1100 BEFORE YOU DIG
ALL UNDERGROUND SERVICES SHOULD BE LOCATED ON SITE BY RELEVANT AUTHORITIES BEFORE ANY WORK IS COMMENCED

REV.	DESCRIPTION	DRAWN	DESIGN	APPR.	DATE
A	PRELIMINARY	G.B.	DG	--	04/10/22

DESIGNED BY D. GUNNELL
DRAFTED BY G. BAKER
DESIGN CHECKED BY
APPROVED BY

UNDERBORE SOLUTIONS

UNDERBORE SOLUTIONS PTY LTD
108 KINGSWOOD ROAD
ENGADINE NSW 2233
Mobile : 0434 317767

DATE: 04.10.2022
SHEET SIZE: A1
HORIZ DATUM:
LEVEL DATUM:

PROJECT: GHD STUARTS POINT MACLEAY ARM CROSSING

TITLE: GHD STUARTS POINT MACLEAY ARM CROSSING HDD BORE ALIGNMENT AND LONGSECTION PLAN

PROJECT No. 101027
SCALE: 1: 800
SHEET 1 OF 1
REV A
DRAWING No. 101027-01

October 2022

MACLEAY ARM UNDERBORE FEASIBILITY REVIEW

GHD & KEMPSEY SHIRE COUNCIL

Stuarts Point Sewerage System – Dunal Release

ABN: 67 348 563 559

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Document History

Job Title	Stuarts Point Sewerage System – Dunal Release
Document Title	**MACLEAY ARM UNDERBORE FEASIBILITY REVIEW**
Prepared for	GHD & Kempsey Shire Council

Version	Date of Issue	Prepared by	Checked by	Approved By
Draft	13/10/2022	David Gunnell		David Gunnell
V1				
Final				

CONTENTS

1. EXECUTIVE SUMMARY

Underbore Solutions has been engaged by GHD to review the basic feasibility of the underbore alignment and profile crossing the Macleay Arm at Kimpton St in Stuarts Point to the Dunal release point to install the new 315mm PN16 PE Effluent Main. The review is to provide a desktop review of trenchless route option and provide comments and recommendations to allow GHD to further design for the Stuarts Point Sewerage System – Effluent Transfer and Disposal Design. This review will investigate the suitability of Horizontal Directional Drilling (HDD) to install the appropriate pipeline at this location.

Preliminary Topography and existing Utilities for the site along with Geotechnical Investigation was provided to allow for a preliminary HDD assessment for the crossing. The feasibility is also based on review of documents, supplied design information, and previous knowledge of underbores in similar ground conditions on similar projects.

It is expected that the underbore of Macleay Arm will be in dense to very dense wet sands above the rock /indurated sands though may also encounter loose sands at shallower depths on the way in and out of the river. These are challenging soil mediums for drilling through, though it is still suitable for HDD and can be managed with suitable drilling fluids and experienced contractors. The soft wet sands limit the ability to steer the HDD drill head so this will limit the geometry for the design and may affect the depth and length achievable for the underbore. The risk of settlement or fracout is higher if the underbore is shallower so greater depth is required to limit the risks.

To limit the risk of fracout, limit settlement potential, and limit the impact from softer loose sands an underbore with steeper entry and exit angle and a depth of at least 10m below the riverbed is likely to be suitable over the approximate 450m distance. An indicative profile has been assessed with the report for an underbore which could be achievable below Macleay Arm.

The option to drill deeper (15m+) below the river was briefly looked at and likely will further limit the risk of fracout and settlement by encountering the potentially stiffer ground conditions shown in the Seismic Analysis though this may also encounter gravels or cobbles in the layers above the rock. The drilling between the softer and hard materials may also then require casing pipes to limit the potential for fracout at the sand rock interface.

Based on the proposed connection and release points the 450m length underbore is achievable from a setup on the western side of the river in Kimpton St Stuarts Point. For the entry location the space on the side of the road is suitable to house the HDD Rig and the ancillary equipment removing the impact on the traffic at this location. The exit location in the dunes only has access for equipment from Grassy Head along the beach to the receive location. Access would need to be made for the excavator and vacuum truck / Fluid Recycling Unit along with the pipe string for installation. Track Mounted or 4x4 equipment and vehicles are likely to be used due to beach sand conditions. Conducting most works form Stuarts Points and limiting the amount of equipment required at the exit will be essential.

This underbore of Macleay Arm is considered suitable but only to be undertaken by a contractor with previous experience drilling below water ways in sandy soils.

Next steps would be for GHD and their Client, or its chosen contractor should undertake a detailed underbore design for the crossing. This will include Profile design, Hydrofracture Analysis, Settlement Analysis, Monitoring Plans and a Detailed Methodology and Fracout Management Plan.

2. INTRODUCTION

It is understood that Kempsey Shire Council contracted GHD to undertake a conceptual design, environmental assessment and geotechnical/geophysical investigation for the proposed effluent transfer infrastructure and Dunal discharge at Stuarts Point, NSW. The proposed transfer infrastructure is understood to comprise a pipeline crossing of the Macleay Arm to a disposal area located on the vegetated dunes adjacent to Stuarts Point Beach. The pipeline is proposed to be installed using trenchless technology.

Underbore Solutions has been engaged by GHD to review the basic feasibility as part of a desktop review of the underbore alignment and potential profile to install the new 315mm PN16 PE Effluent Main below Macleay Arm at Stuarts Point. This review will investigate the suitability of Horizontal Directional Drilling (HDD) to install the appropriate pipeline at this location including:

1. Appropriate drill rig size and type for this project (machine specifications)
2. Specifics around how and where the machine would be set-up
3. Challenges and risks with installing the proposed HDD
4. Recommendations

3. TRENCHLESS TECHNOLOGY

Trenchless techniques are often considered as the preferred method for installing underground assets especially under surfaces such as major roadways, under rivers and railway where conventional trenching is not a suitable option. Due to the reduced costs in restoration and minimal impacts on the ground surface, Trenchless techniques have also become popular in heavy residential and commercial areas.

When designing infrastructure, a variety of construction techniques should be considered to ensure that the correct and most efficient method is chosen. An array of information should be assessed including benefits, constraints, risks, and cost when considering the appropriate construction technique in each area. All sites are different and should be assessed as such as in most cases not one method is suitable for all installations and often a combination of Trenching and Horizontal Directional Drilling (HDD) and/or Thrust Boring is required to meet the installation needs of the project.

Trenchless Benefits

Deciding when it is appropriate to engage a Trenchless technique to install part or all an underground asset can usually come down to several major factors. All these factors should be seen as a benefit to the client and construction of the project. These being:

a) Requirement to minimise disruption and disturbance any surface structures
b) Ability to install under existing surfaces and structures (road, rail, water)
c) Minimal disturbance to sensitive areas
d) Avoid existing underground utilities
e) Ability to install under areas of limit accessibility
f) Installation in or below difficult ground conditions
g) Lower reinstatement costs
h) Lower overall project cost
i) Possible shortening of proposed routes
j) Minimising risks and impacts
k) More effective design and/or operation

Trenchless Constraints

Along with every other construction method being used, Trenchless techniques also have certain constraints restricting its practicality. When deciding on using a Trenchless technique you must ensure you investigate all parameters relating to this method. To ensure correct and practical design the project should cater for the Trenchless technique. In each individual Trenchless project, there can often be an array of issues that need to be resolved. Through careful planning and consideration in design many issues can be surmised and minimised prior to construction.

These must include:

a) Likely and achievable ground conditions to be drilled (method dependant)
b) Above and below existing structures and assets
c) Practical set up and set back distances
d) Achievable bend radius and/or Grade
e) Available area for storage or stringing out of product
f) Required depths and achievable depths at required connection points or alignment changes

g) Achievable overall underbore distances (method dependant)
h) Product specifications to be installed
i) Active and Passive Interference which could impact on the location equipment
j) Underbore Guidance – Laser guided or Pilot Tube or unguided for Thrust bores or if The HDD drill head can be located with a walk over or a wire line or gyro system

Other areas of concern

- Entry and exist depths (dewatering, shoring, zone of impact)
- Entry and exist angles (Method and equipment dependant)
- Clearances to existing utilities
- Required depths to reduce risks like the possibility of frac-outs, subsidence, or damage to existing utilities

Safe Drilling Clearances

To assign a safe drilling distance from the existing utilities, first the existing utilities must be located and potholed to confirm their depth. During design it may be beneficial to undertake a preliminary utility review that would include a DBYD inquiry, electronic location of conflicting utilities and possible potholing of those utilities thought to have a major impact on the design. These findings should be overlayed on a single plan to allow for easy assessment.

It is also worth noting that the Trenchless techniques, which rely on electronic locating of the drill head for construction, may find it difficult to maintain these required separations effectively if the locating equipment is picking up interference to the signal. One of the largest sources of active interference comes from the existing electrical cables. It may be that the underbore is required to be at greater depths for safety, outside of the standard alignment to reduce interference or it may be more practical to design the underbore away from the existing cabling where possible.

Designing a safe drilling clearance below structures and waterways requires an in-depth investigation into the geology. A geotechnical investigation including boreholes down to below the proposed depth of installation must be carried out to gather factual data for the HDD Designer and/or HDD operator to assess the potential risks of frac-out, required downhole tooling and likely pulling forces. The geotechnical investigation may also require a Geophysics Survey in between boreholes to fill in the gaps in the geotechnical data along the alignment with the interpretive model.

Set Up Requirements

HDD rigs being surface launch machines require a setback distance before they are at the required entry depth and angle. This incorporates the length of the machine, entry angle and required depth in the entry pit. In most cases it could be assumed that 10-12m would be required for the machine to reach an entry depth of 700mm. Additional lengths will be required for larger rigs or for greater entry depth. This and all other relevant requirements should be taken on a site-specific basis only.

The alignment of the pipeline and proximity of boundary fences, trees or other surface features must also be considered when looking at an available entry point for HDD. Most HDD rigs have a centreline of the rod as 1.2m to 2.5m. This means that a rig will need to encroach on the property to be able to fit within an easement close to the boundary line or if there are structures in the way that will not allow this, the bore will be required to begin outside of the alignment and be steered back on to alignment along the path. Ancillary equipment (pumps,

mixing systems, vacuum truck, support vehicle, etc.) must also be considered as these will need to be stationed near the rig site to assist in the drilling process. Thrust Boring (Microtunnel/Augerbore) requires a large deep pit to be excavated which will incorporate the length of the pipe to be installed, Stroke/thrust length of the machine and working space. These vary from contractor to contractor but could be up to 11m in length and 3m wide

Types of Trenchless Methods

Horizontal Directional Drilling

(HDD)

- Surface launched.
- Shallow entry and exit pits required.
- Produces a shallow arc.
- Steer-able.
- Suitable in most ground conditions.
- Requires area for laying out product pipe.
- Uses positive downhole pressure to support the borehole.
- Not always suitable when incorporating a casing.

Microtunnelling

- Pit launched.
- Straight bore (very accurate, Laser Guided).
- Requires pits down below Installation depth. (6mx3m)
- Can be limited, depending on ground conditions.
- Installs casing/pipe directly behind drilling unit.
- Excellent, for maintaining borehole stability.
- Larger the bore, the longer its achievability.
- May be limited contractor base.

Auger Boring

- Pit launched.
- Straight bore (may not be as accurate as Microtunnel).
- May incorporate Pilot Tube for greater accuracy
- May be limited in drive length
- Requires large pits down below installation depth. (11mx3m)
- Can be limited depending on ground conditions.
- Can install steel casing directly behind drilling unit.
- Limited contractors.
- Due to auger cutting action can cause ground destabilisation in unsuitable ground conditions.

Pipe Ramming

- Pit launched, Straight bore
- Requires pits down below installation depth. (10mx3m)
- Suitable in soft/poor ground conditions
- Limited contractors, relatively short distances. (20m-30m)
- Installs open pipe (casing) directly into the ground by a ramming technique

4. MACLEAY ARM CROSSING UNDERBORE REVIEW

The proposed underbore crossing of Macleay Arm at Kimpton St Stuarts Point for the installation of the new 315mm PN16 PE Effluent Main is as indicated below and has been assessed for feasibility of installation via HDD Method.

Preliminary Topography and existing Utilities for the site along with Geotechnical Investigation was provided to allow for a preliminary HDD assessment for the crossing. The feasibility is also based on review of documents, supplied design information, and previous knowledge of underbores in similar ground conditions on similar projects.

Location: The location of the Macleay Arm crossing is from the corner of Kimpton St and Marine Pde at the northern end Stuarts Point. The proposed underbore crossing is located to the northern side of the roadway and runs east across the Macleay Arm River to the Dunal release point between the river and the ocean.

Access: The site for the underbore of Macleay Arm assumed to be accessible for the expected Heavy Vehicles via Stuarts Point to Kimpton St though weight limits on bridges and low hanging wires needs to be further assessed prior to construction. Best available set area will be to the east of Macleay Arm to the northern side of Kimpton St as the access to the release location is via the beach from Grassy Head.

Track mounted equipment and 4x4 vehicles are going to be required to traverse down the beach. Works around the release location may require additional clearing and stabilisation of the soils for vehicles and equipment to turn around. Use of ground matts or other materials may be used if aggregate can't be bought in and laid for the temporary works. Access to the site may also be by boat from Stuarts Point if a suitable landing area can be made. This will reduce the time taken for personnel and small equipment or items to get from the launch site to the receive site.

The pedestrian Beach access across the bridge at Stuarts Point may also be used and a small dune buggy type of vehicle may be used to ferry works to and from the release site.

Vehicle Access

Personnel Access

Surface Topography: Some surface level details have been provided for the area indicating that there are some varying heights along the underbore route including the Macleay Arm riverbed indicated as approximately 4m below water level. The river width is approximately 330m wide at the crossing location. The Stuarts Point Side is indicated around RL5 assuming the water level at RL0 placing the entry point 5m above the river level whilst the release location is indicated as RL1.5 and the riverbed is shown down to RL-4.3.

The survey levels and the seismic refraction survey levels were combined to provide the topography for the underbore long section. Further survey will be required when undertaking detailed design.

The area in Kimpton St is fairly flat and best sited as the site for setup of the drilling equipment whilst the exit site is currently covered in vegetation which will need some site modification for equipment and pipe string on the eastern Dune side.

Kimpton St

Dune Side

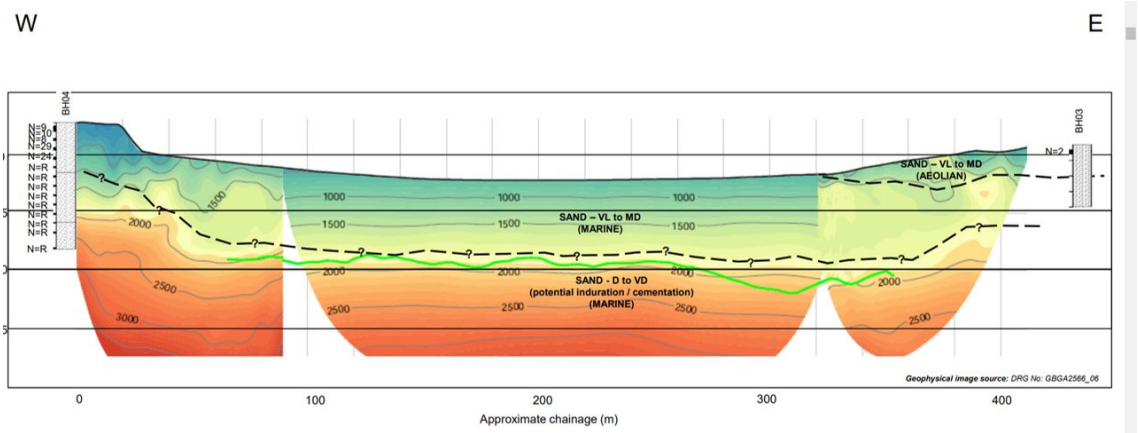
Sub Surface: The site specific geotech information provided for this review shows the underbore is likely to be within the dense to very dense sandy soils and below the water table. The report noted:

– The Macleay Arm crossing comprises horizontal beds of sand that generally increase in strength with depth, including interpreted medium dense material at the surface (corresponding with a seismic velocity from 700 m/s) and dense to very dense material from around RL -5 m AHD (corresponding with seismic velocities greater than 1,500 m/s).

– The apparent horizontal layering becomes slightly less uniform towards both the eastern and western margin of the Macleay Arm, potentially indicating the presence of bar deposits or shell beds.

– The profile encountered in borehole BH04 indicates the interpreted rock levels in the GBG report (refer to Appendix F) may represent a velocity contrast between very dense sands and less dense material

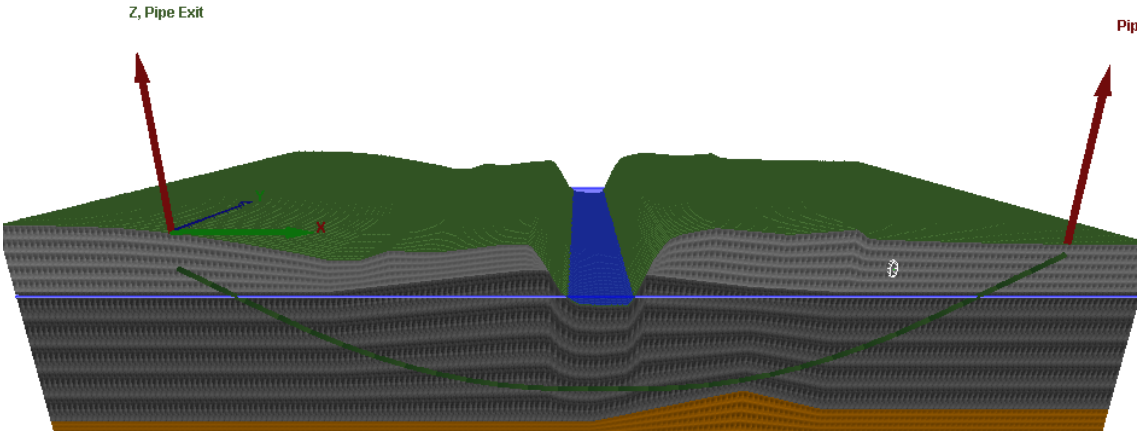
– Sands that generally increase in density with depth are expected to be encountered where the proposed trenchless section is shallower than about RL -18 m AHD. Very dense sands or possibly rock is expected to be encountered below this level.

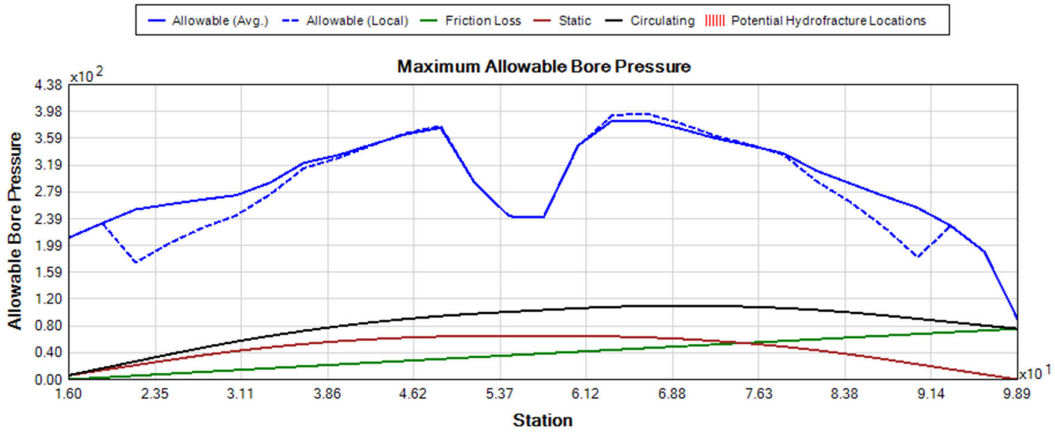


This can be difficult soil medium for drilling through especially with very low N values shown, though it is still suitable for HDD and can be managed with suitable drilling fluids and experienced contractors.

Drilling shorter distances in sands is generally preferred when trying to maintain shallower depths though there are benefits in drilling deeper into the dense layers for longer underbores. This will increase the overburden pressure and stability of the soil profile limiting the risk of fracout. The 450m long distance of the effluent main and depth of the river (4m below water level) allow for the larger radius geometry and deeper achievable depth for the HDD underbore at the site though going too deep may encounter rock or unconsolidated materials like gravels and cobbles.

Below is a preliminary soil profile with underbore profile through the sands and further below a preliminary hydrofracture analysis which indicates that an underbore within the sands at 10m+m below the riverbed is possible at this location though an experienced contractor with previous history drilling below waterways within these soil conditions is a must to limit the risk and be confident in achieving the underbore.





Existing Utilities: From provided information and a brief review of the Site "Before You Dig" responses there are a limited number of utilities within the underbore area.

Telstra, Essential Energy and Kempsey Shore Council show their Comms, Power and Water as all running within the southern side of Kimpton St near the house properties and not crossing the underbore alignment at this location. It is not anticipated that any utilities are currently on the dune side.

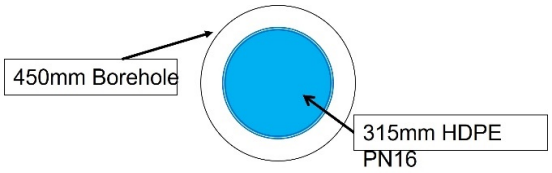
All utilities indicated were taken into consideration though there may be other utilities in the location that may impact further on the underbore especially at entry and exit locations. Further assessment of the utilities will be required by the driller prior to undertaking the underbore to ensure no conflict with other assets occurs.

Site Setup: The HDD Rig and equipment set up for the underbore of Macleay Arm at Kimpton St as this best suited using the access to Stuarts Point for the Heavier Vehicles and using the flatter area to the northern side of the Kimpton Road Surface. For the entry location the space on the side of the road is suitable to house the HDD Rig and the ancillary equipment removing the impact on the traffic at this location, though some vehicles may make use of the road surface in this area. The exit location in the dunes would need to have some ground modifications to allow access and house the excavator and vacuum truck along with the pipe string for installation. An area approx. 40x20 is required at the entry whilst 20x20 plus the pipe string area is required at the release location.

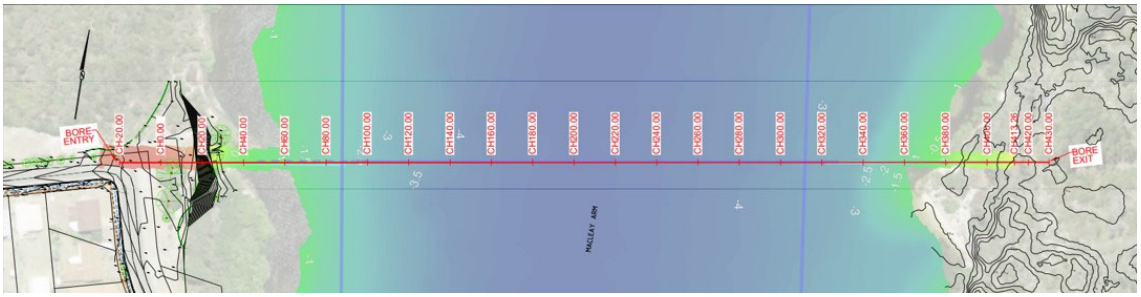
Indicative Setup and Exit Area

Trenchless Length and Diameter: The product pipe requirement for the installation has been indicated as a single underbore housing a 315mm PE PN16 Effluent Pipe which is suitable for the HDD installation over 450m and at 10m+ depth of cover below the riverbed as indicated in the profile drawing. The hydraulics for the pipeline and pipe rating is to be assessed by the pipeline engineers to ensure the pipeline size and rate suits the operational requirements.

To install a 315mm PE PN16 would require an approximate 450mm to 500mm borehole to allow for the pipeline to be safely installed via HDD Method. The underbore length for the profile has been indicated as approximately 450m between Kimpton St to the Dunal Release point though this could be extended or shorted slightly to suit the site, avoid utilities and provide the best release location.



Indicative Pipe and Borehole Configuration

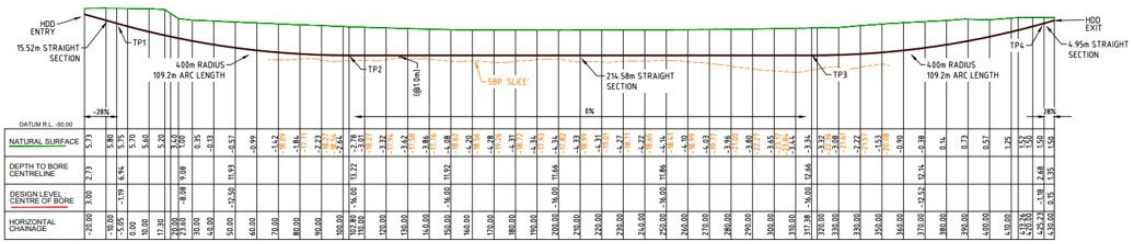


Approximate Length and Location of Underbore

Trenchless Depth and Geometry: The depth of the underbore will be dependent on the ground conditions at the site and the depth required to pass safely below the riverbed. The geometry will be limited due to the sandy ground conditions at the site reducing the ability to steer the drill head more quickly. A design would look to use a large radius in design to allow for some tolerance when drilling the underbore and enable the contractor to install the pipe more effectively. A 400m radius has been factored into the preliminary design to allow for the steering capabilities in the loose sands at the site. Shallower entry and exit pits will likely be preferred to limit the excavation in the non-cohesive soils.

To limit the risk of fracout an underbore of at least 10m below the riverbed in the dense to very dense sands is likely to be suitable. An indicative profile below shows an underbore which could be achievable below Macleay Arm.

The option to drill deeper (15m+) below the river was briefly looked at and likely will further limit the risk of fracout and settlement by encountering the potentially stiffer ground conditions shown in the Seismic Analysis though this may also encounter gravels or cobbles in the layers above the rock. The drilling between the softer and hard materials may also then require casing pipes to limit the potential for fracout at the sand rock interface.



Further assessment on the underbore profiles will need to be undertaken. This will include settlement analysis, hydrofracture analysis and pull calculations.

Trenchless Method: An HDD method is the proposed trenchless technique for this site due to the length of the underbore, pipe installation requirements, existing utilities, and likely ground conditions. A medium to large HDD rig would be suitable for the pipe weight and allow for the geometry to suit the HDD profile on a 400m minimum bend radius along with standard entry and exit angles though the HDD rig may be required to be setback from the entry point to allow for the drill to enter the ground at the required depth and angle whilst avoiding existing utilities. The profile above indicates an underbore of 450m length whilst reaching a depth of around 12m below the riverbed zone with tolerance to go slightly shallower or slightly deeper to limit the risk of fracout or avoid unfavourable ground condition.

This HDD Rig will require approximately 10m to 15m for the drill rig to sit and to enter the pit at the required angle. The ancillary equipment for the site including a fluid delivery system and support vehicles would need to be setup near the rig. The site appears to have a few limitations on room on the Stuart Point side due to residential traffic and parking which will see access limited to Kimpton St during the works.

For HDD the pipe will be installed from the exit location back to the HDD Rig entry location. This site requires the same length as the underbore of lay down area for the pipeline to be welded and strung out prior to installation. This is feasible if the area is cleared with some access required along the beach to string pipes.

Drilling in the expected sandy soils anticipated at the site is suitable for the HDD. Steering the drill head on a 400m minimum bend in sandy soils is suitable for HDD though tolerance can be built in the overall design of the underbore to allow for any under-steer, harder ground condition and to limit the pressure on the pipe.

A mud return line will be required to be placed between the release location and the entry site to maintain fluid circulation when drilling. This may be strung out and laid on the bottom of the river or may require a second small drill across the river to allow for the return of fluids.

Steering the underbore across the Macleay Arm would most likely be undertaken using a wireline or gyro steering tool to maintain accurate line, level and depth below the river however advancements in standard handheld devices may also make this achievable.

Risk and Constraints: Drilling below the river over the 450m meter is obviously the biggest risk with the potential for fracout the largest risk. The soft wet sands in the area can pose a constraint and risk on the underbore. The soft soils limit the ability to steer the HDD drill head so this will limit the geometry for the design and may affect the depth and length achievable for the underbore. The risk of settlement or fracout is higher if the underbore is shallower so greater depth may be required to limit the risks. In addition, harder ground may also be encounter in the area which increases issues when drilling between the soft and hard ground conditions. Underboring below the Macleay Arm should be drilled at 10m+ plus cover to limit potential settlement or fracout.

Site setup and vehicle movements will also be an issue on both sides of the underbore and due to the location next to the roadway in Kimpton St and the release site having to be accessed from the beach. Access appears suitable for track mounted equipment and 4x4 vehicles though this needs to be further assessed.

Further Investigation: Further investigation would include a detailed survey, underground utility investigation and final design. Tendering for a suitably qualified HDD contractor with previous experience in similar underbores below waterways in sandy soils.

5. COMMENTS AND RECOMMENDATIONS.

Based on the information provided and several assumptions, including existing underground services and geology, the proposed underbore crossing of Macleay Arm is considered achievable using a Horizontal Directional Drilling (HDD) methodology over approximately 450m with a 10m+ cover below the riverbed.

It is expected that the underbore of Macleay Arm will be in dense to very dense wet sands above the rock /indurated sands though may also encounter loose sands at shallower depths on the way in and out of the river. These are challenging soil mediums for drilling through, though it is still suitable for HDD and can be managed with suitable drilling fluids and experienced contractors. The soft wet sands limit the ability to steer the HDD drill head so this will limit the geometry for the design and may affect the depth and length achievable for the underbore. The risk of settlement or fracout is higher if the underbore is shallower so greater depth is required to limit the risks.

To limit the risk of fracout, limit settlement potential, and limit the impact from softer loose sands an underbore with steeper entry and exit angle and a depth of at least 10m below the riverbed is likely to be suitable over the approximate 450m distance. An indicative profile has been assessed with the report for an underbore which could be achievable below Macleay Arm.

The option to drill deeper (15m+) below the river was briefly looked at and likely will further limit the risk of fracout and settlement by encountering the potentially stiffer ground conditions shown in the Seismic Analysis though this may also encounter gravels or cobbles in the layers above the rock. The drilling between the softer and hard materials may also then require casing pipes to limit the potential for fracout at the sand rock interface.

Based on the proposed connection and release points the 450m length underbore is achievable from a setup on the western side of the river in Kimpton St Stuarts Point. For the entry location the space on the side of the road is suitable to house the HDD Rig and the ancillary equipment removing the impact on the traffic at this location. The exit location in the dunes only has access for equipment from Grassy Head along the beach to the receive location. Access would need to be made for the excavator and vacuum truck / Fluid Recycling Unit along with the pipe string for installation. Track Mounted or 4x4 equipment and vehicles are likely to be used due to beach sand conditions. Conducting most works form Stuarts Points and limiting the amount of equipment required at the exit will be essential.

This underbore of Macleay Arm is considered suitable but only to be undertaken by a contractor with previous experience drilling below water ways in sandy soils.

Next steps would be for GHD and their Client, or its chosen contractor should undertake a detailed underbore design for the crossing. This will include Profile design, Hydrofracture Analysis, Settlement Analysis, Monitoring Plans and a Detailed Methodology and Fracout Management Plan.

For further information please contact Underbore Solutions.

6. LIMITATIONS

This report has been prepared by Underbore Solutions in conjunction with information supplied by GHD, DBYD and Google. In preparing this report, Underbore Solutions has relied on this information to achieve appropriate solutions and recommendations relating to this project. Underbore Solutions has not verified the accuracy or completeness of information supplied. Therefore, the information supplied by Underbore Solutions in this report is based on part or all the data supplied.

As the construction methods used with Trenchless Technology occur under the grounds surface, all suggestions and recommendations are based extensively on judgment, experience, and knowledge as well as opinion. Underbore Solutions will not be liable in relation to any incorrect conclusions or recommendations noted should any data and supplied information be incorrect, concealed, withheld, or misrepresented in any way, shape, or form.

The information supplied should been seen as a concept design only as a wide variation of equipment is available within the Trenchless industry which could alter the limitations and achievability of bore. These limitations could also be influenced by the experience and professionalism of the chosen contractor.

This report should be seen as obsolete if the bore is repositioned or altered in any way.

Due to the minimal availability of geotechnical information of the area, there is a possibility that a variation in ground conditions could occur during the process. This may produce additional unknown risks and issues which should be observed and managed by the chosen contractor during the construction period.

Additional construction activities at or adjacent to the work site, as well as natural events such as weather, floods, ground water variations, may also alter the information supplied.

Underbore Solutions will not be liable for the updating of this report to account for any events, circumstances or other relating incidences that may occur after the date of this report.

The costing estimates covers all work and processes required to be undertaken by the Trenchless contractor to complete the bores and installation of products unless otherwise mentioned. As all these contractors operate different size, make and types of Trenchless machines, actual pricing can vary. The following is to be used as a guide only and caution should be undertaken when choosing an appropriate contractor.

The estimates may not include allowances for removal of contaminates, relocation of utilities, supply of product pipe, additional trenching requirements, excavation of pits, grouting of the borehole, purchase of easements, permits, monitoring and project management.

Stuarts Point Sewerage System
Macleay Arm Crossing
HDD Analysis - Generated Output
Preliminary Assessment 05/10/2022

WARNING: The accuracy of the data obtained by the BoreAid® system is highly dependent upon accurate data gathering, data input and proper use of the software. Vermeer is not responsible for that information. BoreAid® data is not intended to replace the need for future on-site utility locating, measuring and verification procedures, which are essential for accurate placement of new underground installations and avoidance of existing utilities.

CALL YOUR ONE-CALL SYSTEM FIRST

WARNING: Always contact your local One-Call system before the start of your digging project. The BoreAid® system is intended to be used with other utility locating methods, such as the use of the One-Call system and the exposing of existing utilities by potholing.

Locate utilities before drilling. Call 811 (U.S. only) or 1-888-258-0808 (U.S. or Canada) or local utility companies or national regulating authority. **In Australia visit https://www.byda.com.au/ for Before You Dig plans.**

Before you start any digging project, do not forget to call the local One-Call system in your area and any utility company that does not subscribe to the One-Call system. For areas not represented by One-Call Systems International, contact the appropriate utility companies or national regulating authority to locate and mark the underground installations. If you do not call, you may have an accident or suffer injuries; cause interruption of services; damage the environment; or experience job delays.

OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:	Stuarts Point Sewerage System Dunal Release Ref: Kimpton St and Marine Pde Stuarts Point Macleay Arm HDD Crossing Start Date: 01-02-2023 End Date: 01-28-2023
Project Owner:	Kempsey Shire Council
Project Contractor:	T.B.A
Project Consultant:	GHD
Designer:	David Gunnell Underbore Solutions Pty Ltd 108 Kingswood Rd Engadine, NSW Australia 2233 Phone: 0434 317 767 Fax: None david.gunn311@gmail.com
Description:	Underbore Macleay Arm from Kimpton St and Marine Pde in Stuarts Point to the Dunal Release point. Install a 315mm PE Sewer pipeline

Input Summary

Start Coordinate	(-20.00, 0.00, 3.00) m
End Coordinate	(430.00, 0.00, 0.00) m
Project Length	450.00 m
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	315.0 mm
Pipe DR	11.0
Pipe Thickness	28.6 mm
Rod Length	6.10 m
Rod Diameter	3.5 in
Drill Rig Location	(-20.00, 0.00, 3.00) m

Soil Summary

Number of Layers: 2

Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 17.2097 (dry), 19.8971 (sat) [kN/m3]
Phi: 30.00, S.M.: 1000.00, Coh: 0.00 [kPa]

Soil Layer #2 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 16.9383 (dry), 27.9048 (sat) [kN/m3]
Phi: 35.00, S.M.: 10000.00, Coh: 20000.00 [kPa]

Obstacle Summary

Number of Obstacles: 1

Obstacle #1 Rivers/Lakes

Point 1 = (-20.00,0.00,0.00) m

Clearance = 0.00 m

UNDER BORE SOLUTIONS

Rod-by-Rod Plan

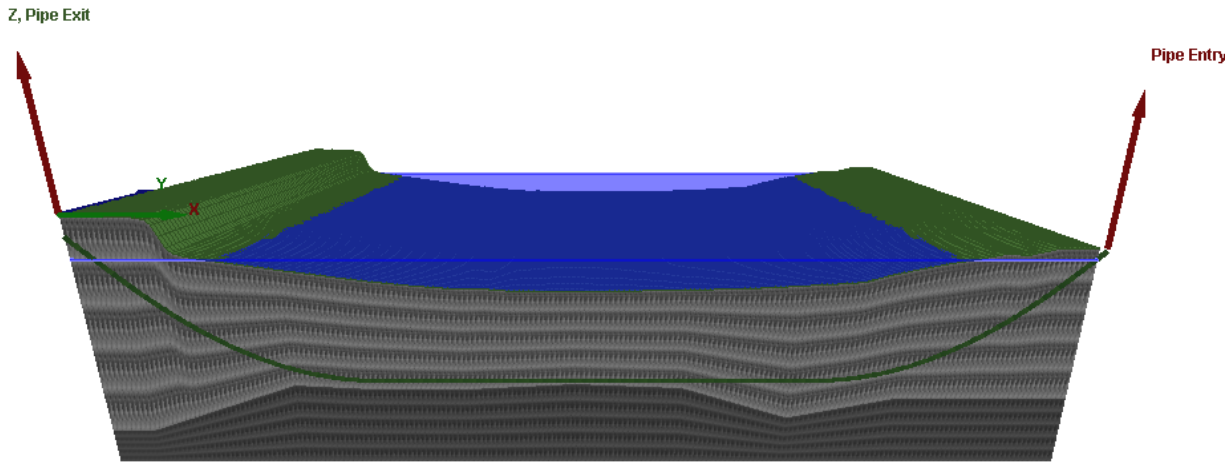
Rod #	Dist (m)	L+/R- (m)	Elev (m)	Depth (m)	Inclin (%)	Azim (%)	Dip (%)	Length (m)	Radius (m)
1	-20.000	0.000	3.000	2.900	-28.00	0.0	0.0	0.0	0.0
2	-14.130	0.000	1.356	4.485	-28.00	0.0	0.0	6.1	0.0
3	-8.260	0.000	-0.287	6.070	-28.00	0.0	0.0	12.2	0.0
4	-2.389	0.000	-1.931	7.655	-28.00	0.0	0.0	18.3	0.0
5	3.487	0.000	-3.551	9.217	-26.82	0.0	0.0	24.4	400.0
6	9.387	0.000	-5.086	10.688	-25.19	0.0	0.0	30.5	400.0
7	15.309	0.000	-6.530	11.839	-23.58	0.0	0.0	36.6	400.0
8	21.253	0.000	-7.884	10.448	-21.98	0.0	0.0	42.7	400.0
9	27.217	0.000	-9.147	9.780	-20.38	0.0	0.0	48.8	400.0
10	33.199	0.000	-10.319	10.515	-18.80	0.0	0.0	54.9	400.0
11	39.198	0.000	-11.400	11.309	-17.23	0.0	0.0	61.0	400.0
12	45.214	0.000	-12.389	12.029	-15.66	0.0	0.0	67.1	400.0
13	51.243	0.000	-13.286	12.664	-14.11	0.0	0.0	73.2	400.0
14	57.286	0.000	-14.092	13.216	-12.55	0.0	0.0	79.2	400.0
15	63.340	0.000	-14.805	13.671	-11.01	0.0	0.0	85.3	400.0
16	69.404	0.000	-15.426	14.031	-9.47	0.0	0.0	91.4	400.0
17	75.477	0.000	-15.954	14.304	-7.93	0.0	0.0	97.5	400.0
18	81.557	0.000	-16.390	14.489	-6.40	0.0	0.0	103.6	400.0
19	87.643	0.000	-16.733	14.595	-4.87	0.0	0.0	109.7	400.0
20	93.734	0.000	-16.983	14.600	-3.35	0.0	0.0	115.8	400.0
21	99.828	0.000	-17.141	14.509	-1.82	0.0	0.0	121.9	400.0
22	105.924	0.000	-17.205	14.346	-0.30	0.0	0.0	128.0	400.0
23	112.020	0.000	-17.207	14.134	-0.03	0.0	0.0	134.1	0.0
24	118.116	0.000	-17.207	13.945	0.00	0.0	0.0	140.2	0.0
25	124.212	0.000	-17.207	13.761	0.00	0.0	0.0	146.3	0.0
26	130.308	0.000	-17.207	13.581	0.00	0.0	0.0	152.4	0.0
27	136.404	0.000	-17.207	13.433	0.00	0.0	0.0	158.5	0.0
28	142.500	0.000	-17.207	13.292	0.00	0.0	0.0	164.6	0.0
29	148.596	0.000	-17.207	13.158	0.00	0.0	0.0	170.7	0.0
30	154.692	0.000	-17.207	13.155	0.00	0.0	0.0	176.8	0.0
31	160.788	0.000	-17.207	13.167	0.00	0.0	0.0	182.9	0.0

UNDER BORE SOLUTIONS

Rod #	Dist (m)	L+/R- (m)	Elev (m)	Depth (m)	Inclin (%)	Azim (%)	Dip (%)	Length (m)	Radius (m)
32	166.884	0.000	-17.207	13.008	0.00	0.0	0.0	189.0	0.0
33	172.980	0.000	-17.207	12.918	0.00	0.0	0.0	195.1	0.0
34	179.076	0.000	-17.207	12.900	0.00	0.0	0.0	201.2	0.0
35	185.172	0.000	-17.207	12.882	0.00	0.0	0.0	207.3	0.0
36	191.268	0.000	-17.207	12.867	0.00	0.0	0.0	213.4	0.0
37	197.364	0.000	-17.207	12.867	0.00	0.0	0.0	219.5	0.0
38	203.460	0.000	-17.207	12.871	0.00	0.0	0.0	225.6	0.0
39	209.556	0.000	-17.207	12.877	0.00	0.0	0.0	231.6	0.0
40	215.652	0.000	-17.207	12.888	0.00	0.0	0.0	237.7	0.0
41	221.748	0.000	-17.207	12.904	0.00	0.0	0.0	243.8	0.0
42	227.844	0.000	-17.207	12.928	0.00	0.0	0.0	249.9	0.0
43	233.940	0.000	-17.207	12.957	0.00	0.0	0.0	256.0	0.0
44	240.036	0.000	-17.207	12.989	0.00	0.0	0.0	262.1	0.0
45	246.132	0.000	-17.207	13.036	0.00	0.0	0.0	268.2	0.0
46	252.228	0.000	-17.207	13.076	0.00	0.0	0.0	274.3	0.0
47	258.324	0.000	-17.207	13.100	0.00	0.0	0.0	280.4	0.0
48	264.420	0.000	-17.207	13.138	0.00	0.0	0.0	286.5	0.0
49	270.516	0.000	-17.207	13.181	0.00	0.0	0.0	292.6	0.0
50	276.612	0.000	-17.207	13.223	0.00	0.0	0.0	298.7	0.0
51	282.708	0.000	-17.207	13.290	0.00	0.0	0.0	304.8	0.0
52	288.804	0.000	-17.207	13.388	0.00	0.0	0.0	310.9	0.0
53	294.900	0.000	-17.207	13.481	0.00	0.0	0.0	317.0	0.0
54	300.996	0.000	-17.207	13.579	0.00	0.0	0.0	323.1	0.0
55	307.092	0.000	-17.207	13.706	0.00	0.0	0.0	329.2	0.0
56	313.188	0.000	-17.207	13.805	0.02	0.0	0.0	335.3	400.0
57	319.284	0.000	-17.160	13.831	1.54	0.0	0.0	341.4	400.0
58	325.378	0.000	-17.019	13.828	3.07	0.0	0.0	347.5	400.0
59	331.469	0.000	-16.786	13.832	4.59	0.0	0.0	353.6	400.0
60	337.557	0.000	-16.460	14.029	6.12	0.0	0.0	359.7	400.0
61	343.638	0.000	-16.041	14.072	7.65	0.0	0.0	365.8	400.0
62	349.712	0.000	-15.529	13.977	9.19	0.0	0.0	371.9	400.0
63	355.778	0.000	-14.925	13.759	10.73	0.0	0.0	378.0	400.0
64	361.834	0.000	-14.229	13.424	12.27	0.0	0.0	384.0	400.0

Rod #	Dist (m)	L+/R- (m)	Elev (m)	Depth (m)	Inclin (%)	Azim (%)	Dip (%)	Length (m)	Radius (m)
65	367.879	0.000	-13.440	12.950	13.82	0.0	0.0	390.1	400.0
66	373.911	0.000	-12.559	12.383	15.38	0.0	0.0	396.2	400.0
67	379.929	0.000	-11.587	11.726	16.94	0.0	0.0	402.3	400.0
68	385.931	0.000	-10.523	11.013	18.51	0.0	0.0	408.4	400.0
69	391.917	0.000	-9.368	10.067	20.10	0.0	0.0	414.5	400.0
70	397.884	0.000	-8.121	8.725	21.69	0.0	0.0	420.6	400.0
71	403.831	0.000	-6.784	7.614	23.29	0.0	0.0	426.7	400.0
72	409.758	0.000	-5.356	6.590	24.90	0.0	0.0	432.8	400.0
73	415.662	0.000	-3.838	5.355	26.52	0.0	0.0	438.9	400.0
74	421.542	0.000	-2.231	3.741	27.33	0.0	0.0	445.0	0.0
75	427.412	0.000	-0.587	2.090	28.00	0.0	0.0	451.1	0.0
76	433.282	0.000	1.056	0.440	28.00	0.0	0.0	457.2	0.0

Virtual Site



Bore Path Information

Section No. 1

Straight in Section View - Straight in Plan View

Start Location: (-20.00,0.00,3.00) m

End Location: (-0.74,0.00,-2.39) m

Inclination Angle: (Start = 15.64 Deg., End = 15.64 Deg.)

Azimuth Angle: (Start = 0.00 Deg., End = 0.00 Deg.)

Number of drill rods in segment = 4

Section No. 2

Curve in Section View - Straight in Plan View

Start Location: (-0.74,0.00,-2.39) m

End Location: (107.11,0.00,-17.21) m

Inclination Angle: (Start = 15.64 Deg., End = 0.00 Deg.)

Azimuth Angle: (Start = 0.00 Deg., End = 0.00 Deg.)

Bend Radius = 400.00 m

Number of drill rods in segment = 18

Section No. 3

Straight in Section View - Straight in Plan View

Start Location: (107.11,0.00,-17.21) m

End Location: (313.11,0.00,-17.21) m

Inclination Angle: (Start = 0.00 Deg., End = 0.00 Deg.)

Azimuth Angle: (Start = 0.00 Deg., End = 0.00 Deg.)

Number of drill rods in segment = 33

Section No. 4

Curve in Section View - Straight in Plan View

Start Location: (313.11,0.00,-17.21) m

End Location: (420.96,0.00,-2.39) m

Inclination Angle: (Start = 0.00 Deg., End = -15.64 Deg.)

Azimuth Angle: (Start = 0.00 Deg., End = 0.00 Deg.)

Bend Radius = 400.00 m

Number of drill rods in segment = 18

Section No. 5

Straight in Section View - Straight in Plan View

Start Location: (420.96,0.00,-2.39) m

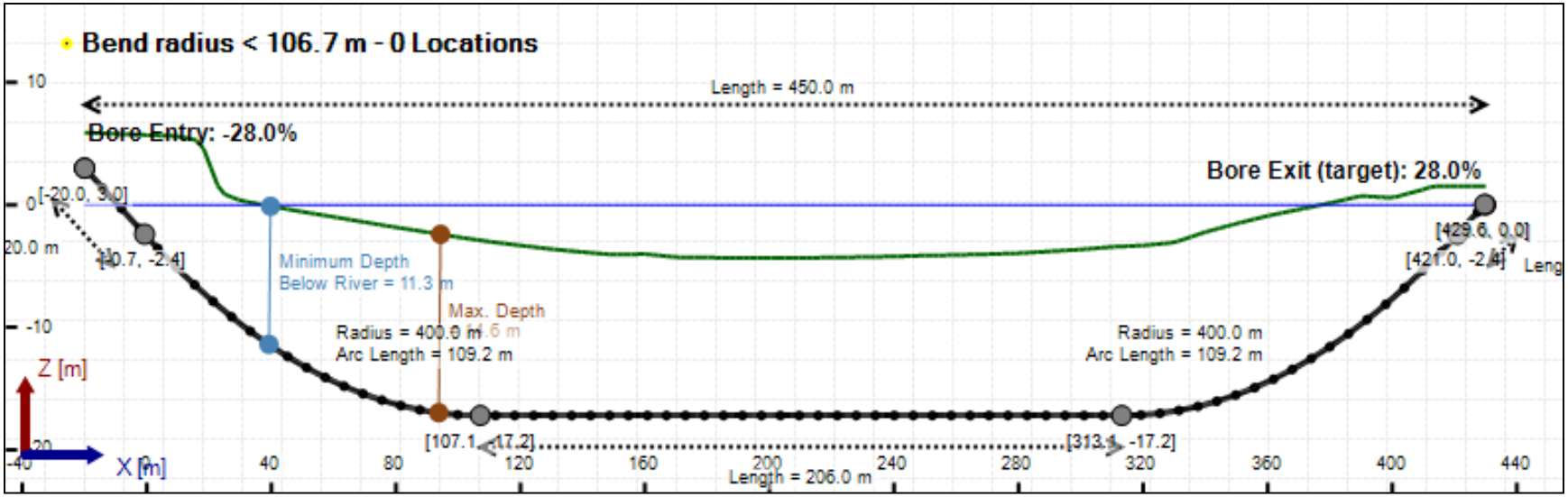
End Location: (429.63,0.00,0.03) m

Inclination Angle: (Start = -15.64 Deg., End = -15.64 Deg.)

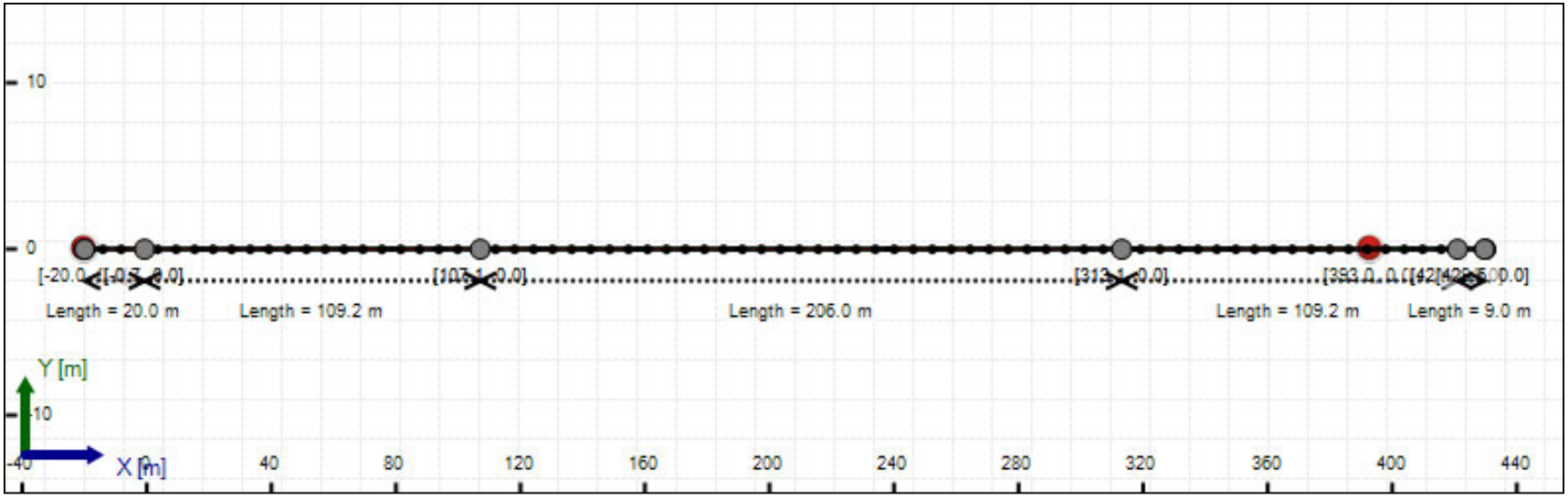
Azimuth Angle: (Start = 0.00 Deg., End = 0.00 Deg.)

Number of drill rods in segment = 3

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Sewer

Pipe Type: HDPE

Classification: IPS

Pipe OD: 315 mm

Pipe DR: 11

Pipe Length: 457.20 m

Internal Pressure: 0 kPa

Borehole Diameter: 0.45 m

Silo Width: 0.45 m

Surface Surcharge: 0 kPa

Short Term Modulus: 396448.51 kPa

Long Term Modulus: 194432.15 kPa

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 9.31607 kN/m3

Allowable Tensile Stress (Short Term): 8273.71 kPa

Allowable Tensile Stress (Long Term): 7584.23 kPa

Allowable Compressive Stress (Short Term): 7928.97 kPa

Allowable Compressive Stress (Long Term): 7928.97 kPa

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 14.71 kN/m3

Hydrokinetic Pressure: 68.95 kPa

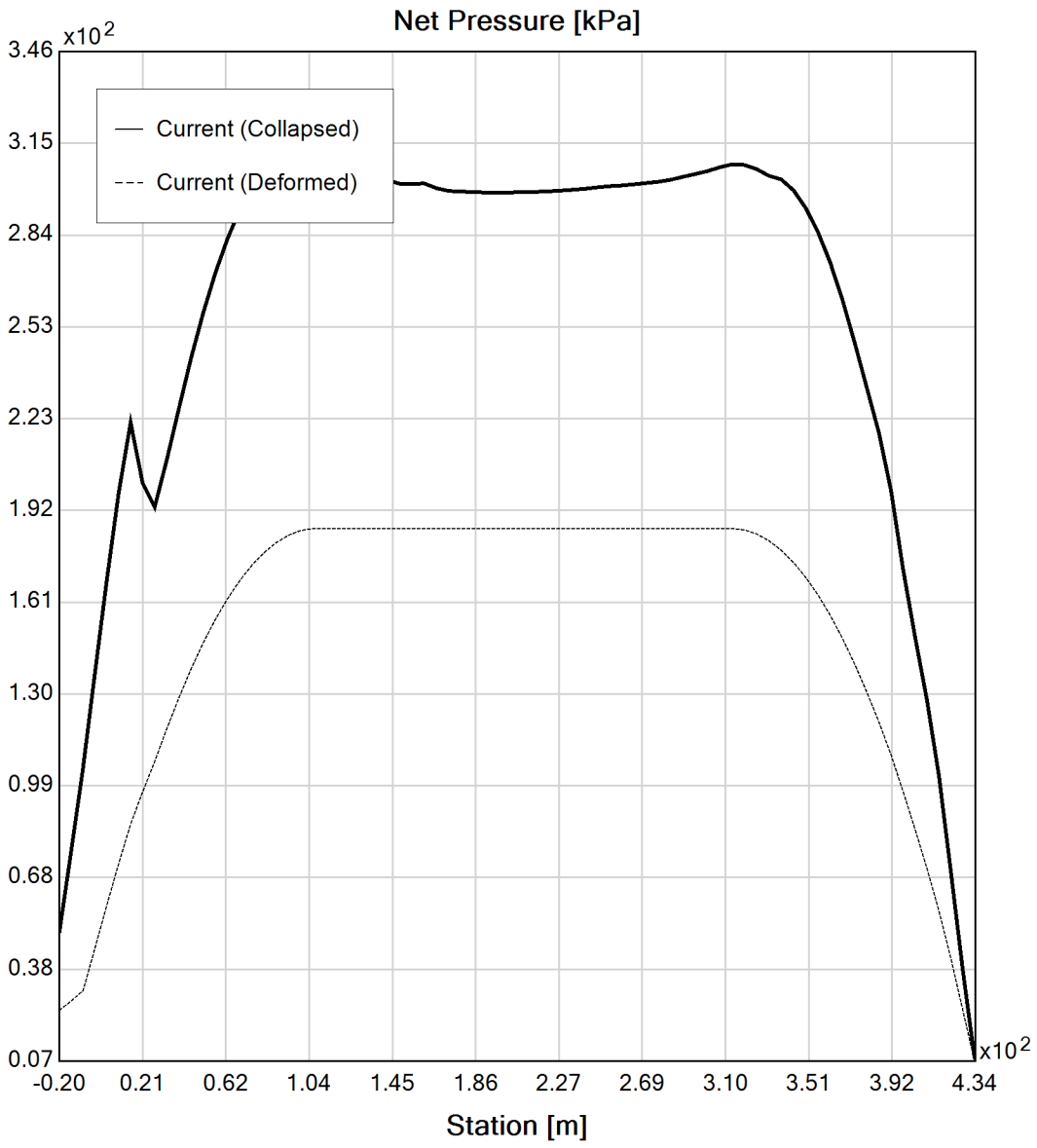
Ballast Unit Weight: 9.81 kN/m3

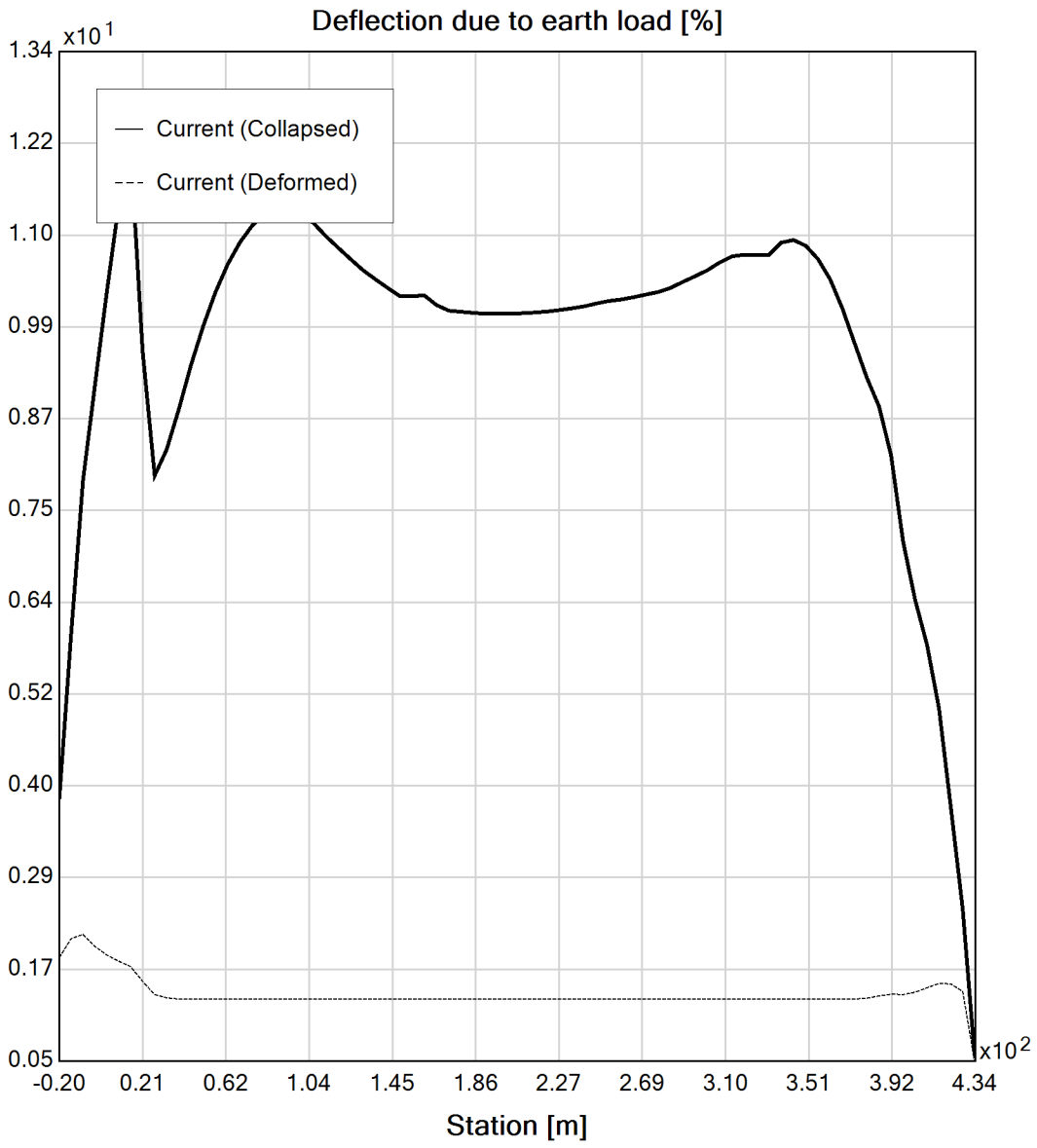
In-service Analysis

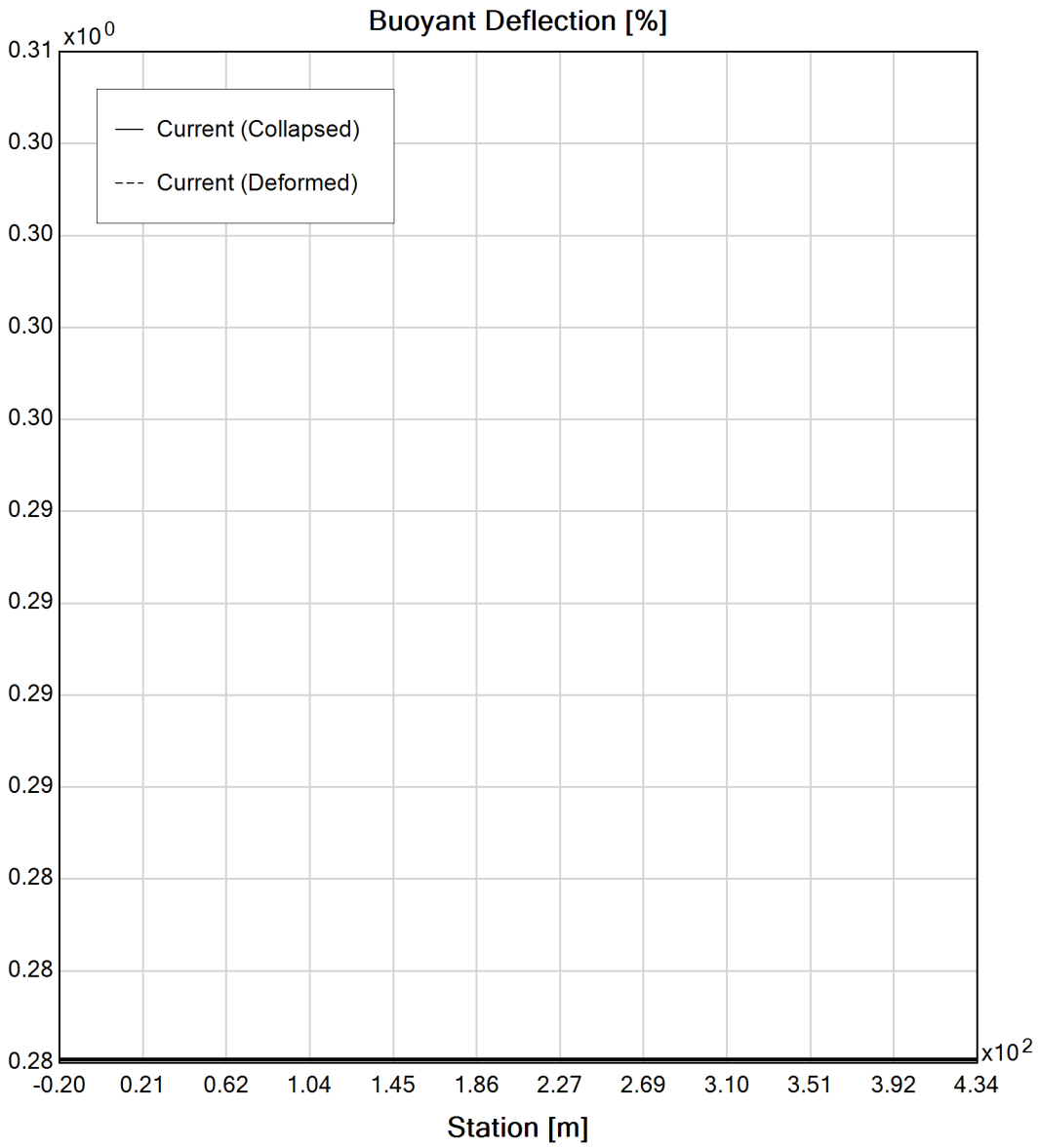
	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.405	7.5	3.1	OK
Unconstrained Collapse [kPa]	297.2	422.9	1.4	OK
Compressive Wall Stress [kPa]	1021.3	7929.0	7.8	OK

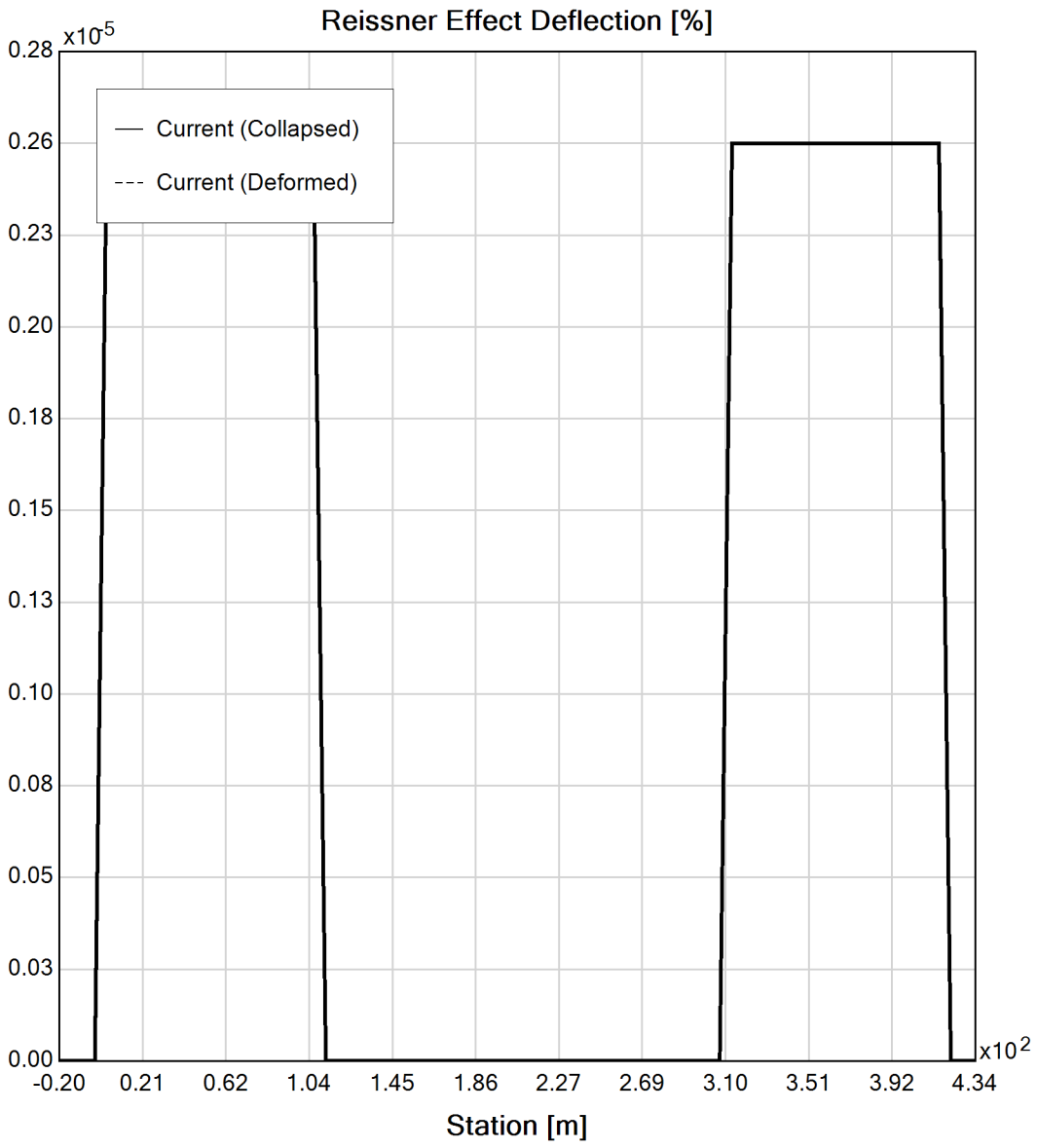
Installation Analysis

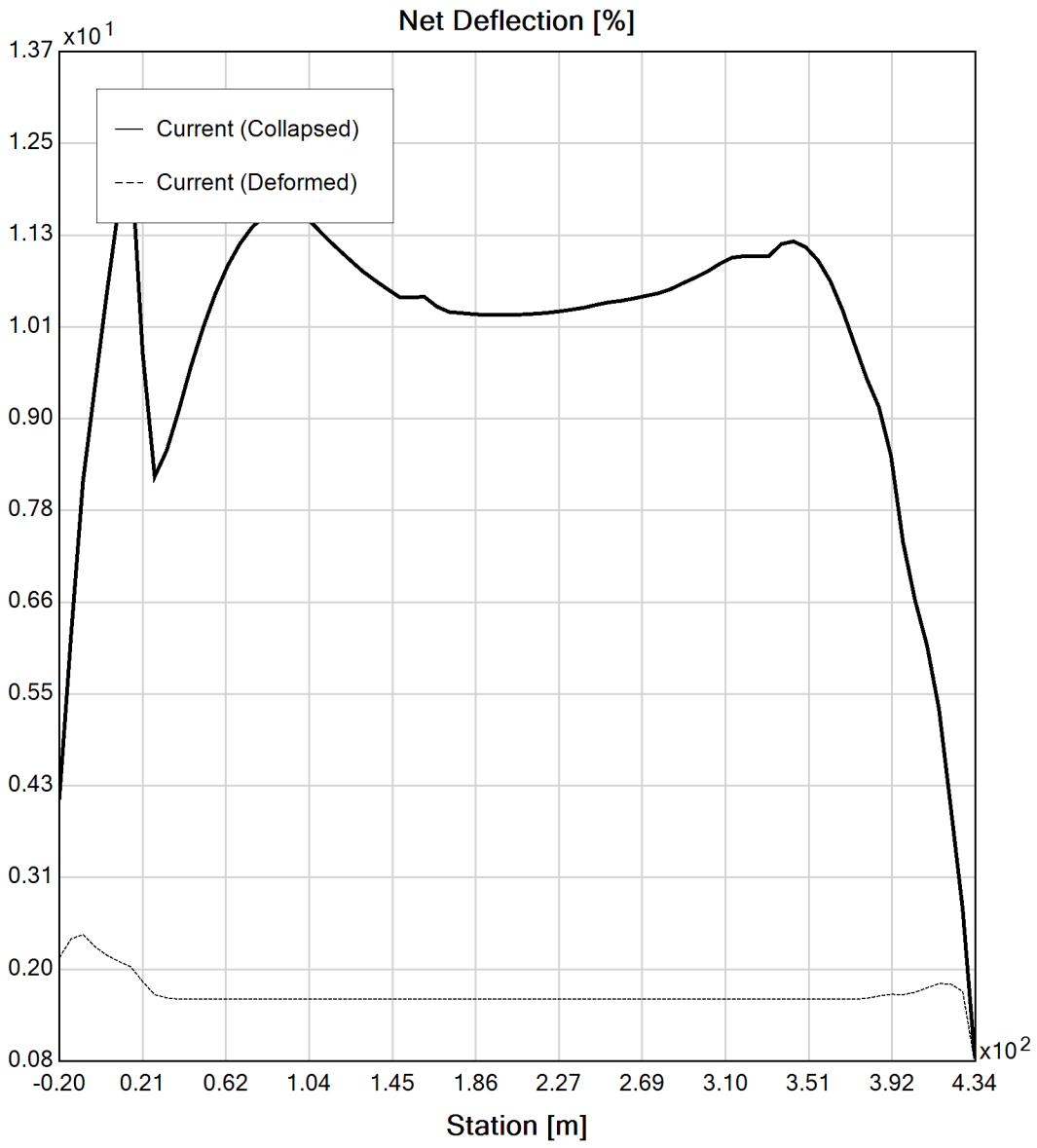
	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.136	7.5	55.0	OK
Unconstrained Collapse [kPa]	168.0	791.6	4.7	OK
Tensile Stress [kPa]	3296.5	8273.7	2.5	OK

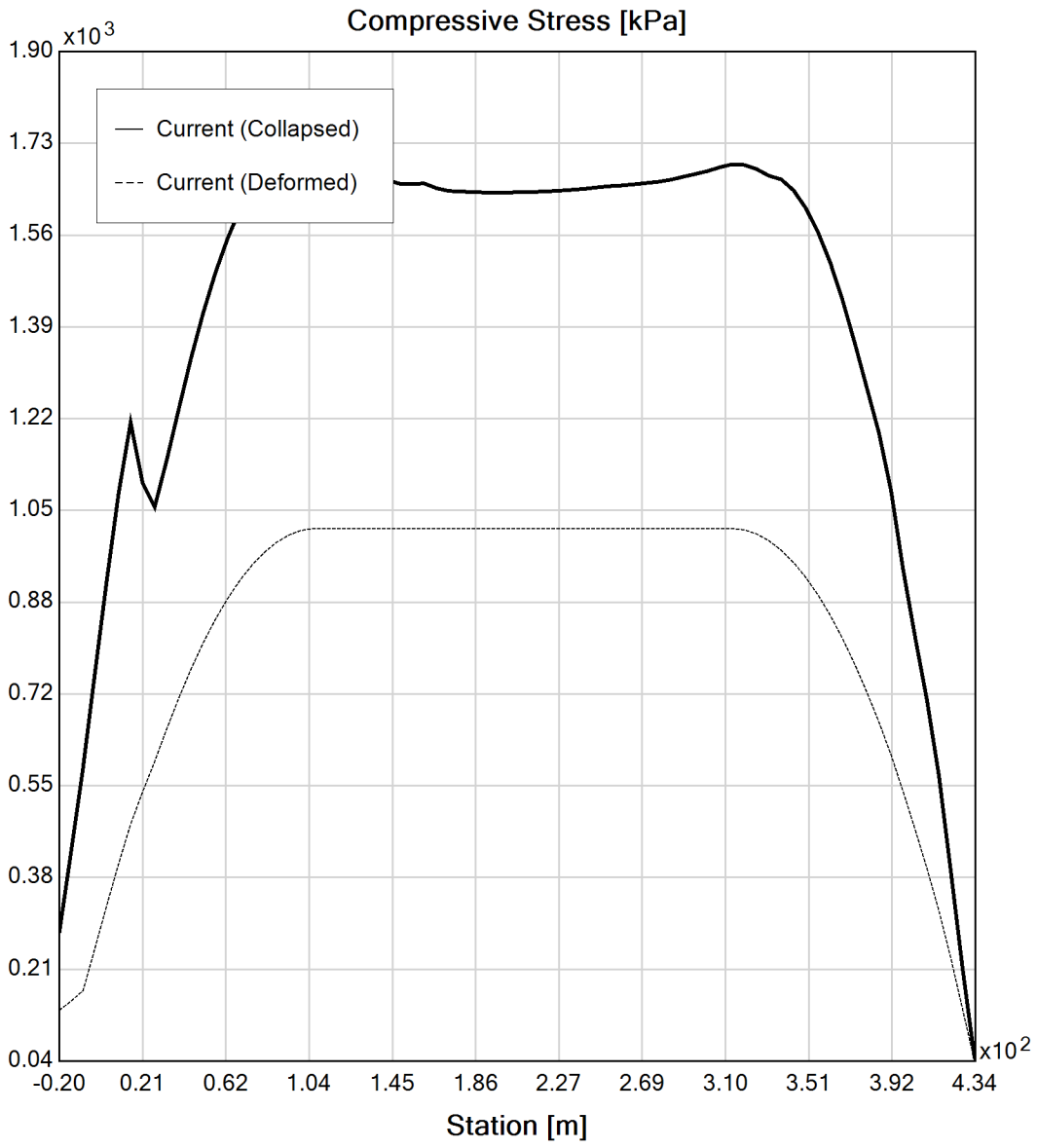

Net Pressure [kPa]
x10 2
3.46
3.15
2.84
2.53
2.23
1.92
1.61
1.30
0.99
0.68
0.38
0.07
Current (Collapsed)
Current (Deformed)
-0.20
0.21
0.62
1.04
1.45
1.86
2.27
2.69
3.10
3.51
3.92
4.34
x10 2
Station [m]

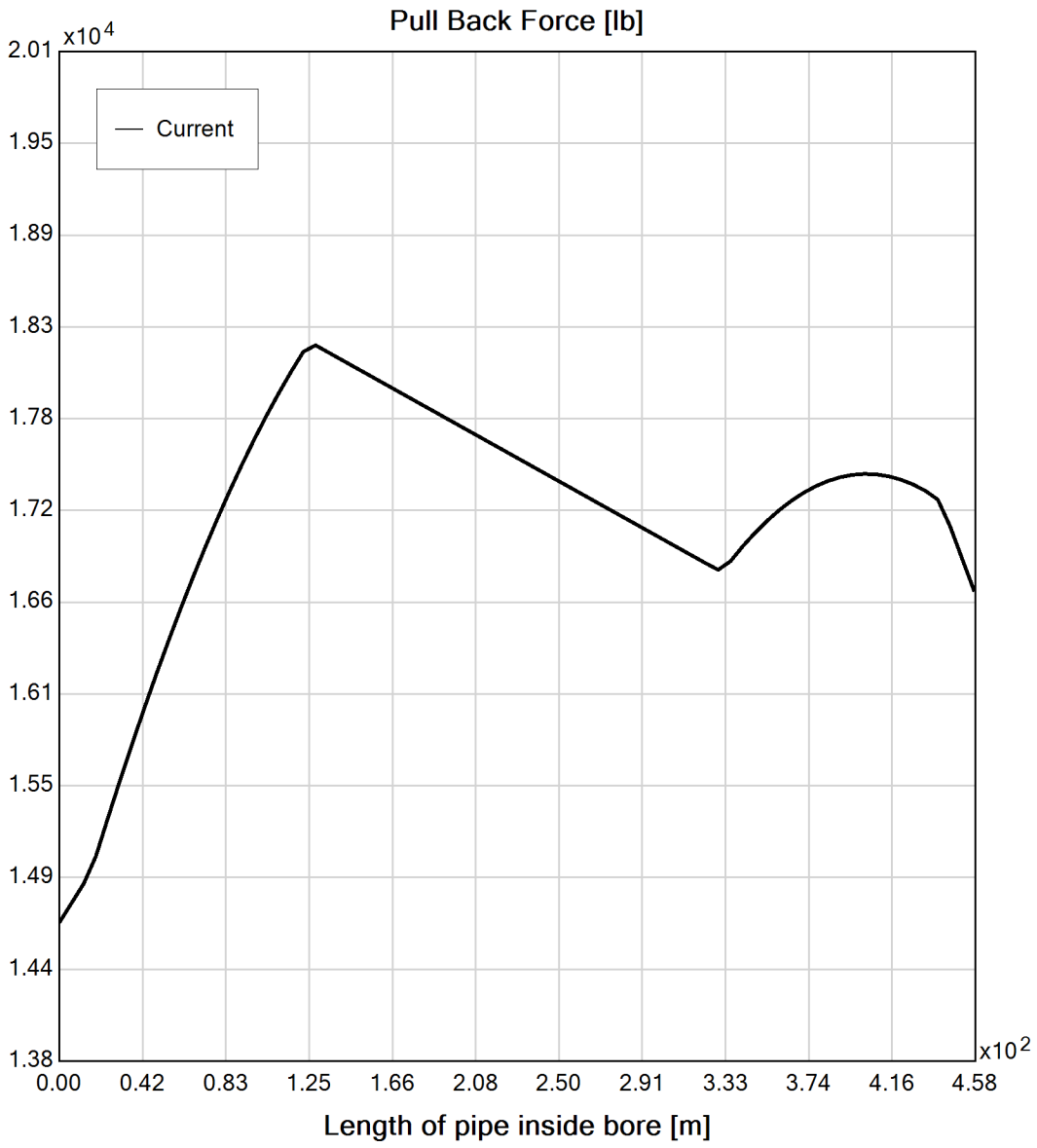

Deflection due to earth load [%]
x10 1
1.34
1.22
1.10
0.99
0.87
0.75
0.64
0.52
0.40
0.29
0.17
0.05
Current (Collapsed)
Current (Deformed)
x10 2
-0.20
0.21
0.62
1.04
1.45
1.86
2.27
2.69
3.10
3.51
3.92
4.34
Station [m]

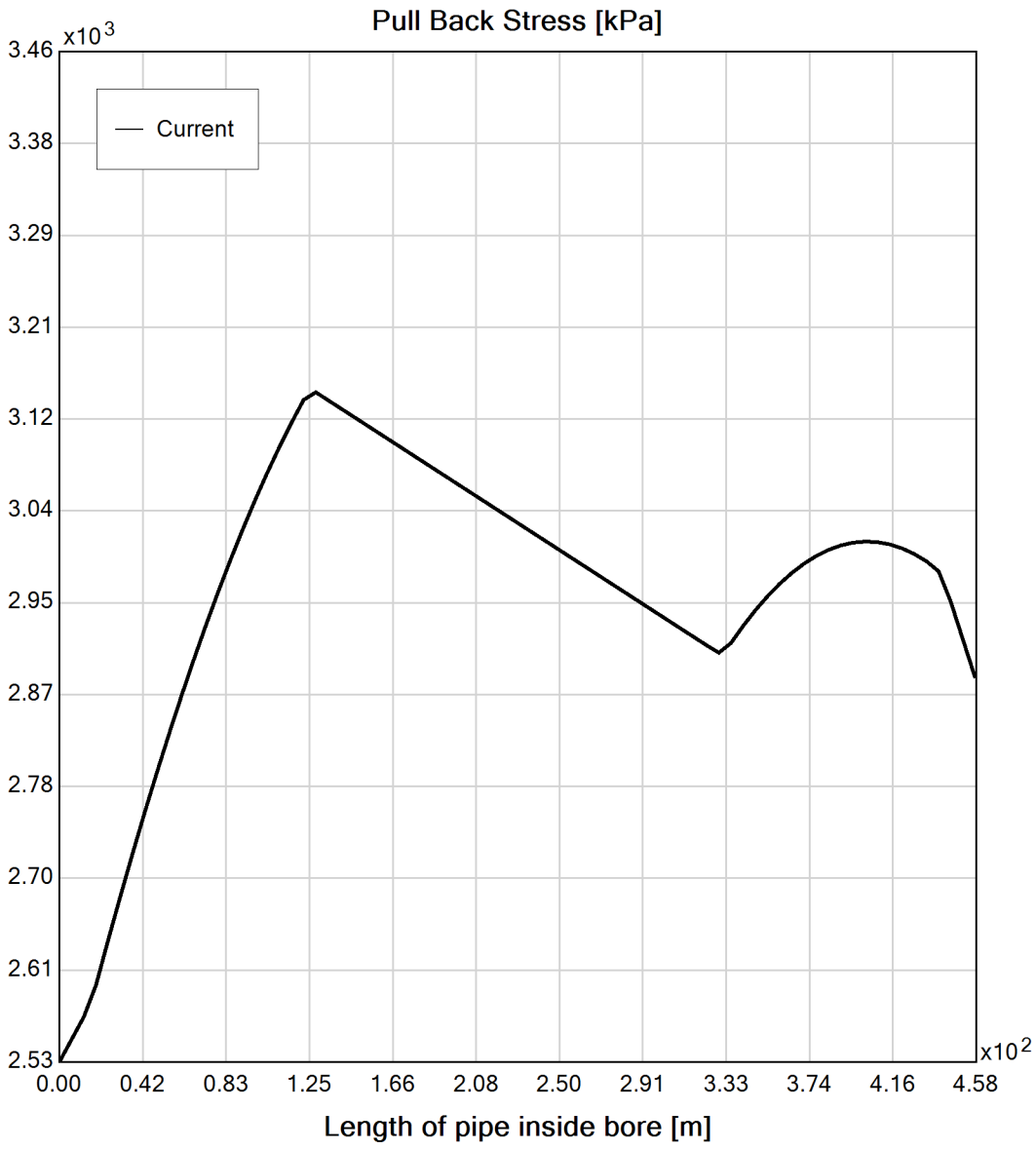

Buoyant Deflection [%]
x10 0
0.31
0.30
0.30
0.30
0.29
0.29
0.29
0.28
0.28
0.28
Current (Collapsed)
Current (Deformed)
x10 2
-0.20
0.21
0.62
1.04
1.45
1.86
2.27
2.69
3.10
3.51
3.92
4.34
Station [m]

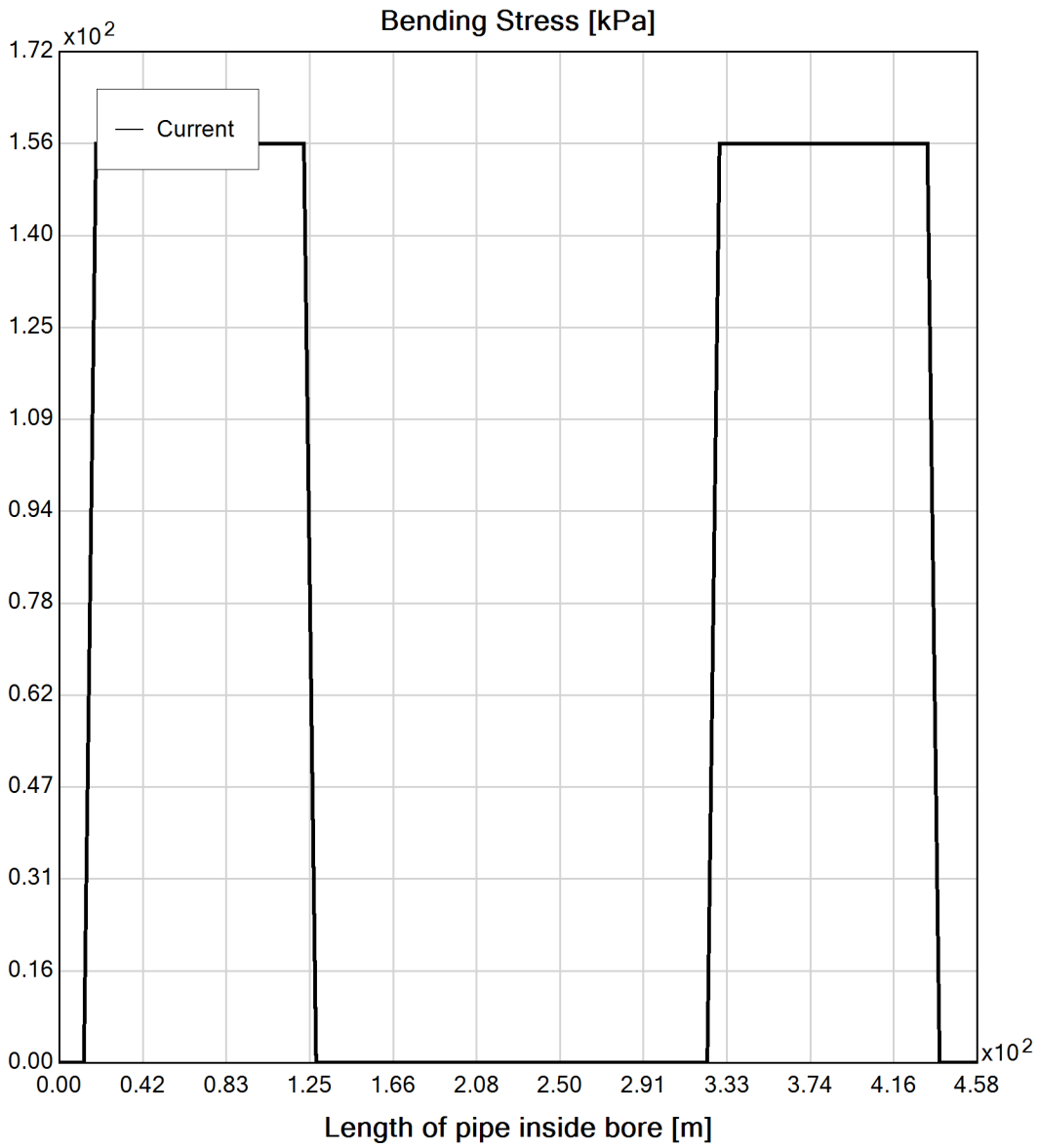

Reissner Effect Deflection [%]
x10-5
0.28
0.26
0.23
0.20
0.18
0.15
0.13
0.10
0.08
0.05
0.03
0.00
Current (Collapsed)
Current (Deformed)
x10 2
-0.20
0.21
0.62
1.04
1.45
1.86
2.27
2.69
3.10
3.51
3.92
4.34
Station [m]

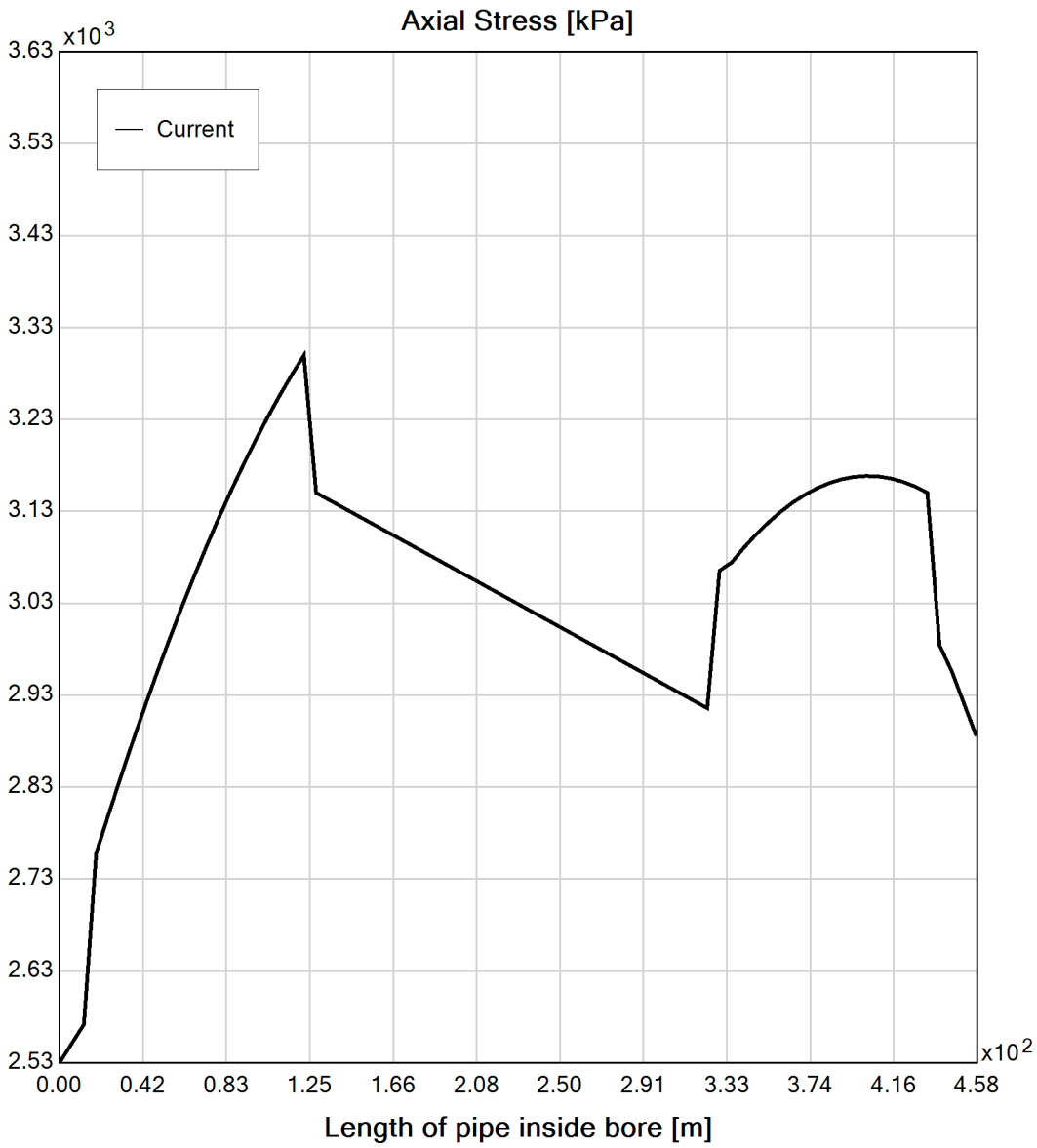

Net Deflection [%]
x10 1
1.37
1.25
1.13
1.01
0.90
0.78
0.66
0.55
0.43
0.31
0.20
0.08
Current (Collapsed)
Current (Deformed)
x10 2
-0.20
0.21
0.62
1.04
1.45
1.86
2.27
2.69
3.10
3.51
3.92
4.34
Station [m]

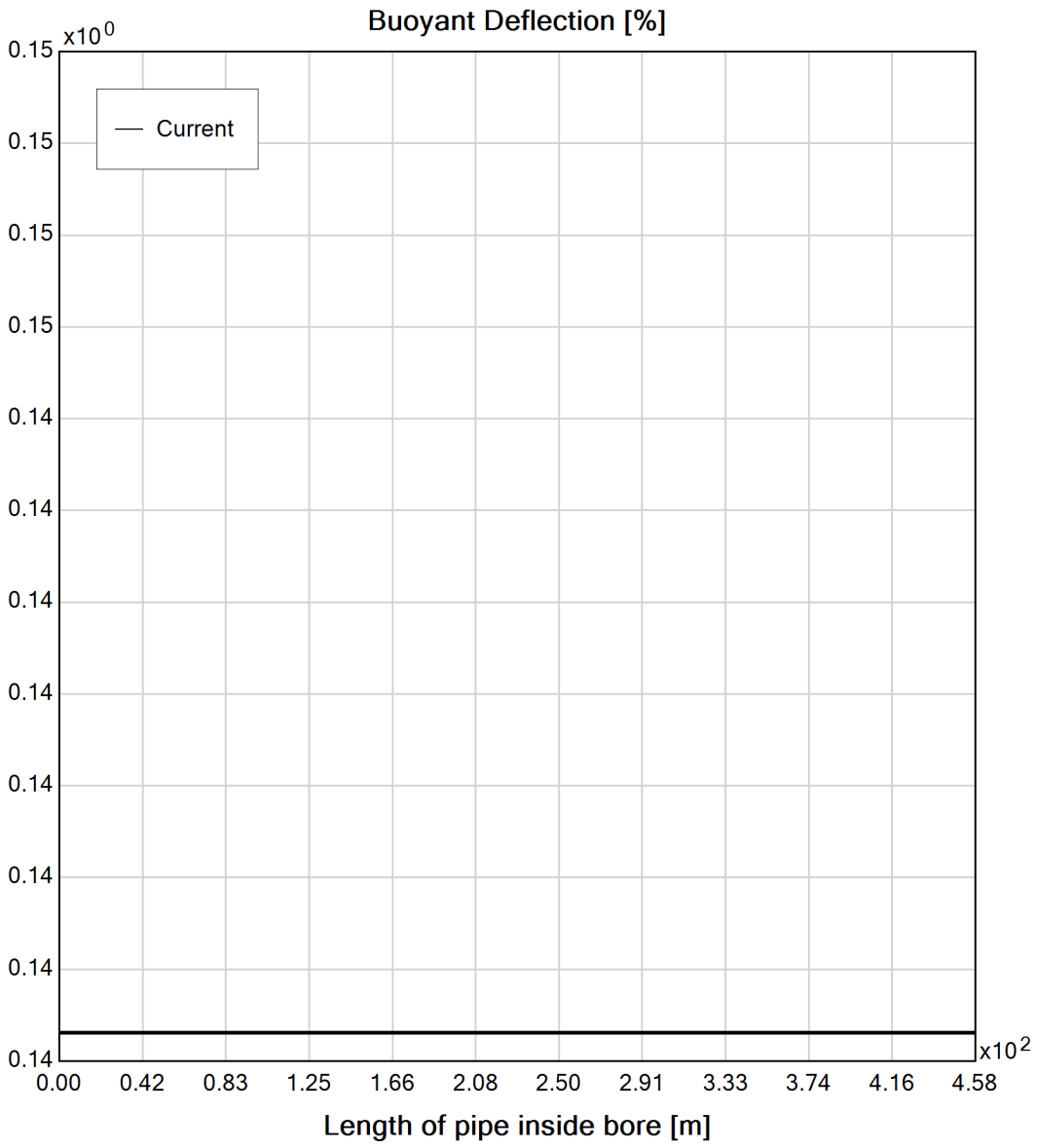

Compressive Stress [kPa]
x10 3
1.90
1.73
1.56
1.39
1.22
1.05
0.88
0.72
0.55
0.38
0.21
0.04
Current (Collapsed)
Current (Deformed)
x10 2
-0.20
0.21
0.62
1.04
1.45
1.86
2.27
2.69
3.10
3.51
3.92
4.34
Station [m]

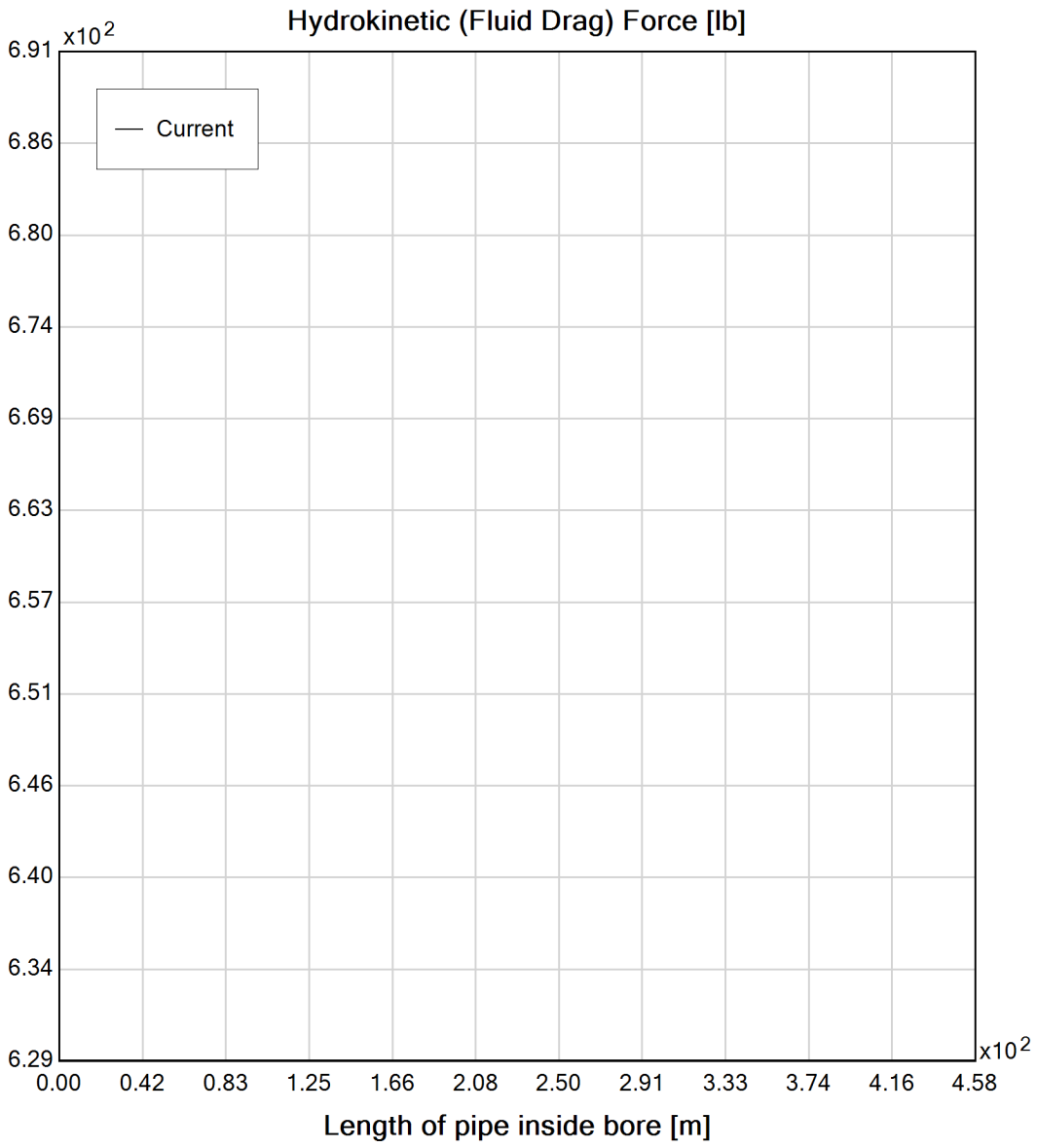

Pull Back Force [lb]
x10^4
2.01
1.95
1.89
1.83
1.78
1.72
1.66
1.61
1.55
1.49
1.44
1.38
Current
x10^2
0.00
0.42
0.83
1.25
1.66
2.08
2.50
2.91
3.33
3.74
4.16
4.58
Length of pipe inside bore [m]


Pull Back Stress [kPa]
x10 3
3.46
3.38
3.29
3.21
3.12
3.04
2.95
2.87
2.78
2.70
2.61
2.53
Current
x10 2
0.00
0.42
0.83
1.25
1.66
2.08
2.50
2.91
3.33
3.74
4.16
4.58
Length of pipe inside bore [m]


Bending Stress [kPa]
x10 2
1.72
1.56
1.40
1.25
1.09
0.94
0.78
0.62
0.47
0.31
0.16
0.00
Current
x10 2
0.00
0.42
0.83
1.25
1.66
2.08
2.50
2.91
3.33
3.74
4.16
4.58
Length of pipe inside bore [m]


Axial Stress [kPa]
x10 3
3.63
3.53
3.43
3.33
3.23
3.13
3.03
2.93
2.83
2.73
2.63
2.53
Current
x10 2
0.00
0.42
0.83
1.25
1.66
2.08
2.50
2.91
3.33
3.74
4.16
4.58
Length of pipe inside bore [m]


Buoyant Deflection [%]
x10 0
0.15
0.15
0.15
0.15
0.14
0.14
0.14
0.14
0.14
0.14
0.14
0.14
Current
x10 2
0.00
0.42
0.83
1.25
1.66
2.08
2.50
2.91
3.33
3.74
4.16
4.58
Length of pipe inside bore [m]


Hydrokinetic (Fluid Drag) Force [lb]
x10 2
6.91
6.86
6.80
6.74
6.69
6.63
6.57
6.51
6.46
6.40
6.34
6.29
Current
x10 2
0.00
0.42
0.83
1.25
1.66
2.08
2.50
2.91
3.33
3.74
4.16
4.58
Length of pipe inside bore [m]

Drill Planner Input Summary:

Bore Length: 457.20 m

Pipe Diameter: 315 mm

Overcut Ratio: 1.40

Maximum Reamer Size: 0.45 m

Drill Rod Length: 6.10 m

Drill Fluid / Soil Ratio: 2.5

Specified Maximum Pump Rate: 150.00 US (liquid) gallon/min

Pump Efficiency: 80.00 %

Drill Fluid Tank Volume: 2839.06 L

Reaming Sequence Summary:

Pilot Bore: 8.000 in @ 10.00 min/rod

Reamer Pass #1: 13.780 in @ 10.00 min/rod

Reamer Pass #2: 17.717 in @ 15.00 min/rod

Drill Planner Results Summary

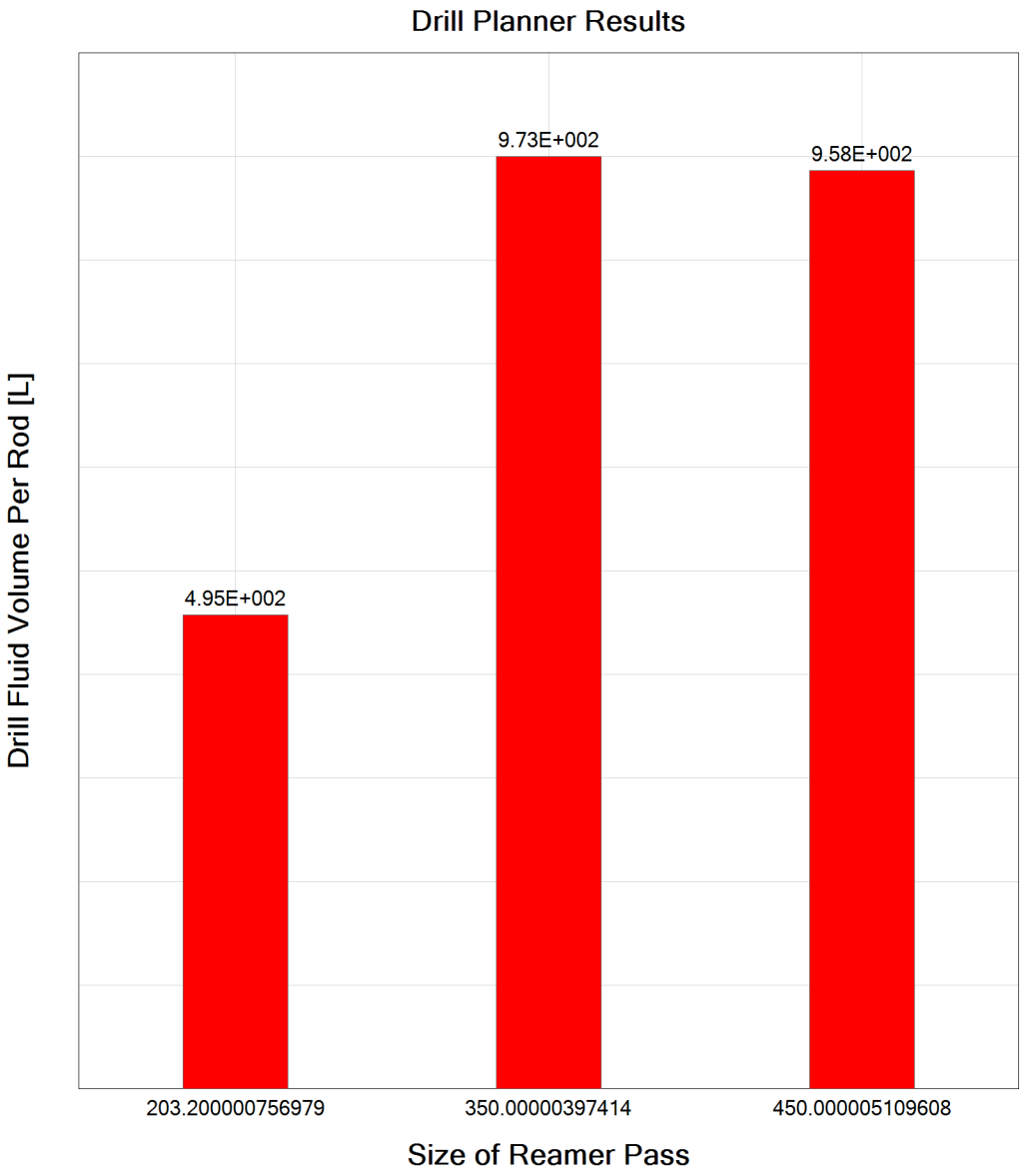
Ream	Diameter [mm]	Soil Volume [L]	Fluid Volume [L]	Time/Rod [min/rod]
Pilot Bore	203.200000756979	197.8	494.5	10.0
1	350.00000397414	389.1	972.7	10.0
2	450.000005109608	383.3	958.2	15.0

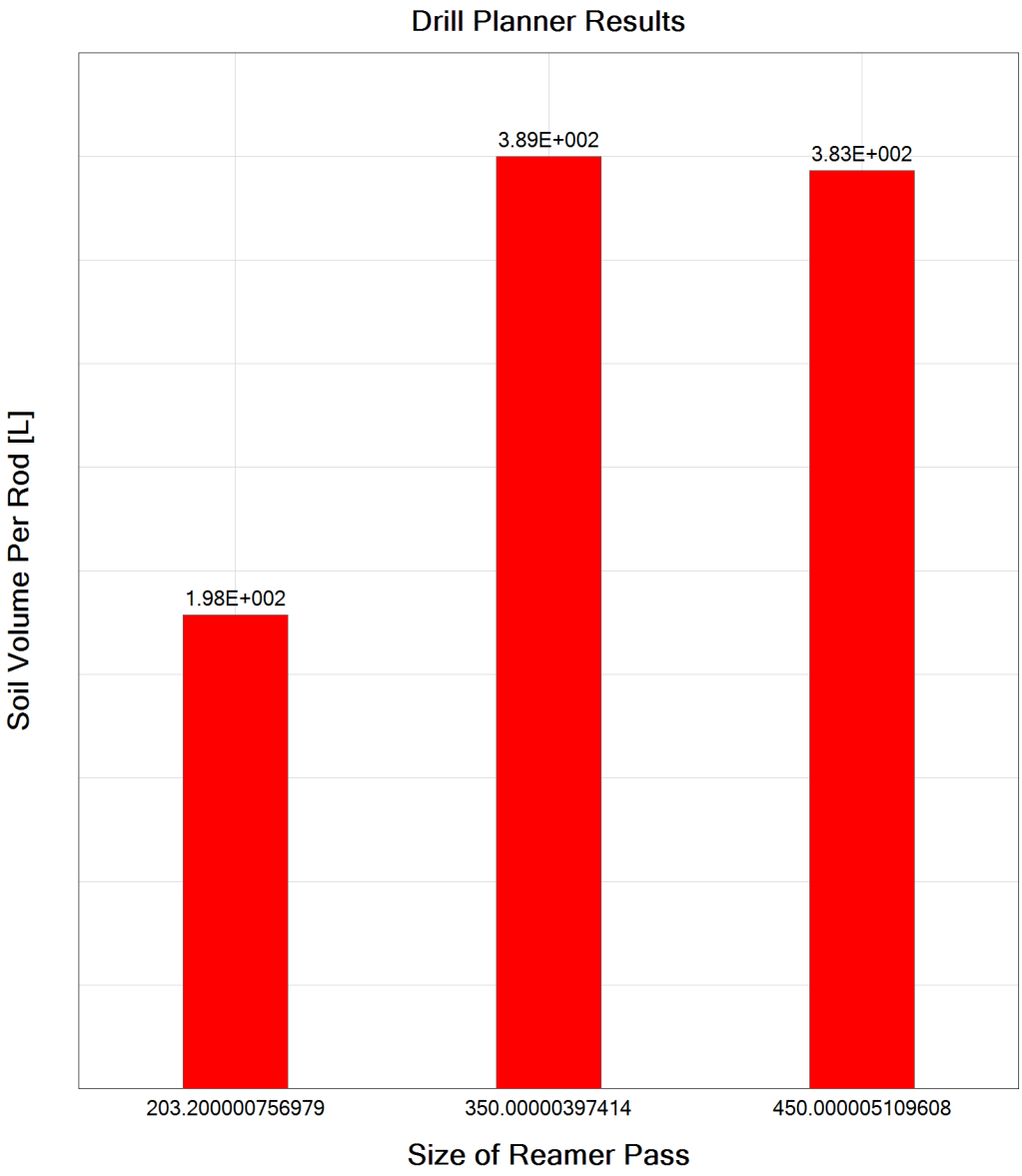
Ream	Fluid Rate [L/min]	# Tanks	Drill Time [min]	Check
Pilot Bore	49.5	13.1	749.5	OK
1	97.3	25.7	749.5	OK
2	63.9	25.3	1124.3	OK

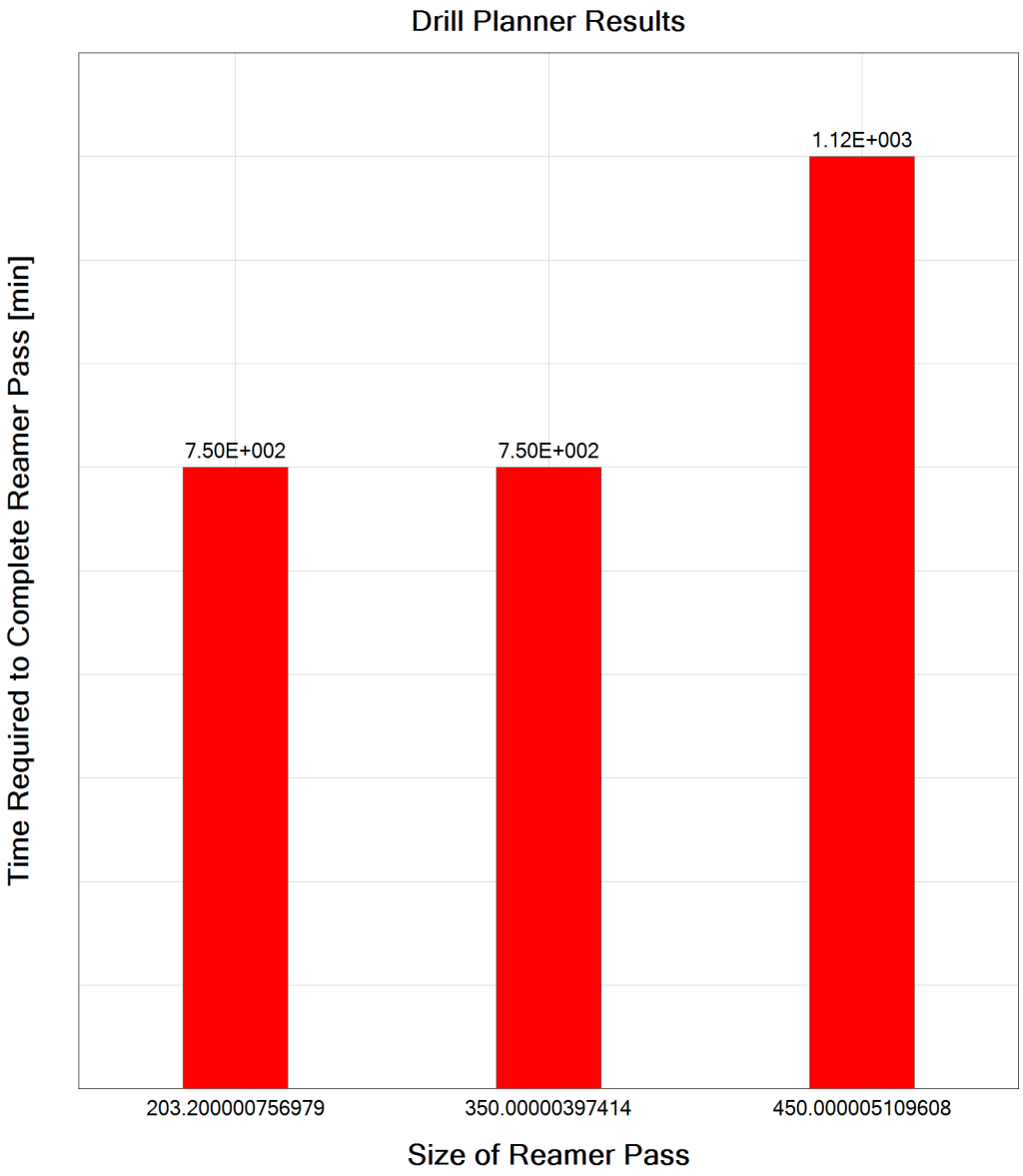
Total Drill Time: 2623.3 min

Total Volume of Drill Fluid: 181786.3 L

Total Number of Tanks: 64.0


Drill Planner Results
Drill Fluid Volume Per Rod [L]
9.73E+002
9.58E+002
4.95E+002
203.200000756979
350.00000397414
450.000005109608
Size of Reamer Pass


Drill Planner Results
Soil Volume Per Rod [L]
3.89E+002
3.83E+002
1.98E+002
203.200000756979
350.00000397414
450.000005109608
Size of Reamer Pass


Drill Planner Results
Time Required to Complete Reamer Pass [min]
7.50E+002
7.50E+002
1.12E+003
203.200000756979
350.00000397414
450.000005109608
Size of Reamer Pass

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 mm	203.20 mm	693.454 kPa	693.454 kPa
1	203.20 mm	350.00 mm	692.945 kPa	692.945 kPa
2	350.00 mm	450.00 mm	692.446 kPa	692.446 kPa

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 120.00 US (liquid) gallon/min

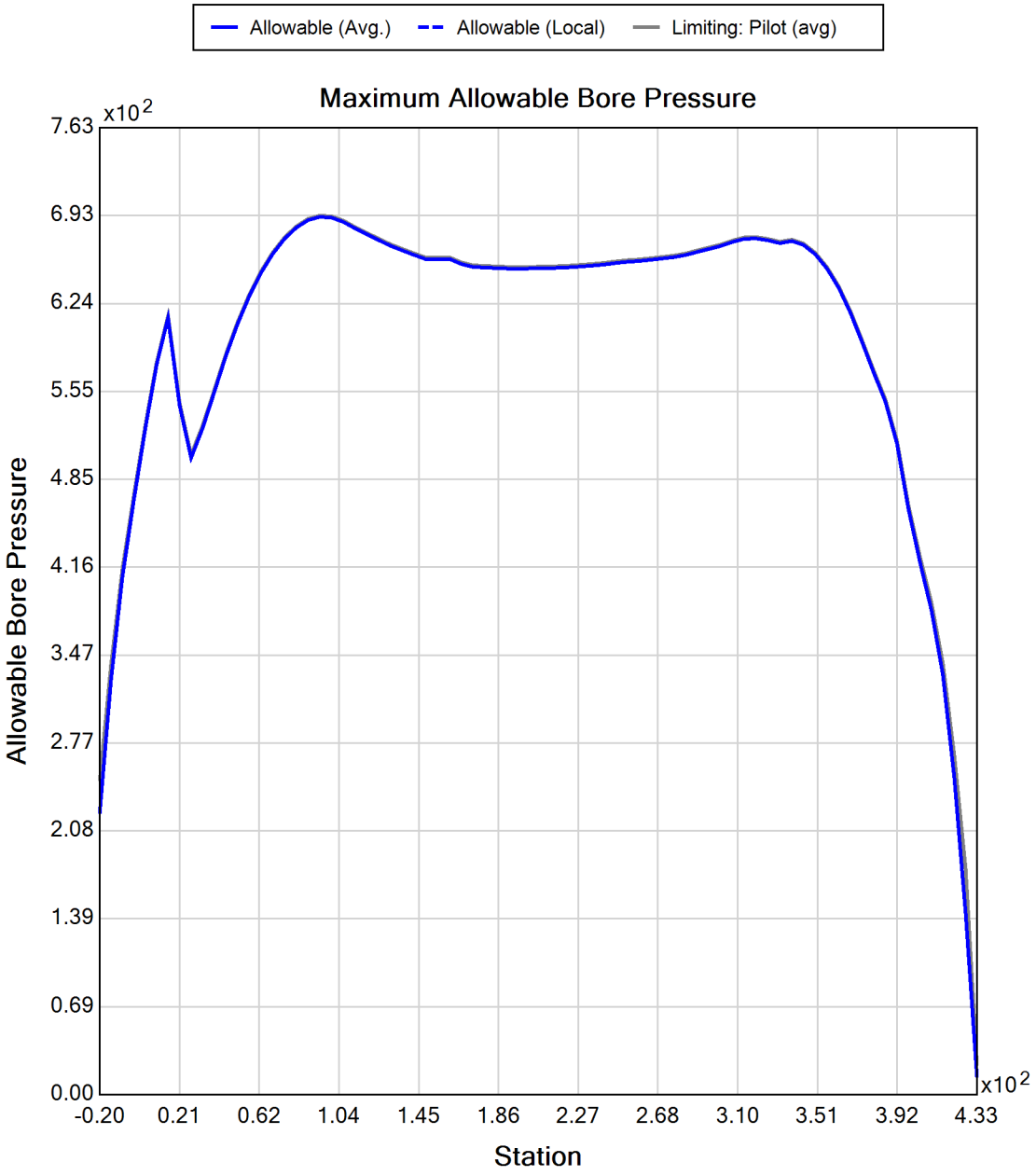
Drill Fluid Density: 10.790 kN/m3

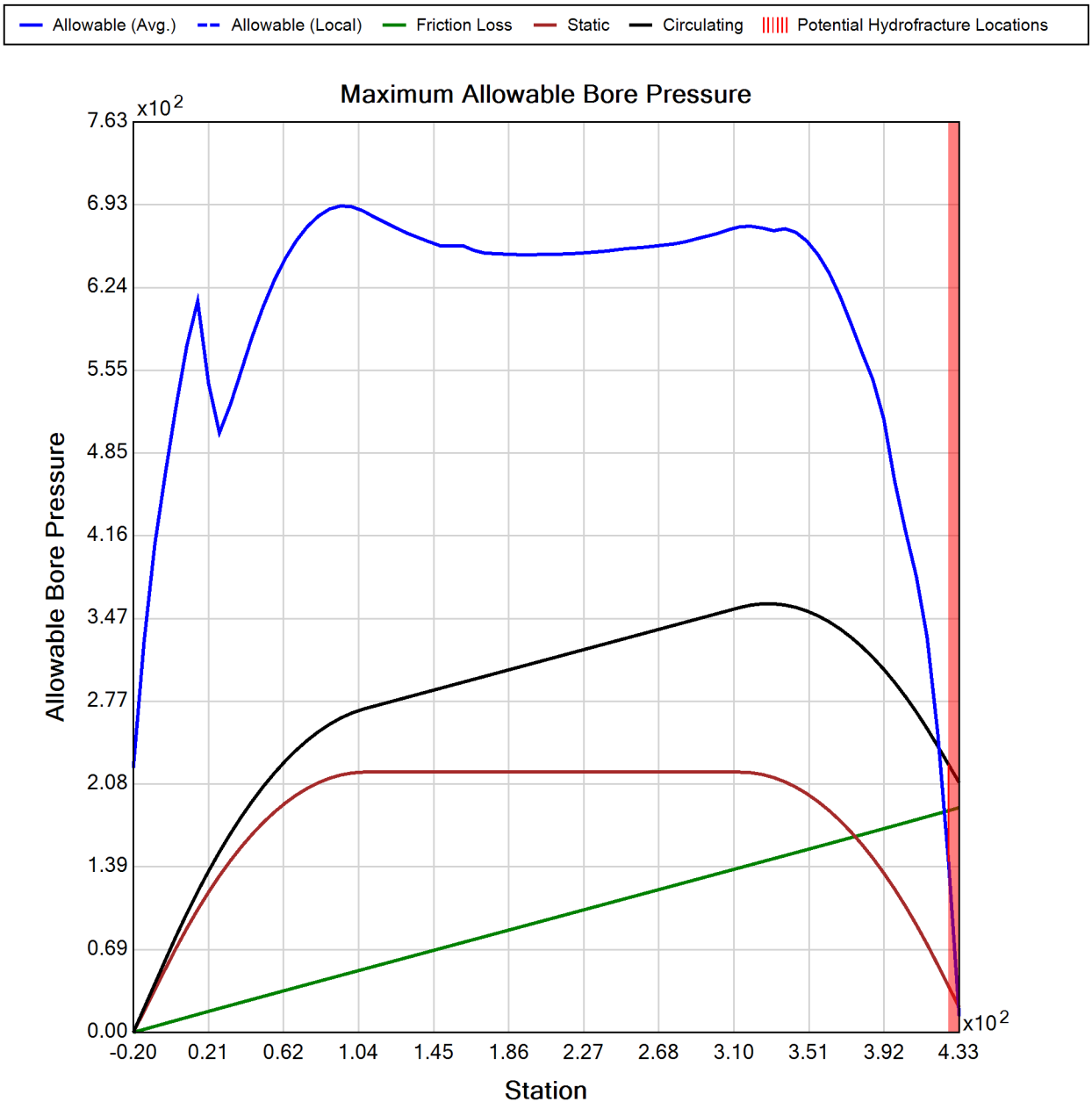
Rheological model: Power-Law

Fluid Consistency Index (K): 63.17

Power Law Exponent (n): 0.14

Effective Viscosity (cP): 333.0


Allowable (Avg.)
Allowable (Local)
Limiting: Pilot (avg)
Maximum Allowable Bore Pressure
x10 2
7.63
6.93
6.24
5.55
4.85
4.16
3.47
2.77
2.08
1.39
0.69
0.00
Allowable Bore Pressure
x10 2
-0.20
0.21
0.62
1.04
1.45
1.86
2.27
2.68
3.10
3.51
3.92
4.33
Station


Allowable (Avg.)
Allowable (Local)
Friction Loss
Static
Circulating
Potential Hydrofracture Locations
Maximum Allowable Bore Pressure
x10 2
7.63
6.93
6.24
5.55
4.85
4.16
3.47
2.77
2.08
1.39
0.69
0.00
Allowable Bore Pressure
-0.20
0.21
0.62
1.04
1.45
1.86
2.27
2.68
3.10
3.51
3.92
4.33
x10 2
Station

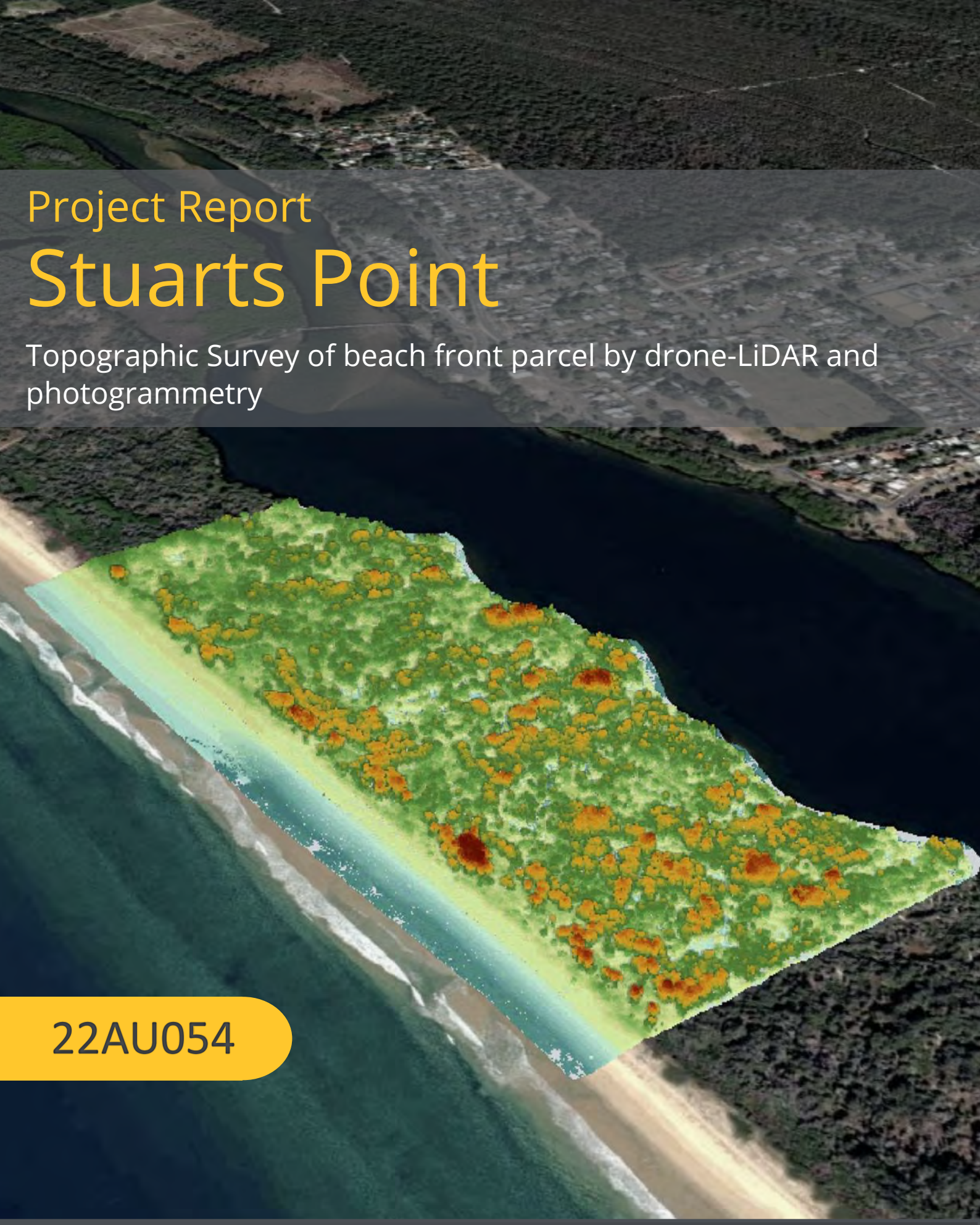
Appendix D

Stuarts Point Survey Report

Project Report

Stuarts Point

Topographic Survey of beach front parcel by drone-LiDAR and photogrammetry



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DIO SPATIAL

Document Control

Revision	Prepared	Reviewed	Authorised	Date
1.0 – new document	B.Hol	Z.Wasson	Z.Wasson	29/09/2022

Contents

1. Summary

Diospatial was engaged by GHD to carry out drone-based survey over a parcel of land near Stuarts Point, NSW.

The data capture included aerial imagery, drone LiDAR and GNSS ground control survey.

The aerial imagery has been processed in photogrammetry software to develop an aerial orthophoto and a high-resolution 3D textured mesh model.

Drone LiDAR was captured at a high point density and classified for ground returns. Ground classified LiDAR returns have been gridded to develop a Digital Terrain Model (DTM) and elevation contours.

Geospatial data from the survey has been hosted on a 3D GIS platform, *Pointerra*, which allows users to visualise, interrogate and download data without the need for specialist software or powerful computing hardware. The web-viewer includes tools for taking measurements, creating points of interest, cutting cross sections, and digitizing features with points and polylines.

Aerial data products (photogrammetry, LiDAR and derivatives) have been assessed to achieve 100mm vertical accuracy or better at 95% confidence interval when compared to a limited network of check points established in clear and open ground.

This report provides brief details of data capture, data processing, quality control and deliverables.

Figure 1 – Stuarts Point – Survey Area Overview

2. Critical Information

Location	Stuarts Point
Field Works	20st September 2022
Field Technicians	Aaron Searle
Subcontractors	Nil
Data Captured	GNSS Control Survey, Aerial Images, Drone LiDAR
LiDAR Sensor	YS Surveyor (S/N SURV-031)
Image Resolution	45MP Images with average ground sampling distance 11mm / pixel
Data Outputs	3D Textured Mesh Model, Aerial Orthophoto, LiDAR Point Cloud, Digital Terrain Model
Coordination	GDA2020, MGA Zone 56 and derived AHD (Ausgeoid2020)
LiDAR Vertical Accuracy	Tested to meet 100mm or better Fundamental Vertical Accuracy at 95 percent confidence level in open terrain using $RMSE_z$ x 1.96.

3. Deliverables

3.1. Schedule of Deliverables

File Name	Format	Description
Project Report	.pdf	Data acquisition, processing, QA/QC
3D GIS Viewer	Pointerra	Access the 3D GIS using this link. Password: surfsup *Hosting Expires 30/09/2023*
Data for Download	GoogleDrive	Download Data from GoogleDrive. *Link Expires 31/12/2022*
01. Geospatial Data	folder	
Contours50cm	dxf	Elevation Contours on 50cm interval
DTM50cm	geoTIFF	LiDAR DTM (raster) on 25cm grid
GroundMesh	dxf	LiDAR DTM (vector) mesh
LiDAR	LAZ	LiDAR, classified for ground returns
Ortho2cm	geoTIFF	Aerial Orthophoto on 2cm pixel resolution
PGPC5cm	LAZ	Photogrammetry Point Cloud on 5cm spacing
02. 3D Models	folder	
3SM	3SM	3D textured mesh model (photogrammetry) in 3SM Bentley native file format
Ground Mesh	OBJ	3D mesh model of the Ground TIN in OBJ format
03. Ortho Renders	folder	Various orthographic renders of the data
04. Quality Reports	Folder	LiDAR and photogrammetry QC reports

3.2. Pointerra

Geospatial Data and 3D Reality Model have been hosted via a 3D web GIS platform for ease of visualisation and access across internal and external stakeholders. We recommend using Google Chrome (web browser) for viewing accessing the Portal.

The Pointerra portal has the ability to host and visualise a large number of file types, including design models, detail survey, etc. As additional spatial data and models become available throughout the lifecycle of the project, these can be added to the digital twin and facilitate stakeholder engagement, collaboration and communication.

The Portal can be accessed via the URL and password in the deliverables transmittal and will remain active through to September 2023. Hosting can be extended beyond this period for a fee.

Figure 2 – Pointerra User Interface, with tools for switching between data layers, taking measurements, cutting cross sections and adding Points of Interest.

4. Survey Coordination

A GNSS Base Station was established on PM48030 and served as base for a UHF RTK rover.

Ground control and validation points were established within the survey area where on-foot access was possible. Each point was observed twice for a period of 60-seconds and the results averaged to achieve the final coordinate value.

Ground control was limited to the eastern side of the beach, as the vegetated area was dense and marsh like, preventing access to the western bank.

Adopted Mark	Easting	Northing	AHD
PM48030	499393.857	6590599.709	4.944
All survey coordination is in GDA2020 MGA56 and derived AHD			

5. Image Capture

Images were captured as raw data inputs to create an orthophoto and reality model. Images were captured using a multirotor remotely piloted aircraft (RPA) equipped with a 45MP camera. Camera positions were geolocated using the RPA's onboard RTK GNSS system.

Photogrammetry software ingested geolocated images and ground survey to produce the above-mentioned data outputs. Ground control points were used as check point to verify the accuracy of the photogrammetry data.

6. LiDAR Capture

LiDAR was captured and processed to create a point cloud. The point cloud was later classified and further processed to create a Digital Terrain Model (DTM) and elevation contours.

LiDAR was captured using a multirotor RPA equipped with a YellowScan Surveyor LiDAR system. A Post Processed Kinematic (PPK) workflow corrected the RPA's trajectory and referenced the data to the project area's adopted mark.

Table 1 – LiDAR Classification Table

Classification Value	Class Name	Includes
1	Unclassified	Unclassified points
2	Ground	Topography points, terrain

7. Quality Control

7.1. Photogrammetry Quality Control

Area	Image Count (no.)	Average Resolution (mm/pixel)	Check Point Error 3D RMSE (mm)
Stuarts Point	1715	15	16

7.2. LiDAR Quality Control

Area	Average Point Spacing (mm)	Final Point Cloud Z RMSE (mm)	*1.96xRMSE* (mm)
Stuarts Point	59	10	19
Fundamental Vertical Accuracy (ICSM Guidelines) at 95% confidence Interval (1.96xRMSE)			

7.2.1. LiDAR Vertical QC

Vertical Quality Control (QC) of LiDAR data was carried out by comparing classified LiDAR point elevations to ground control points. Vertical QC of the LiDAR data was carried out using GlobalMapper's LiDAR QC tool, where:

1) Inverse distance weighting (IDW) of the control points is used to calculate the expected Z value of the nearby LiDAR points.
2) Calculate the difference (delta) between the measured ground control point elevation and the RMS LiDAR elevation value for the corresponding cell.
3) Report the delta RMSE across the data set as the achieved vertical accuracy at 1 sigma.
4) Report the Fundamental Vertical accuracy at 1.96 x RMSE as per ICSM Guidelines for Elevation Data.

The internal accuracy, or precision, of the LiDAR data is ±30mm, based on precision limitations of the LiDAR sensor utilised for the survey.

7.2.1. LiDAR Horizontal QC

Horizontal Quality Control of the LiDAR data was carried out by visually assessing the planimetric alignment of LiDAR derived Digital Terrain Model and Orthophoto.

7.2.2. Classification and DTM QC

LiDAR point cloud classification and DTM surface was visually checked along at various locations across the site using cross sections. A sample of cross section QC is detailed in the 'Quality Reports' folder.

8. Quality Reports

LiDAR and photogrammetry quality control reports are available in the Deliverables folder.

Appendix E

Safety in Design

HSE040 Safety in Design Risk Assessment

Notes: *Designs with significant quantities of dangerous goods may require detailed risk assessments under Dangerous Goods or Major Hazard legislation
* Most industrial processes will require an industry specific assessment, e.g. HAZOP and/or Quantitative Risk Assessment for facilities that have chemical or high-pressure processes under Dangerous Goods or Major Hazard legislation.

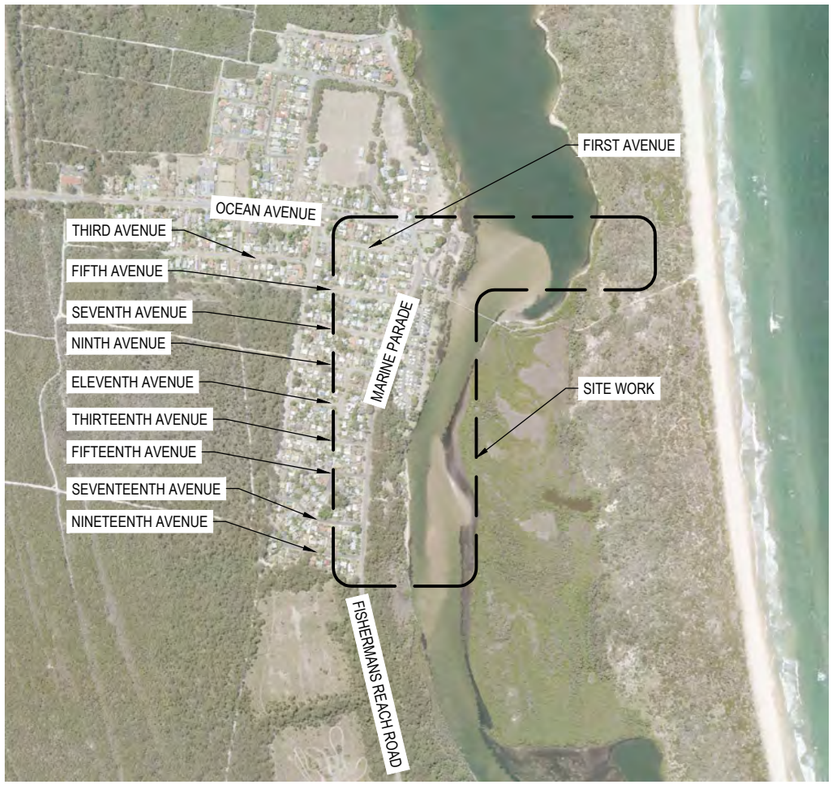
Design Life Cycle:	Investigation and Design	Setup, Construction and Commissioning	Operation	Maintenance	Disposal		Date:	27/01/2023	Revision No:	
Job Name:	SPSS - Effluent transfer and disposal design and investigations	Job No:	12551313	Client	Kempsey Shire Council		Design:	Concept Design		
People involved in Risk Assessment:	Joe O'Donoghue, Renee Johnson									

Design Ref	Design Life Cycle Stage (Select from Drop Down Box)	Hazards What could cause injury or ill health, damage to property or damage to the environment	Risk What could go wrong and what might happen as a result	Existing Control Measures	Initial Risk Rating C	Initial Risk Rating L	Initial Risk Rating RR	Potential Control Measures (Consider Hierarchy of Control - Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	Responsibility	By When	Decision / Status	Residual Risk Rating C	Residual Risk Rating L	Residual Risk Rating RR	Comments
	Investigation and Design	Impact on public roads/traffic	Vehicle collision with surveyors or site investigation workers		D - Critical	2 - Unlikely	Moderate	Avoid investigations requiring personel to work near roads were practicable	GHD	Design		D - Critical	1 - Very Unlikely	Moderate	
	Investigation and Design	Live services	Potholders damage services / electrocution	BYDA Searches	E- Catastrophic	3 - Possible	Extreme	Show BYDA services on model and drawings to help identify risks. Potholer SMP	GHD	Design		E- Catastrophic	2 - Unlikely	Significant	
	Setup, Construction and Commissioning	Excavation	Falls into open excavations leading to injury to workers or members of the public		B - Major	3 - Possible	Low	Excavations to be covered and construction fencing to be used.	GHD	Construction		B - Major	2 - Unlikely	Negligible	
	Setup, Construction and Commissioning	Slips/Trips/Falls	Falls and trips around trenches		B - Major	3 - Possible	Low	Keep working conditions dry and tidy	GHD Contractor	Construction		B - Major	2 - Unlikely	Negligible	
	Setup, Construction and Commissioning	Mobile plant & equipment	Collision injuries		B - Major	3 - Possible	Low	Propose measures for safe site access from public roads, provide site roads, and proposed storage compounds to reduce vehicle movements.	GHD Contractor	Construction		B - Major	2 - Unlikely	Negligible	
	Setup, Construction and Commissioning	Pollution/contamination/ spills/releases/emissions	Pollution from construction activities entering bushland / waterways eg. ASS runoff		C- Severe	2 - Unlikely	Low	Reduce quantity of excavation open at any time, particularly near waterways. Contractor CEMP.	Contractor	Construction		C- Severe	1 - Very Unlikely	Low	
	Setup, Construction and Commissioning	Pressure	Effluent main burst causing injuries to workers.		D - Critical	1 - Very Unlikely	Moderate	Design limit pressure through pipeline diameter selection and structural pipeline calculations to confirm adequate depth. SMP for pressure testing.	GHD Contractor	Construction		D - Critical	1 - Very Unlikely	Moderate	
	Setup, Construction and Commissioning	Public interference	Unauthorised access to site - injury to staff and unauthorised personel		B - Major	2 - Unlikely	Negligible	Temporary security fencing around construction zones.	Contractor	Construction		B - Major	1 - Very Unlikely	Negligible	
	Setup, Construction and Commissioning	Impact on public roads/traffic	Collision injuries during construction works.		D - Critical	2 - Unlikely	Moderate	Works to be separate/deliniated from live traffic where practicable. Contractor TMP.	Contractor	Construction		D - Critical	1 - Very Unlikely	Moderate	
	Setup, Construction and Commissioning	Manual handling	Injuries to workers unloading, storing, and craning pipes.		D - Critical	2 - Unlikely	Moderate	Provide good quality access roads, crane pads, and proposed compounds. Contractor SMP	GHD Contractor	Construction		D - Critical	1 - Very Unlikely	Moderate	
	Setup, Construction and Commissioning	Hot Works	Injury from welding pipes/fittngs		D - Critical	2 - Unlikely	Moderate	Take measures to check for flamable gas.	Contractor	Construction		D - Critical	1 - Very Unlikely	Moderate	
	Setup, Construction and Commissioning	Strike of underground/overhead services (electrical)	Injuries/death from electrocution/engulfment		E- Catastrophic	3 - Possible	Extreme	BYDA, SWP, services location and marking.	Contractor	Construction		E- Catastrophic	2 - Unlikely	Significant	
	Setup, Construction and Commissioning	Drilling fluids	Environmental impact on the Macleay Arm		D - Critical	2 - Unlikely	Moderate	Trenchless crossing depth selected to provide constant strata. Drilling SWP/procedures to include management of drilling fluids and frac out emergency response.	Contractor	Construction		D - Critical	1 - Very Unlikely	Moderate	
	Maintenance	Manual handling	Injuries caused by removing and replacing valves.		B - Major	3 - Possible	Low	Design valve depth to be as shallow as practicable.	GHD	Design		B - Major	2 - Unlikely	Negligible	
	Operation	Manual handling	Injuries caused by operating valves.		B - Major	3 - Possible	Low	Design valves with adequate space to be able to operate, keep as shallower as possible to avoid creating a confined space and locate away from roadways, etc as possible.	GHD	Design		B - Major	2 - Unlikely	Negligible	

Appendix F

Concept Design Drawings

KEMPSEY SHIRE COUNCIL
SPSS - EFFLUENT TRANSFER, DISPOSAL DESIGN AND INVESTIVATIONS
12551313



LOCALITY PLAN
N.T.S

DRAWING LIST

DRG No.	DRAWING TITLE
12551313-G001	COVER SHEET, LOCALITY PLAN AND DRAWING LIST
12551313-G002	GENERAL NOTES
12551313-G003	SHEET LAYOUT PLAN
12551313-W001	PLAN AND LONGITUDINAL SECTION - SHEET 1 OF 10
12551313-W002	PLAN AND LONGITUDINAL SECTION - SHEET 2 OF 10
12551313-W003	PLAN AND LONGITUDINAL SECTION - SHEET 3 OF 10
12551313-W004	PLAN AND LONGITUDINAL SECTION - SHEET 4 OF 10
12551313-W005	PLAN AND LONGITUDINAL SECTION - SHEET 5 OF 10
12551313-W006	PLAN AND LONGITUDINAL SECTION - SHEET 6 OF 10
12551313-W007	PLAN AND LONGITUDINAL SECTION - SHEET 7 OF 10
12551313-W008	PLAN AND LONGITUDINAL SECTION - SHEET 8 OF 10
12551313-W009	PLAN AND LONGITUDINAL SECTION - SHEET 9 OF 10
12551313-W010	PLAN AND LONGITUDINAL SECTION - SHEET 10 OF 10
12551313-W011	TYPICAL DETAILS
12551313-W012	DUNAL DISPOSAL AREA DISCHARGE PIPEWORK TYPICAL DETAILS

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS Drafting Check -
Designer - Design Check -

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

Status PRELIMINARY Status Code

Drawing Title COVER SHEET, LOCALITY PLAN AND DRAWING LIST

Size A3

Drawing No. 12551313-G001

Rev B

Plot Date: 25 January 2023 - 1:17 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-G001.dwg

GENERAL:

1. ALL PIPES AND FITINGS TO BE CONSTRUCTED AS PER WSA 03 2022 (REGIONAL NSW) SPECIFICATIONS.
2. DN315 PE100 POLYETHYLENE PIPE MATERIAL TO BE USED FOR THE ALIGNMENT.
3. PIPEWORK TO BE INSTALLED AS PER AS/NZS 2033.
4. CONSTRUCT TRENCH STOPS AT GRADES IN ACCORDANCE WITH WSA 03 2022 (REGIONAL NSW) SPECIFICATIONS.
5. MINIMUM COVER REQUIREMENTS TO MEET WSA 03 2022 (REGIONAL NSW) SPECIFICATIONS.
6. TRENCH TYPES IN ACCORDANCE WITH WSA 03 2022 (REGIONAL NSW) SPECIFICATIONS.

SERVICES:

1. LOCATION OF EXSTING SERVICES SHOWN ON CONCEPT DESIGN DRAWINGS IS INDICATIVE ONLY. EXACT LOCATION OF SERVICES TO BE CONFIRMED BY CONSTRUCTION CONTRACTOR ON SITE.
2. CONSTRUCTION CONTRACTOR TO ENSURE PIPELINE IS INSTALLED MAINTAINING MINIMUM HORIZONTAL AND VERTICAL CLEARANCES AS PER WSA 03 2022 (REGIONAL NSW) SPECIFICATIONS.

WWTP CONNECTION:

1. WWTP OF EFFLUENT TRANSFER PIPELINE TO INCLUDE BLANK FLANGE AND INLINE THRUST RESTRAINT.
2. DETAILED DESIGN OF EFFLUENT TRANSFER PIPELINE CONNECTION AT STUARTS POINT WWTP TO BE COMPLETED AS PART OF SEPARATE WORKS.

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS **Drafting Check** -
Designer - **Design Check** -

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

Status PRELIMINARY Status Code

Drawing Title GENERAL NOTES

Size **A3**

Drawing No. 12551313-G002

Rev B

Plot Date: 25 January 2023 - 12:56 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-G002.dwg

PLAN

SCALE 1:10000

Rev	Description	Author	Checked	Approved	Date
B	CONCEPT DESIGN	RJ		AF	17.01.23
A	PRELIMINARY	RJ		AF	06.12.22

Author: J. REGLAMOS — Drafting Check: -
Designer: - — Design Check: -

0 100 200 300m
SCALE 1:10,000 AT ORIGINAL SIZE

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Project No. 12551313

Client: KEMPSEY SHIRE COUNCIL

Project: SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

Status: PRELIMINARY — Status Code

Drawing Title: SHEET LAYOUT PLAN

Drawing No. 12551313-G003

Size: A3

Rev: B

Plot Date: 25 January 2023 - 12:30 PM Plotted by: Jeyzon Reglamos

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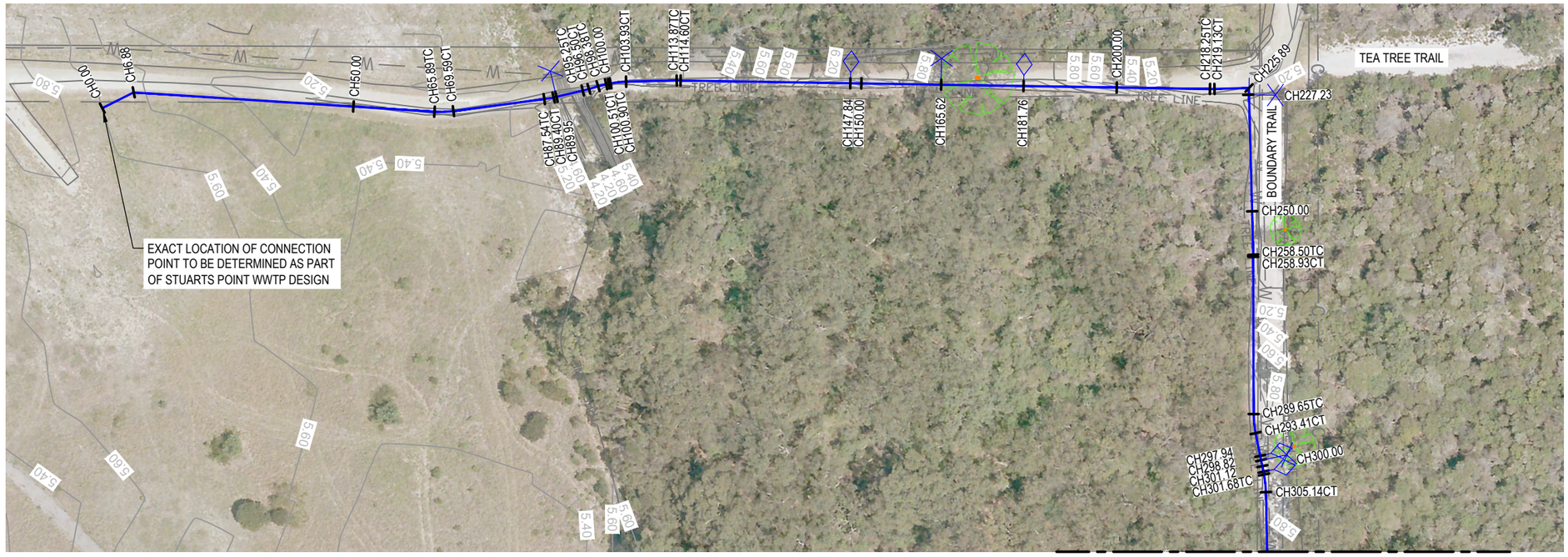


PLAN

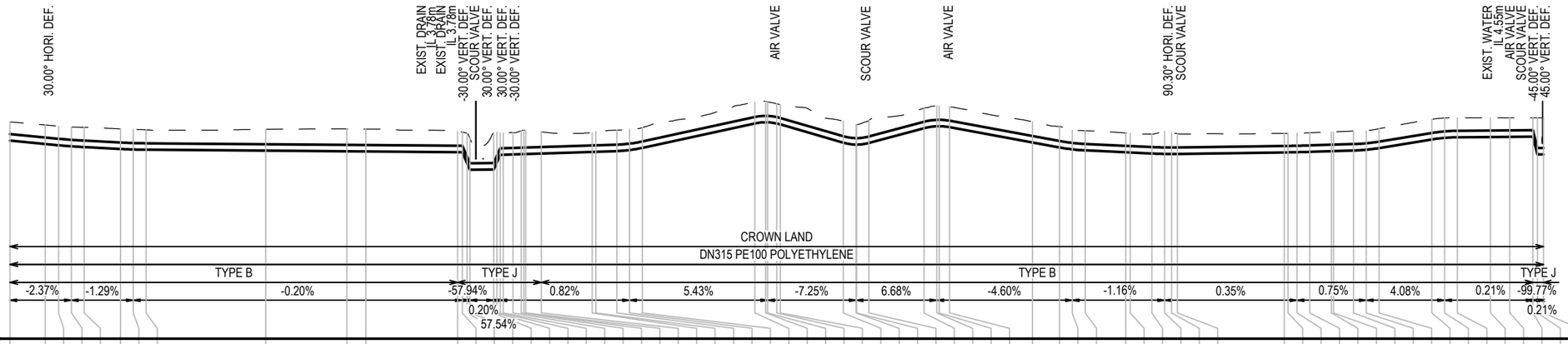
SCALE 1:1000

LEGEND:

- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- RM — PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN200 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- S — PROPOSED PRESSURE SEWER RETICULATION NETWORK (DESIGN BY OTHERS)
- EXISTING FENCE
- SW — EXISTING STORMWATER
- W — EXISTING WATER
- S — EXISTING SEWER
- E — EXISTING ELECTRICAL
- C — EXISTING COMMUNICATION
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- TREES
- SCOUR VALVE
- AIR VALVE
- ISOLATION VALVE

NOTE:

1. DEEPER TRENCH MAY BE POSSIBLE IF GEOTECHNICAL CONDITIONS ARE SUITABLE TO REDUCE NUMBER OF AIR VALVES AND SCOUR VALVES.



DATUM RL. -5.0

CHAINAGE	DEPTH TO INVERT	PIPE INVERT LEVEL	EXISTING SURFACE
0.00	0.915	4.685	5.600
6.88	0.927	4.522	5.449
9.51	0.934	4.460	5.394
12.01	0.940	4.408	5.348
14.51	0.969	4.368	5.337
21.62	0.983	4.277	5.260
24.12	0.984	4.251	5.235
26.62	0.971	4.239	5.210
50.00	1.044	4.193	5.237
65.89	1.093	4.161	5.254
69.59	1.094	4.153	5.247
87.54	1.010	4.118	5.127
88.47	0.983	4.116	5.099
89.40	1.464	3.577	5.041
89.95	1.559	3.258	4.817
94.62	1.777	3.267	5.045
95.25	1.466	3.626	5.092
95.88	1.063	3.988	5.051
96.50	1.065	3.993	5.058
98.38	1.067	4.008	5.075
100.00	1.146	4.022	5.168
100.51	1.172	4.026	5.198
100.90	1.159	4.029	5.188
103.93	1.058	4.054	5.112
113.87	0.949	4.135	5.083
114.60	0.987	4.141	5.127
118.71	1.027	4.174	5.201
121.21	1.000	4.224	5.224
123.71	0.991	4.330	5.322
145.70	1.035	5.523	6.559
147.84	1.020	5.581	6.601
148.20	1.004	5.580	6.584
150.00	0.966	5.522	6.488
150.70	0.971	5.478	6.449
163.02	1.056	4.584	5.641
165.52	0.987	4.490	5.478
165.62	0.982	4.490	5.472
168.02	1.113	4.570	5.684
178.80	0.981	5.290	6.270
181.30	0.995	5.386	6.381
181.76	0.998	5.389	6.386
183.80	1.004	5.342	6.346
200.00	1.011	4.596	5.607
205.33	1.022	4.351	5.373
207.83	0.939	4.257	5.196
210.33	0.966	4.206	5.172
218.25	0.948	4.114	5.062
219.13	0.943	4.104	5.047
223.39	0.946	4.054	5.000
225.89	1.111	4.035	5.146
227.23	1.047	4.032	5.079
228.39	0.984	4.034	5.018
249.30	0.925	4.108	5.032
250.00	0.927	4.110	5.037
251.80	0.929	4.119	5.048
254.30	0.936	4.135	5.071
258.50	0.943	4.167	5.110
258.93	0.944	4.170	5.114
262.82	0.953	4.200	5.153
265.32	0.918	4.240	5.157
267.82	0.950	4.321	5.271
278.15	0.992	4.742	5.734
280.65	0.970	4.820	5.790
283.15	0.950	4.850	5.800
289.65	0.936	4.864	5.800
293.41	0.929	4.871	5.800
297.94	0.919	4.881	5.800
298.82	1.794	4.006	5.800
300.00	1.792	4.008	5.800

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS — Drafting Check -
Designer - — Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE
0 2.5 5.0 7.5m
0 10 20 30m
N

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

Status PRELIMINARY — Status Code

Drawing Title PLAN AND LONGITUDINAL SECTION - SHEET 1 OF 10

Drawing No. 12551313-W001

Size A3

Rev B

Plot Date: 25 January 2023 - 12:31 PM Plotted by: Jeyzon Reglamos

File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg

PLAN

SCALE 1:1000

LEGEND:

- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- RM — PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN200 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- S — PROPOSED PRESSURE SEWER RETICULATION NETWORK (DESIGN BY OTHERS)
- / — EXISTING FENCE
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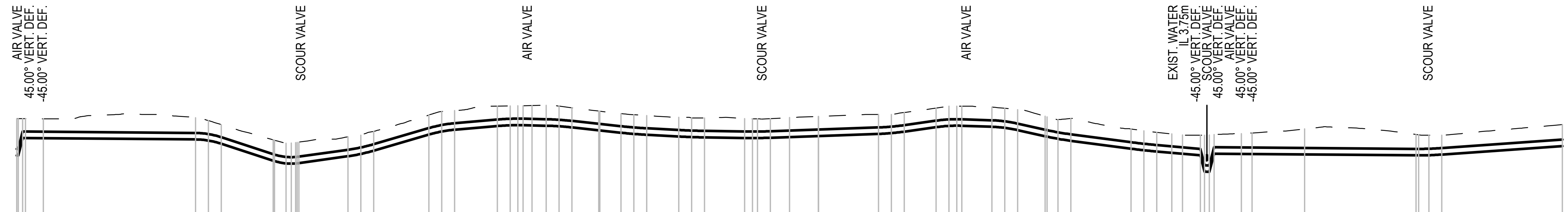
- C — EXISTING COMMUNICATION
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- TREES
- SCOUR VALVE
- AIR VALVE
- ISOLATION VALVE

NOTE:

1. DEEPER TRENCH MAY BE POSSIBLE IF GEOTECHNICAL CONDITIONS ARE SUITABLE TO REDUCE NUMBER OF AIR VALVES AND SCOUR VALVES.



TENURE: CROWN LAND

PIPE TYPE: DN315 PE100 POLYETHYLENE

TRENCH TYPE: TYPE J | TYPE B | TYPE J

DESIGN GRADE: 0.21% | 100.21% | -0.20% | -8.17% | 3.50% | 7.29% | 2.15% | -0.55% | -2.70% | -1.34% | -0.38% | 0.88% | 3.53% | -0.84% | -5.60% | -3.28% | -2.20% | -102.14% | -1.25% | 97.58% | -0.20% | 1.76%

DATUM RL. -5.0

CHAINAGE	DEPTH TO INVERT	PIPE INVERT LEVEL	EXISTING SURFACE
300.00	1.792	4.008	5.800
300.27	1.791	4.009	5.800
301.12	0.944	4.856	5.800
301.68	0.945	4.855	5.800
305.14	0.937	4.848	5.785
334.70	1.053	4.789	5.842
337.20	0.967	4.734	5.702
339.70	0.925	4.580	5.505
349.77	1.008	3.758	4.766
350.00	1.010	3.739	4.749
352.27	0.974	3.626	4.600
353.26	0.994	3.615	4.609
354.13	1.014	3.623	4.637
354.41	1.016	3.630	4.647
354.77	1.017	3.641	4.658
364.27	0.949	3.974	4.922
366.77	0.913	4.085	4.998
369.27	0.941	4.244	5.185
379.99	0.950	5.025	5.975
382.49	0.969	5.175	6.145
384.99	0.926	5.261	6.187
393.28	0.965	5.440	6.404
395.78	0.938	5.476	6.415
397.26	0.939	5.482	6.421
398.28	0.946	5.480	6.425
400.00	0.963	5.470	6.433
402.75	0.990	5.455	6.445
405.25	0.980	5.428	6.408
407.75	0.951	5.374	6.325
412.96	0.932	5.233	6.165
413.17	0.932	5.227	6.159
417.28	0.929	5.116	6.045
419.78	0.929	5.057	5.986
422.28	0.932	5.015	5.947
428.50	0.927	4.932	5.859
431.00	0.932	4.905	5.837
433.50	0.947	4.889	5.836
441.28	0.940	4.860	5.800
442.79	0.929	4.857	5.785
443.78	0.926	4.858	5.784
446.28	0.929	4.872	5.801
450.00	0.942	4.905	5.847
455.61	0.954	4.954	5.908
455.63	0.954	4.954	5.908
467.26	0.943	5.057	6.000
469.76	0.905	5.095	6.000
472.26	0.927	5.167	6.095
478.45	0.923	5.386	6.309
480.95	0.953	5.447	6.400
482.49	0.943	5.457	6.400
483.45	0.947	5.453	6.400
489.28	0.954	5.404	6.358
491.78	0.946	5.353	6.299
494.28	0.993	5.243	6.236
499.59	0.971	4.946	5.916
500.00	0.964	4.923	5.887
502.09	0.932	4.820	5.752
504.59	1.082	4.724	5.806
516.29	0.957	4.340	5.297
518.79	0.943	4.265	5.208
521.29	0.933	4.203	5.136
524.19	0.918	4.139	5.057
526.26	0.913	4.093	5.006
529.77	0.984	4.016	5.000
530.54	1.777	3.223	5.000
531.50	1.797	3.211	5.009
532.40	0.927	4.095	5.022
537.71	0.988	4.085	5.073
539.80	1.025	4.080	5.105
550.00	1.239	4.060	5.299
571.61	1.014	4.017	5.031
572.12	0.999	4.016	5.016
574.11	0.976	4.024	5.000
576.61	0.944	4.056	5.000
600.00	1.044	4.468	5.512

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS Drafting Check -
Designer - Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE 0 2.5 5.0 7.5m
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE 0 10 20 30m

N

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

Status PRELIMINARY Status Code

Drawing Title PLAN AND LONGITUDINAL SECTION - SHEET 2 OF 10

Size A3

Drawing No. 12551313-W002 Rev B

Plot Date: 25 January 2023 - 12:31 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg

LEGEND:

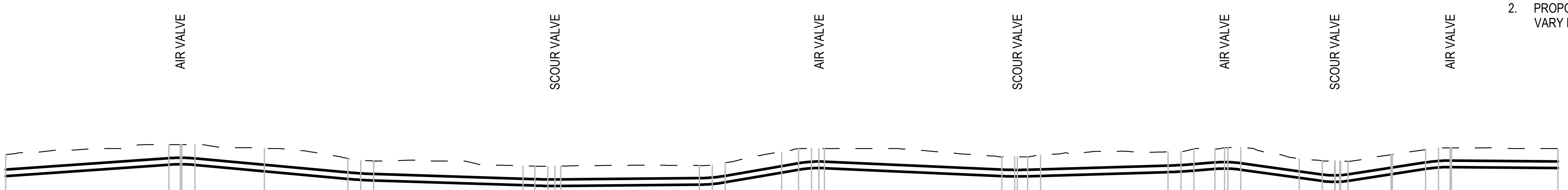
- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- RM — PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN200 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- S — PROPOSED PRESSURE SEWER RETICULATION NETWORK (DESIGN BY OTHERS)
- / — EXISTING FENCE
- SW — EXISTING STORMWATER
- W — EXISTING WATER
- S — EXISTING SEWER
- E — EXISTING ELECTRICAL
- C — EXISTING COMMUNICATION
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- TREES
- SCOUR VALVE
- AIR VALVE
- ISOLATION VALVE

PLAN

SCALE 1:1000

NOTE:

1. DEEPER TRENCH MAY BE POSSIBLE IF GEOTECHNICAL CONDITIONS ARE SUITABLE TO REDUCE NUMBER OF AIR VALVES AND SCOUR VALVES.
2. PROPOSED PRESSURE SEWER RETICULATION MAINS VARY FROM DN50 TO DN125.



TENURE: CROWN LAND | PRIVATE LAND

PIPE TYPE: DN315 PE100 POLYETHYLENE

TRENCH TYPE: TYPE B

DESIGN GRADE: 1.76% | -2.29% | -0.80% | 0.23% | 4.29% | -1.12% | 0.74% | 2.04% | -3.48% | 3.84% | -0.22%

DATUM RL. -4.0

CHAINAGE	EXISTING SURFACE	PIPE INVERT LEVEL	DEPTH TO INVERT
600.00	5.512	4.468	1.044
631.57	6.000	5.025	0.975
633.74	6.000	5.045	0.955
634.07	6.000	5.044	0.956
636.57	5.987	5.012	0.975
650.00	5.820	4.705	1.115
666.12	5.323	4.336	0.987
668.62	5.238	4.288	0.950
671.12	5.202	4.259	0.943
700.00	4.970	4.029	0.941
702.27	4.954	4.010	0.944
704.77	4.942	3.997	0.945
706.16	4.944	3.995	0.949
707.27	4.951	3.996	0.955
734.07	4.985	4.057	0.927
736.57	4.997	4.088	0.909
739.07	5.120	4.170	0.950
750.00	5.626	4.639	0.986
753.23	5.800	4.778	1.022
755.73	5.800	4.851	0.949
757.19	5.800	4.863	0.937
758.23	5.800	4.857	0.943
792.51	5.400	4.473	0.927
795.01	5.400	4.456	0.944
795.52	5.400	4.456	0.944
797.51	5.400	4.463	0.937
800.00	5.491	4.482	1.009
824.63	5.645	4.665	0.980
827.13	5.642	4.692	0.950
829.63	5.785	4.735	1.051
833.70	5.782	4.818	0.964
835.55	5.842	4.837	1.005
836.20	5.848	4.834	1.014
838.70	5.853	4.782	1.071
850.00	5.314	4.388	0.925
854.46	5.210	4.233	0.977
856.83	5.200	4.192	1.008
856.96	5.200	4.192	1.008
857.84	5.194	4.200	0.995
857.99	5.193	4.202	0.991
859.46	5.192	4.242	0.949
867.75	5.506	4.561	0.945
868.01	5.515	4.571	0.944
874.43	5.754	4.818	0.936
876.93	5.840	4.889	0.951
879.16	5.839	4.909	0.930
879.43	5.839	4.909	0.931
900.00	5.800	4.863	0.937

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS Drafting Check -
Designer - Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE (0 2.5 5.0 7.5m)
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE (0 10 20 30m)

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Project No. 12551313

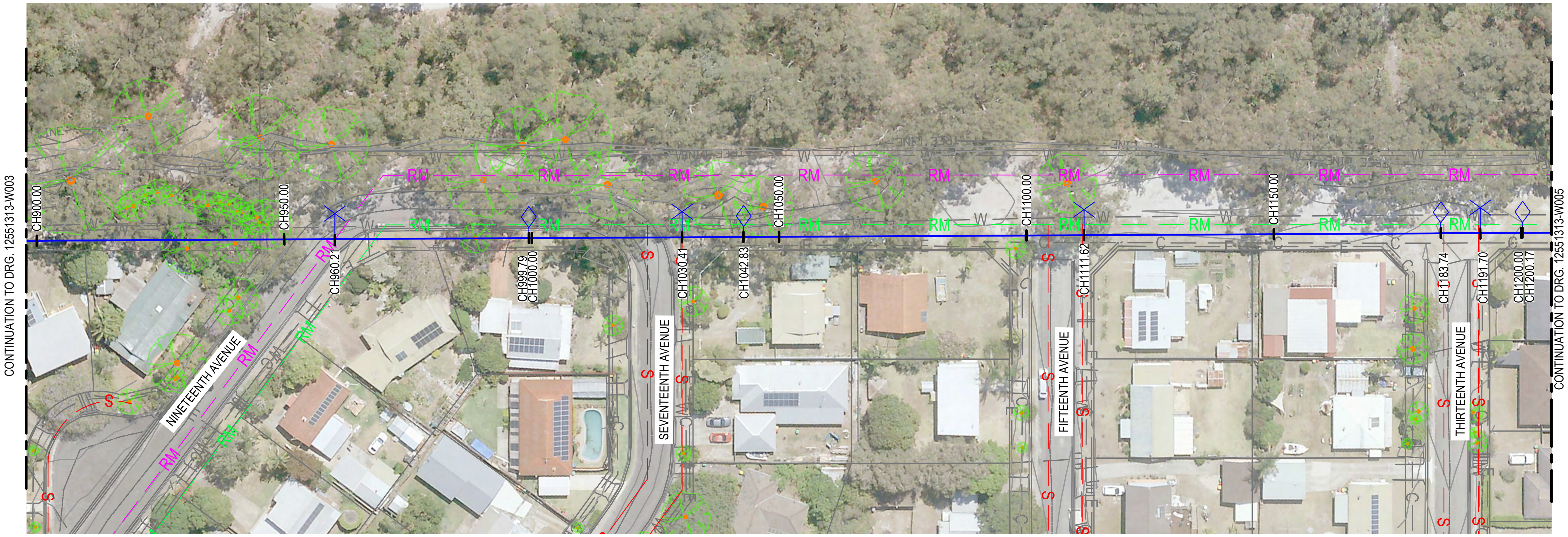
Client: KEMPSEY SHIRE COUNCIL
Project: SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS
Status: PRELIMINARY
Status Code

Drawing Title: PLAN AND LONGITUDINAL SECTION - SHEET 3 OF 10

Size A3

Drawing No. 12551313-W003
Rev B

Plot Date: 25 January 2023 - 12:32 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg



LEGEND:

- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- RM — PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
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- TREES
- SCOUR VALVE
- AIR VALVE
- ISOLATION VALVE

PLAN

SCALE 1:1000

NOTE:

1. SNAKING THE RISING MAIN ABOVE THE STORMWATER CULVERTS WITH CONCRETE ENCASEMENT MAY BE POSSIBLE IF ACCEPTABLE TO COUNCIL.
2. PROPOSED PRESSURE SEWER RETICULATION MAINS VARY FROM DN50 TO DN125.
3. DEPTHS OF PROPOSED PRESSURE SEWER MAINS DESIGNED BY OTHERS ARE YET TO BE CONFIRMED.

TENURE: PRIVATE LAND | NINETEENTH AVE | ROAD RESERVE | SEVENTEETH AVE | ROAD RESERVE

PIPE TYPE: DN315 PE100 POLYETHYLENE

TRENCH TYPE: TYPE B | TYPE J | TYPE B | TYPE J | TYPE B | TYPE J | TYPE B | TYPE J | TYPE B

DESIGN GRADE: -0.22% | -1.62% | -2.81% | -0.20% | -100.20% | 1.33% | 103.23% | 1.06% | -1.30% | -0.20% | -100.44% | -0.20% | 101.56% | 0.84% | -1.63% | -0.20% | -101.84% | -1.81% | 101.19% | 0.28% | -102.51% | -2.68% | 96.95% | 0.81% | -0.24%

DATUM RL. -4.0

CHAINAGE	DEPTH TO INVERT	PIPE INVERT LEVEL	EXISTING SURFACE
900.00	0.937	4.863	5.800
900.15	0.937	4.863	5.800
902.65	0.951	4.849	5.800
905.15	0.934	4.817	5.751
924.87	0.967	4.497	5.464
927.37	0.949	4.449	5.398
929.87	0.974	4.386	5.360
936.82	1.051	4.191	5.242
939.32	1.063	4.137	5.200
941.82	1.084	4.116	5.200
950.00	1.101	4.099	5.200
959.71	1.292	4.080	5.372
960.21	1.787	3.578	5.365
968.53	1.763	3.689	5.452
969.19	1.084	4.376	5.460
997.54	0.944	4.676	5.621
999.79	0.960	4.688	5.648
1000.00	0.962	4.688	5.650
1000.04	0.962	4.688	5.650
1002.54	0.987	4.671	5.657
1012.08	1.129	4.547	5.676
1014.58	1.079	4.521	5.600
1017.08	1.090	4.510	5.600
1022.90	1.102	4.498	5.600
1023.42	1.627	3.973	5.600
1030.41	1.787	3.959	5.747
1031.13	1.066	4.699	5.766
1041.13	1.028	4.783	5.811
1042.83	0.987	4.791	5.777
1043.63	0.975	4.789	5.764
1046.13	0.958	4.764	5.722
1050.00	0.954	4.701	5.655
1063.87	0.941	4.474	5.416
1066.37	0.957	4.443	5.400
1068.87	0.971	4.429	5.400
1100.00	1.204	4.366	5.570
1103.99	1.242	4.358	5.600
1104.36	1.618	3.982	5.600
1111.62	1.750	3.850	5.600
1112.28	1.079	4.521	5.600
1150.00	0.980	4.627	5.608
1183.74	1.074	4.722	5.797
1184.30	1.649	4.139	5.788
1191.70	1.767	3.941	5.708
1192.41	1.078	4.624	5.703
1196.32	1.014	4.656	5.670
1198.82	0.932	4.669	5.601
1200.00		4.671	

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS | Drafting Check -
Designer - | Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE — 0, 2.5, 5.0, 7.5m
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE — 0, 10, 20, 30m

N

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

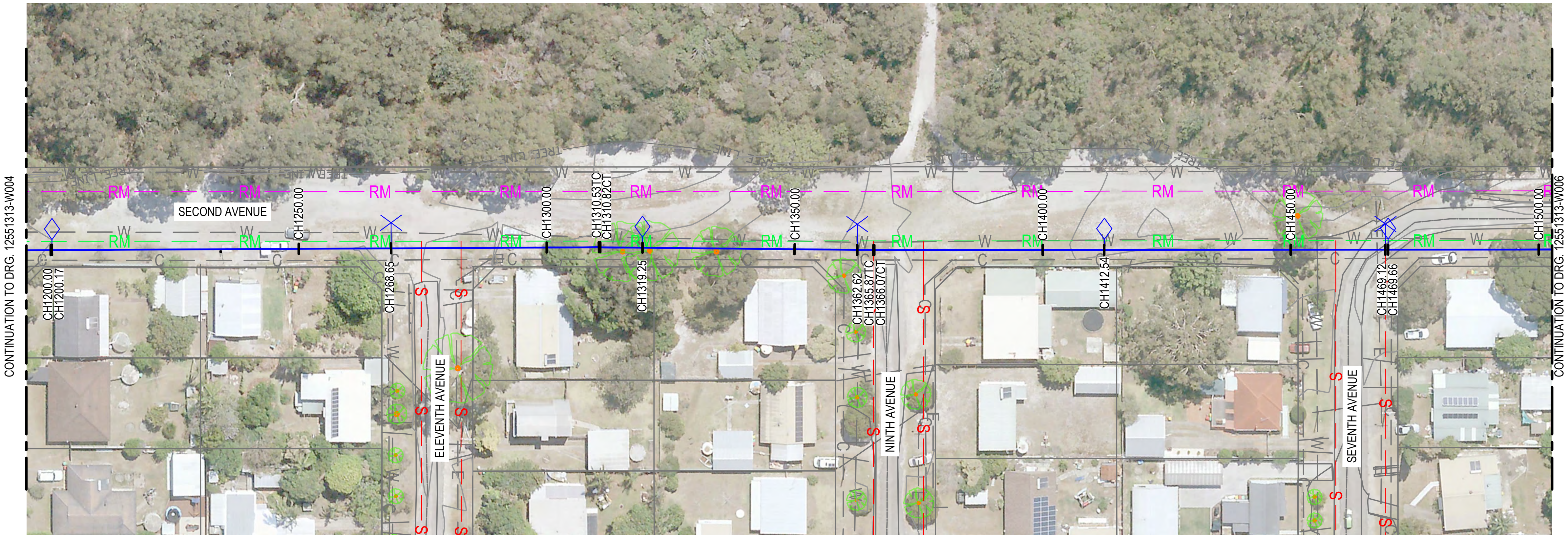
Status PRELIMINARY | Status Code

Drawing Title PLAN AND LONGITUDINAL SECTION - SHEET 4 OF 10

Size A3

Drawing No. 12551313-W004 | Rev B

Plot Date: 25 January 2023 - 12:32 PM | Plotted by: Jeyzon Reglamos | File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg



PLAN

SCALE 1:1000

LEGEND:

- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- PROPOSED DN200 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- PROPOSED PRESSURE SEWER RETICULATION NETWORK (DESIGN BY OTHERS)
- EXISTING FENCE
- EXISTING STORMWATER
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- AIR VALVE
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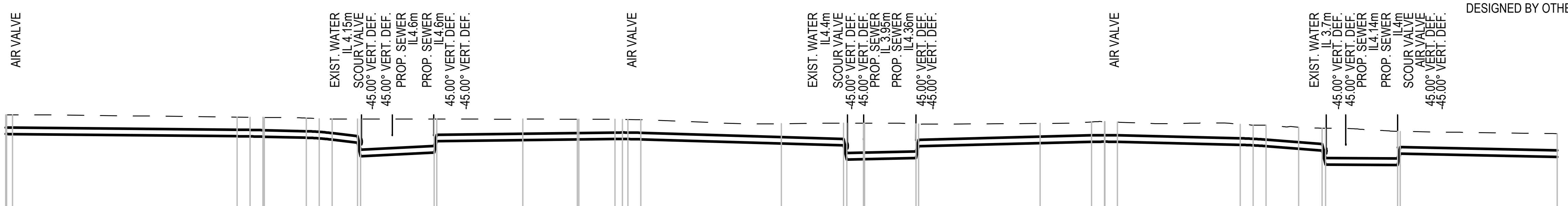
NOTE:

1. SNAKING THE RISING MAIN ABOVE THE STORMWATER CULVERTS WITH CONCRETE ENCASEMENT MAY BE POSSIBLE IF ACCEPTABLE TO COUNCIL.
2. PROPOSED PRESSURE SEWER RETICULATION MAINS VARY FROM DN50 TO DN125.
3. DEPTHS OF PROPOSED PRESSURE SEWER MAINS DESIGNED BY OTHERS ARE YET TO BE CONFIRMED.



TENURE: ROAD RESERVE

PIPE TYPE: DN315 PE100 POLYETHYLENE

TRENCH TYPE: TYPE B | TYPE J | TYPE B | TYPE J | TYPE B | TYPE J | TYPE B

DESIGN GRADE: -0.24% | -0.61% | -3.04% | -105.34% | 1.28% | 100.43% | 0.30% | -0.75% | -106.64% | 0.56% | 102.50% | 0.64% | -0.61% | -1.95% | 101.87% | -0.20% | 103.29% | -0.51%

DATUM RL. -5.0

DEPTH TO INVERT	0.929	0.929	0.930	0.925	0.926	0.932	0.932	0.951	0.946	0.998	1.147	1.800	1.619	1.076
PIPE INVERT LEVEL	4.671	4.671	4.670	4.566	4.557	4.544	4.543	4.493	4.462	4.402	4.253	3.600	3.781	4.324
EXISTING SURFACE	5.600	5.600	5.600	5.490	5.483	5.476	5.475	5.444	5.408	5.400	5.400	5.400	5.400	5.400
CHAINAGE	1200.00	1200.17	1201.32	1244.77	1247.27	1249.77	1250.00	1258.13	1260.63	1263.13	1268.03	1268.65	1282.83	1283.37

DEPTH TO INVERT	1.018	0.976	0.974	0.953	0.947	0.945	0.946	0.961	1.079	1.758	1.740	1.739	1.642	1.073
PIPE INVERT LEVEL	4.374	4.406	4.407	4.428	4.430	4.429	4.417	4.212	4.121	3.442	3.460	3.461	3.517	4.079
EXISTING SURFACE	5.393	5.382	5.381	5.381	5.377	5.374	5.363	5.173	5.200	5.200	5.200	5.200	5.159	5.153
CHAINAGE	1300.00	1310.53	1310.82	1317.82	1319.25	1320.32	1322.82	1350.00	1361.99	1362.62	1365.87	1366.07	1375.99	1376.54

DEPTH TO INVERT	0.953	0.964	0.967	0.966	0.952	0.990	0.973	1.011	1.034	1.082	1.755	1.627	1.072	1.121
PIPE INVERT LEVEL	4.229	4.293	4.301	4.301	4.294	4.150	4.127	4.086	3.963	3.874	3.200	3.172	3.724	3.569
EXISTING SURFACE	5.182	5.257	5.268	5.268	5.246	5.141	5.099	5.097	4.997	4.957	4.955	4.798	4.797	4.690
CHAINAGE	1400.00	1409.97	1412.47	1412.54	1414.97	1438.68	1441.18	1443.68	1450.00	1454.54	1455.20	1469.12	1469.66	1500.00

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS Drafting Check -
Designer - Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE 0 2.5 5.0 7.5m
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE 0 10 20 30m

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

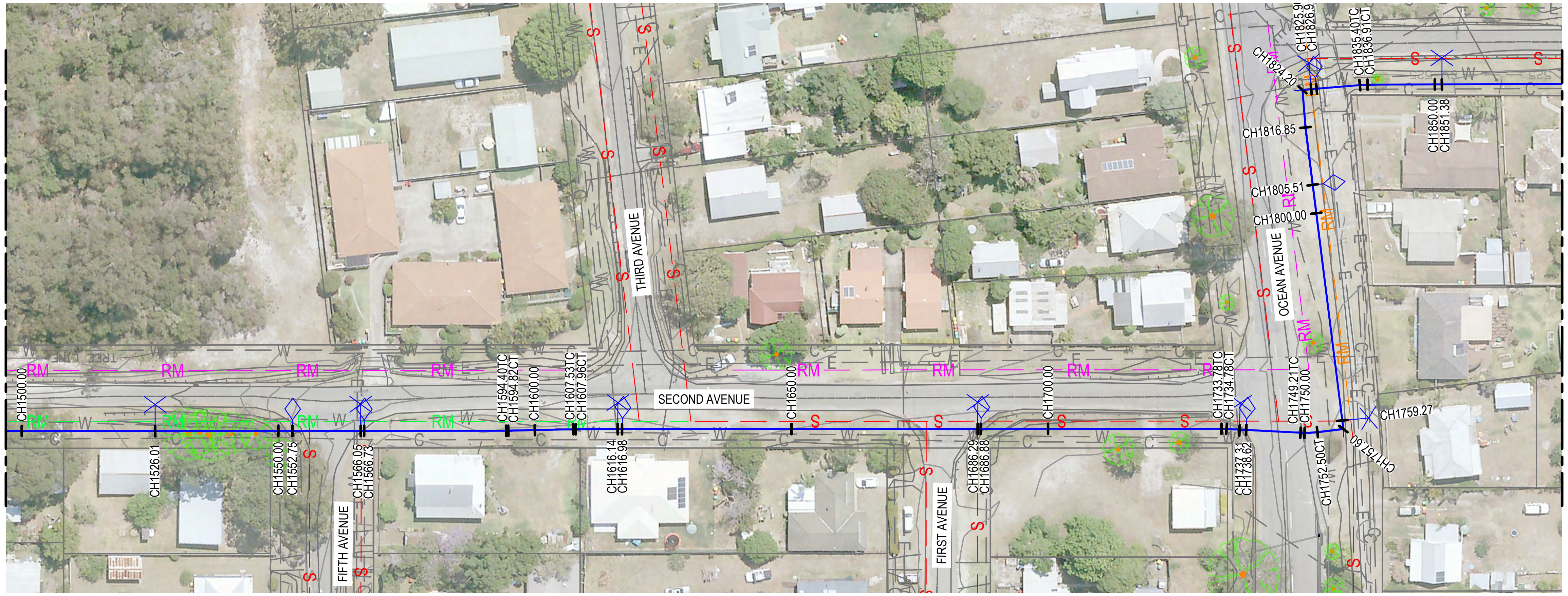
Status PRELIMINARY Status Code

Drawing Title PLAN AND LONGITUDINAL SECTION - SHEET 6 OF 10

Size A3

Drawing No. 12551313-W005 Rev B

Plot Date: 25 January 2023 - 12:32 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg



PLAN

SCALE 1:1000

LEGEND:

- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- RM — PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
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- AIR VALVE
- ISOLATION VALVE

NOTE:

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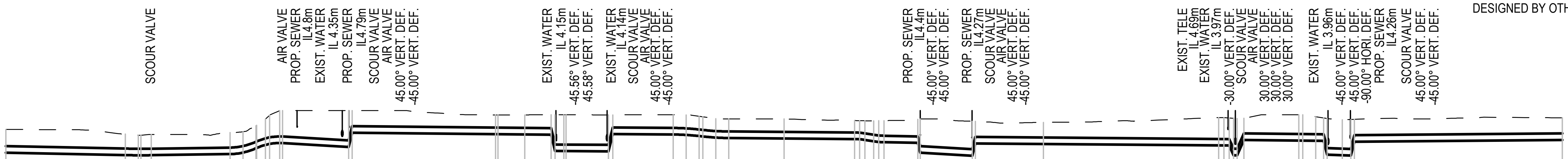
3. DEPTHS OF PROPOSED PRESSURE SEWER MAINS DESIGNED BY OTHERS ARE YET TO BE CONFIRMED.



TENURE: ROAD RESERVE | OCEAN AVE | ROAD RESERVE

PIPE TYPE: DN315 PE100 POLYETHYLENE

TRENCH TYPE: TYPE B | TYPE J | TYPE B | TYPE J | TYPE B | TYPE J | TYPE B | TYPE B | TYPE J | TYPE B | TYPE J | TYPE B

DESIGN GRADE: -0.51% | 0.34% | 10.92% | -1.45% | 101.42% | -0.24% | -102.45% | -0.20% | 100.38% | -0.21% | -2.81% | -0.20% | -4.05% | -0.48% | -101.54% | -1.53% | -0.20% | -54.06% | -0.20% | 56.98% | -0.28% | -100.89% | -0.97% | 101.41% | 0.22%

DATUM RL. -5.0

CHAINAGE	EXISTING SURFACE	PIPE INVERT LEVEL	DEPTH TO INVERT
1500.00	4.690	3.569	1.121
1523.02	4.463	3.451	1.012
1525.52	4.400	3.444	0.957
1526.01	4.411	3.444	0.968
1528.02	4.448	3.447	1.001
1543.21	4.537	3.499	1.038
1545.71	4.578	3.574	1.004
1548.21	4.865	3.781	1.084
1548.34	4.885	3.794	1.090
1550.00	5.187	3.942	1.245
1550.84	5.372	3.990	1.382
1552.75	5.600	4.035	1.565
1553.34	5.600	4.031	1.569
1566.05	5.600	3.847	1.753
1566.73	5.600	4.531	1.069
1594.40	5.388	4.465	0.923
1594.82	5.387	4.464	0.924
1600.00	5.385	4.451	0.933
1605.08	5.397	4.439	0.958
1605.85	5.397	3.649	1.748
1607.53	5.396	3.646	1.750
1607.96	5.396	3.645	1.751
1616.14	5.391	3.628	1.763
1616.98	5.392	4.471	0.921
1628.61	5.400	4.447	0.953
1631.11	5.389	4.425	0.964
1633.61	5.325	4.371	0.954
1634.34	5.298	4.351	0.947
1636.84	5.204	4.297	0.907
1639.34	5.200	4.275	0.925
1650.00	5.200	4.254	0.946
1663.58	5.119	4.227	0.892
1664.58	5.113	4.215	0.898
1665.58	5.108	4.185	0.923
1667.25	5.103	4.117	0.987
1668.25	5.107	4.085	1.022
1669.25	5.113	4.072	1.041
1675.78	5.174	4.040	1.134
1676.24	5.198	3.572	1.626
1686.29	5.083	3.418	1.664
1686.88	5.078	4.011	1.067
1700.00	5.028	3.984	1.044
1733.78	5.262	3.917	1.346
1734.78	5.260	3.915	1.345
1735.79	5.239	3.913	1.326
1736.67	5.235	3.439	1.796
1737.31	5.216	3.438	1.778
1738.62	5.229	4.185	1.044
1749.21	5.400	4.155	1.245
1750.00	5.400	4.153	1.247
1752.50	5.303	4.146	1.157
1754.02	5.245	4.141	1.104
1754.68	5.221	3.475	1.746
1757.60	5.150	3.447	1.704
1759.27	5.170	3.430	1.740
1759.93	5.178	4.099	1.078
1800.00	5.250	4.186	1.063

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS | Drafting Check -
Designer - | Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE — 0 2.5 5.0 7.5m
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE — 0 10 20 30m

N

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www.ghd.com

Project No. 12551313

Client: KEMPSEY SHIRE COUNCIL

Project: SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

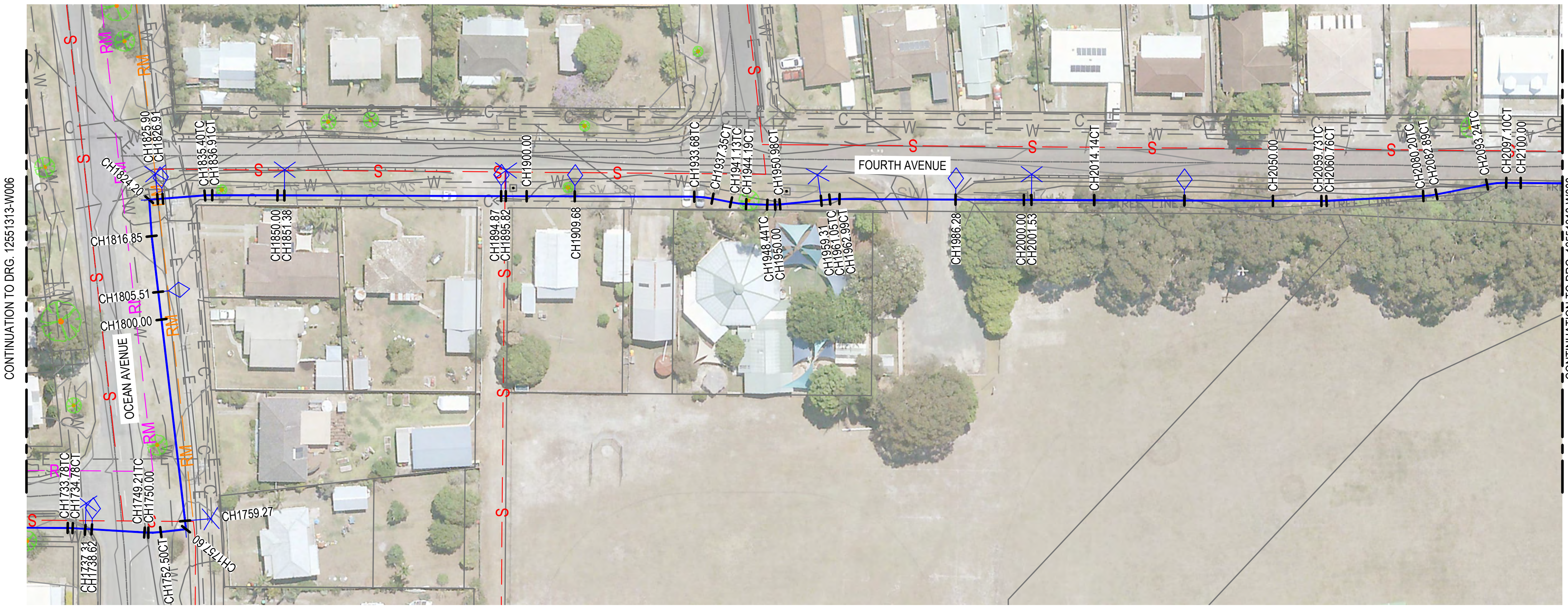
Status: PRELIMINARY | Status Code

Drawing Title: PLAN AND LONGITUDINAL SECTION - SHEET 6 OF 10

Size A3

Drawing No. 12551313-W006 | Rev B

Plot Date: 25 January 2023 - 12:33 PM | Plotted by: Jeyzon Reglamos | File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg



LEGEND:

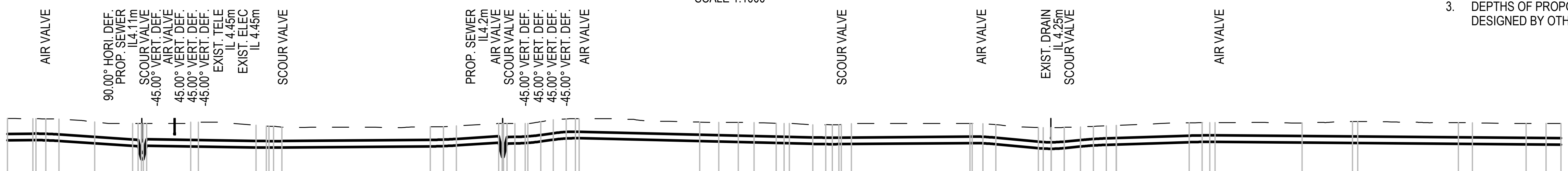
- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- PROPOSED DN200 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- PROPOSED PRESSURE SEWER RETICULATION NETWORK (DESIGN BY OTHERS)
- EXISTING FENCE
- EXISTING STORMWATER
- EXISTING WATER
- EXISTING SEWER
- EXISTING ELECTRICAL
- EXISTING COMMUNICATION
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- TREES
- SCOUR VALVE
- AIR VALVE
- ISOLATION VALVE

NOTE:

1. DEEPER TRENCH MAY BE POSSIBLE IF GEOTECHNICAL CONDITIONS ARE SUITABLE TO REDUCE NUMBER OF AIR VALVES AND SCOUR VALVES.
2. PROPOSED PRESSURE SEWER RETICULATION MAINS VARY FROM DN50 TO DN125.
3. DEPTHS OF PROPOSED PRESSURE SEWER MAINS DESIGNED BY OTHERS ARE YET TO BE CONFIRMED.

PLAN

SCALE 1:1000



TENURE: ROAD RESERVE

PIPE TYPE: DN315 PE100 POLYETHYLENE

TRENCH TYPE: TYPE B

DESIGN GRADE: 0.22% | -1.70% | -100.21% | 0.31% | 100.79% | -0.41% | 0.20% | 1.65% | -0.27% | -101.79% | 101.55% | 0.26% | 3.49% | -0.61% | 0.20% | -2.36% | 2.45% | 0.81% | -0.20%

DATUM RL. -5.0

CHAINAGE	DEPTH TO INVERT	PIPE INVERT LEVEL	EXISTING SURFACE
1800.00	1.063	4.186	5.250
1804.95	1.039	4.197	5.236
1805.51	1.037	4.198	5.234
1807.45	1.039	4.190	5.230
1809.95	1.055	4.160	5.214
1816.85	1.036	4.042	5.079
1824.20	1.083	3.917	5.000
1825.27	1.101	3.899	5.000
1825.90	1.735	3.265	5.000
1826.25	1.734	3.266	5.000
1826.91	1.071	3.929	5.000
1835.40	1.173	3.894	5.067
1836.91	1.179	3.888	5.067
1848.03	1.078	3.843	4.921
1850.00	1.044	3.837	4.881
1850.53	1.034	3.837	4.870
1851.38	1.027	3.836	4.864
1853.03	0.987	3.838	4.824
1881.69	0.951	3.895	4.846
1884.19	0.940	3.909	4.849
1886.69	0.944	3.941	4.885
1894.87	0.924	4.076	5.000
1895.56	1.624	3.376	5.000
1895.82	1.625	3.375	5.000
1896.47	0.964	4.036	5.000
1897.99	0.960	4.040	5.000
1900.00	0.942	4.058	5.000
1900.49	0.934	4.066	5.000
1902.99	0.957	4.133	5.090
1905.42	0.963	4.218	5.181
1907.92	0.945	4.280	5.225
1909.68	0.945	4.292	5.237
1910.42	0.947	4.290	5.237
1933.68	0.924	4.148	5.072
1937.35	0.928	4.126	5.054
1941.13	0.954	4.103	5.057
1944.19	0.960	4.084	5.044
1948.44	0.957	4.059	5.016
1950.00	0.956	4.049	5.005
1950.98	0.957	4.043	5.000
1955.55	0.927	4.015	4.942
1958.05	0.937	4.005	4.943
1959.31	0.938	4.004	4.942
1960.55	0.937	4.005	4.942
1961.05	0.945	4.006	4.951
1962.99	0.981	4.010	4.991
1985.89	0.944	4.056	5.000
1986.28	0.944	4.056	5.000
1988.39	0.952	4.045	4.997
1990.89	0.944	4.002	4.946
1999.08	1.003	3.809	4.812
2000.00	1.011	3.791	4.802
2001.53	1.020	3.780	4.800
2001.58	1.020	3.780	4.800
2004.08	1.012	3.811	4.823
2007.21	0.950	3.888	4.838
2009.71	0.925	3.939	4.864
2012.21	0.921	3.970	4.891
2014.12	0.926	3.985	4.911
2014.14	0.926	3.985	4.911
2028.19	0.936	4.099	5.035
2030.69	0.931	4.113	5.043
2032.20	0.931	4.115	5.045
2033.19	0.932	4.114	5.046
2050.00	0.953	4.080	5.033
2059.73	1.041	4.061	5.102
2060.76	1.041	4.059	5.100
2080.20	1.030	4.020	5.049
2082.89	1.026	4.014	5.040
2093.24	1.006	3.994	5.000
2097.10	1.014	3.986	5.000
2100.00	1.020	3.980	5.000

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS Drafting Check -
Designer - Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE: 0 2.5 5.0 7.5m
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE: 0 10 20 30m

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E ntlmail@ghd.com W www.ghd.com
www.ghd.com

Project No. 12551313

Client: KEMPSEY SHIRE COUNCIL

Project: SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

Status: PRELIMINARY

Status Code

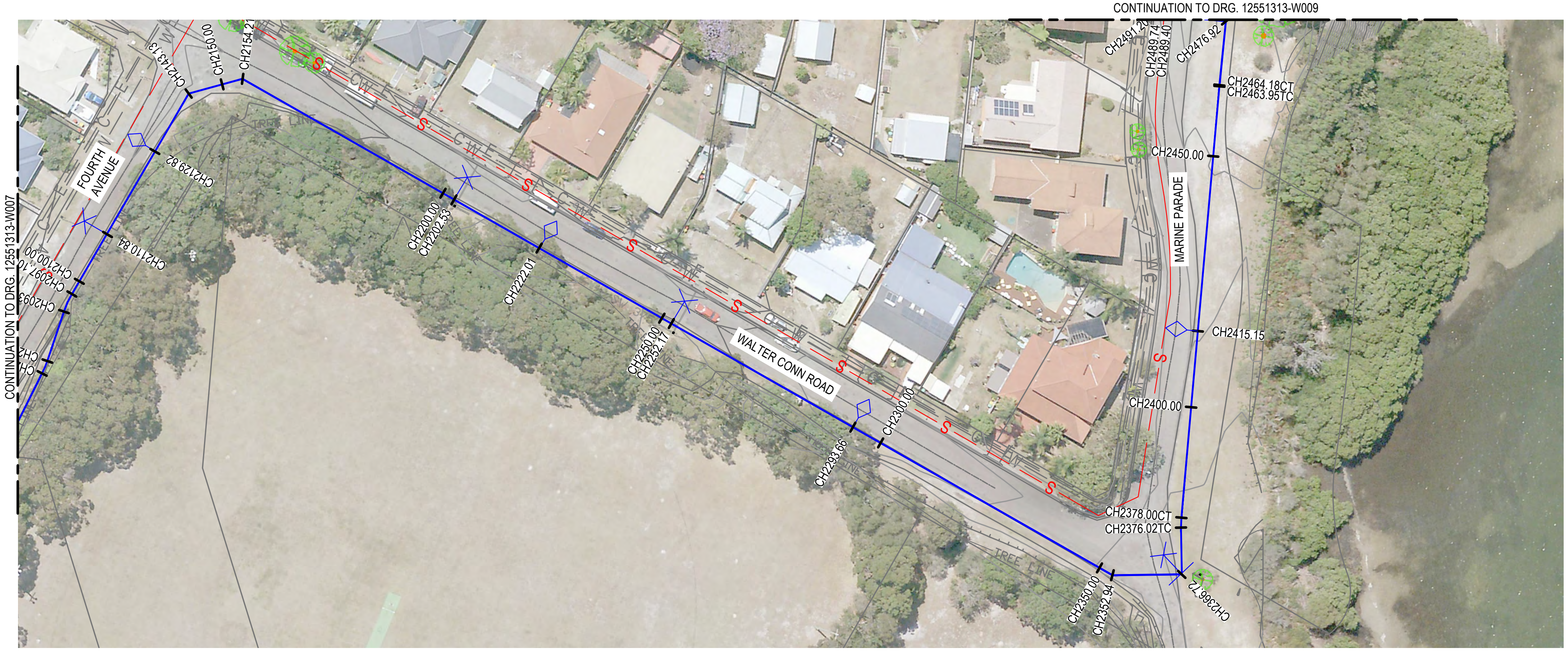
Drawing Title: PLAN AND LONGITUDINAL SECTION - SHEET 7 OF 10

Size A3

Drawing No. 12551313-W007

Rev B

Plot Date: 25 January 2023 - 12:33 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CAD\Drawings\12551313-W001-W010.dwg



LEGEND:

- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- RM — PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN200 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- S — PROPOSED PRESSURE SEWER RETICULATION NETWORK (DESIGN BY OTHERS)
- / — EXISTING FENCE
- SW — EXISTING STORMWATER
- W — EXISTING WATER
- S — EXISTING SEWER
- E — EXISTING ELECTRICAL
- C — EXISTING COMMUNICATION
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- TREES
- SCOUR VALVE
- AIR VALVE
- ISOLATION VALVE

NOTE:

1. DEEPER TRENCH MAY BE POSSIBLE IF GEOTECHNICAL CONDITIONS ARE SUITABLE TO REDUCE NUMBER OF AIR VALVES AND SCOUR VALVES.
2. PROPOSED PRESSURE SEWER RETICULATION MAINS VARY FROM DN50 TO DN125.
3. DEPTHS OF PROPOSED PRESSURE SEWER MAINS DESIGNED BY OTHERS ARE YET TO BE CONFIRMED.

PLAN

SCALE 1:1000

SCOUR VALVE
AIR VALVE
44.00° HORI. DEF.
45.00° HORI. DEF.
EXIST. DRAIN IL 4.25m SCOUR VALVE
AIR VALVE
EXIST. DRAIN IL 4.25m SCOUR VALVE
AIR VALVE
-30.00° HORI. DEF.
SCOUR VALVE -90.00° HORI. DEF.

TENURE: ROAD RESERVE | MARINE PDE | ROAD RESERVE

PIPE TYPE: DN315 PE100 POLYETHYLENE

TRENCH TYPE: TYPE B

DESIGN GRADE: -0.20% | 0.97% | -0.61% | 1.22% | -0.61% | 2.29% | 0.21% | -0.28% | -0.74% | 0.77%

DATUM RL. -4.0

CHAINAGE	EXISTING SURFACE	PIPE INVERT LEVEL	DEPTH TO INVERT
2100.00	5.000	3.980	1.020
2109.98	5.000	3.960	1.040
2110.84	5.000	3.959	1.041
2112.48	5.000	3.963	1.037
2114.98	5.034	3.980	1.055
2126.75	5.152	4.093	1.058
2129.25	5.199	4.108	1.091
2129.82	5.200	4.108	1.092
2131.75	5.200	4.102	1.098
2143.13	5.200	4.033	1.167
2150.00	5.087	3.992	1.096
2154.21	5.090	3.966	1.123
2200.00	4.800	3.689	1.111
2200.86	4.800	3.683	1.117
2202.53	4.800	3.678	1.122
2203.36	4.800	3.680	1.120
2205.86	4.800	3.699	1.101
2218.69	4.800	3.855	0.945
2221.19	4.800	3.874	0.926
2222.01	4.800	3.875	0.925
2223.69	4.800	3.870	0.930
2250.00	4.800	3.708	1.092
2251.12	4.800	3.701	1.099
2252.17	4.800	3.698	1.102
2253.62	4.800	3.704	1.096
2256.12	4.823	3.743	1.080
2275.81	5.129	4.194	0.935
2278.31	5.196	4.238	0.958
2280.81	5.200	4.256	0.944
2291.49	5.240	4.279	0.961
2293.66	5.206	4.281	0.925
2293.99	5.201	4.281	0.920
2296.49	5.200	4.277	0.923
2300.00	5.200	4.267	0.933
2350.00	5.200	4.129	1.071
2350.44	5.200	4.128	1.072
2352.94	5.200	4.118	1.082
2355.44	5.200	4.102	1.098
2364.22	5.200	4.037	1.163
2366.67	5.100	4.028	1.071
2366.72	5.097	4.028	1.069
2369.22	5.076	4.038	1.038
2376.02	5.145	4.091	1.054
2378.00	5.154	4.106	1.048
2398.69	5.200	4.266	0.934
2400.00	5.200	4.277	0.923

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS | Drafting Check -
Designer - | Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE: 0 2.5 5.0 7.5m
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE: 0 10 20 30m

N

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E ntlmail@ghd.com W www.ghd.com
www.ghd.com

Project No. 12551313

Client: KEMPSEY SHIRE COUNCIL

Project: SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

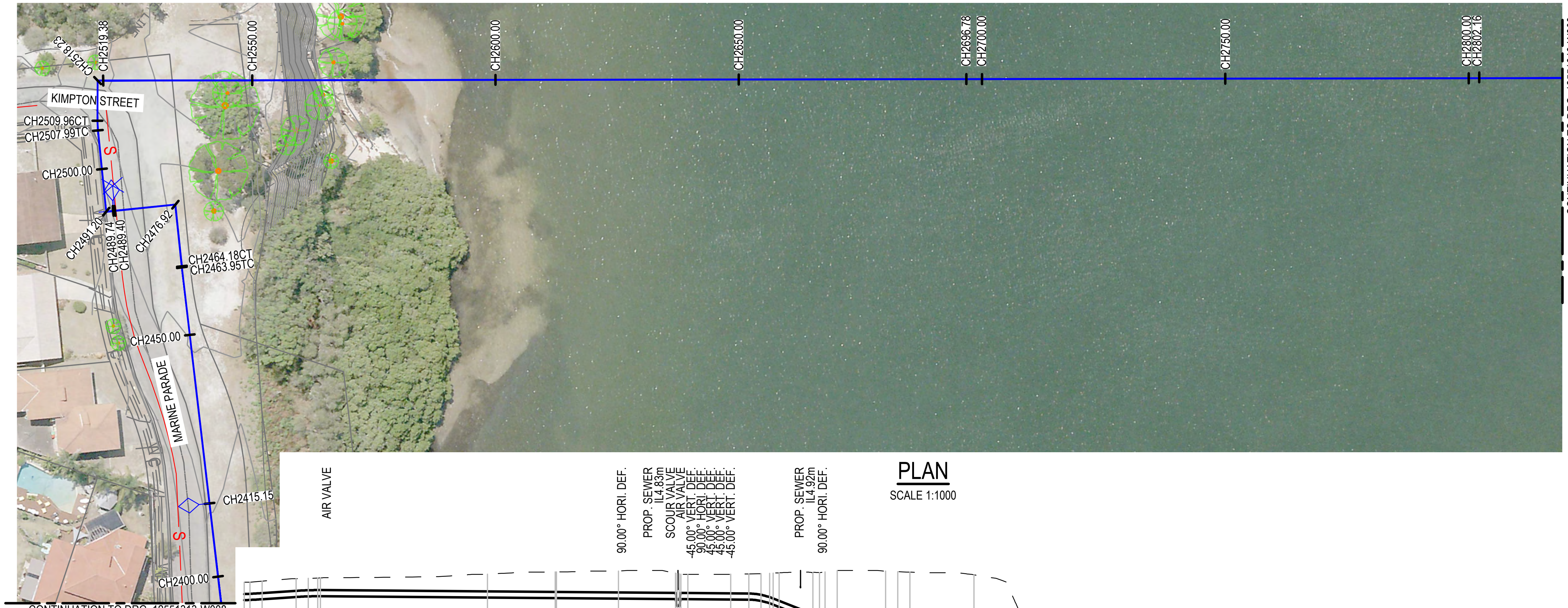
Status: PRELIMINARY | Status Code

Drawing Title: PLAN AND LONGITUDINAL SECTION - SHEET 8 OF 10

Size A3

Drawing No. 12551313-W008 | Rev B

Plot Date: 25 January 2023 - 12:33 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg



PLAN

SCALE 1:1000

LEGEND:

- PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
- RM — PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- RM — PROPOSED DN200 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
- S — PROPOSED PRESSURE SEWER RETICULATION NETWORK (DESIGN BY OTHERS)
- / — EXISTING FENCE
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- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- TREES
- SCOUR VALVE
- AIR VALVE
- ISOLATION VALVE

NOTE:

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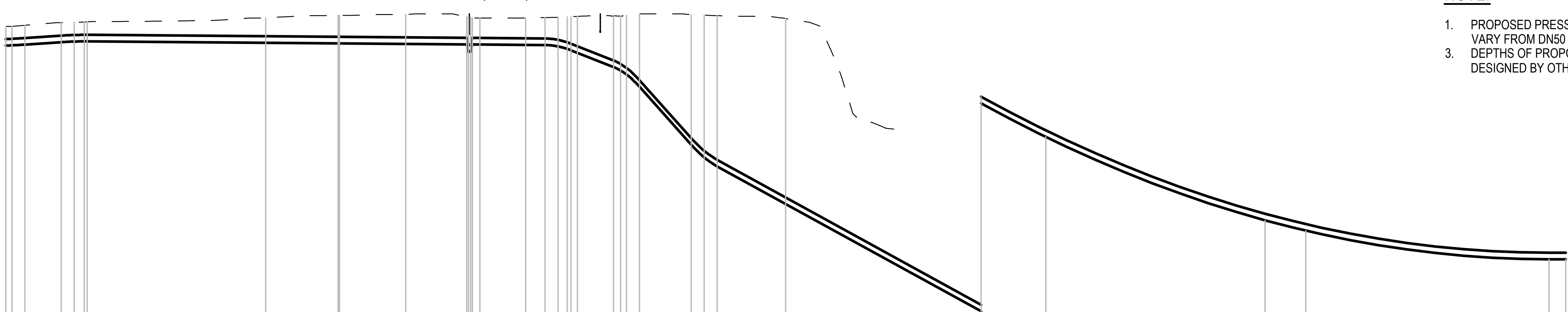
3. DEPTHS OF PROPOSED PRESSURE SEWER MAINS DESIGNED BY OTHERS ARE YET TO BE CONFIRMED.



TENURE: ROAD RESERVE | MARINE PDE | ROAD RESERVE | MACLEAY ARM

PIPE TYPE: DN315 PE100 POLYETHYLENE

TRENCH TYPE: TYPE B | TRENCHLESS

DESIGN GRADE: 0.77% | 1.66% | -0.20% | -99.93% | -0.90% | 101.03% | -0.21% | -9.86% | -28.03% | -13.73% | 0.00%

DATUM RL. -14.0

DATUM RL. -24.0

CHAINAGE	EXISTING SURFACE	PIPE INVERT LEVEL	DEPTH TO INVERT
2400.00	5.200	4.277	0.923
2401.19	5.200	4.291	0.909
2403.69	5.251	4.327	0.924
2410.69	5.384	4.443	0.941
2413.19	5.400	4.473	0.927
2415.15	5.413	4.480	0.933
2415.69	5.425	4.480	0.945
2450.00	5.611	4.411	1.200
2463.95	5.729	4.383	1.345
2464.18	5.729	4.383	1.346
2476.92	5.771	4.357	1.414
2488.65	5.669	4.334	1.335
2489.00	5.652	3.987	1.665
2489.40	5.633	3.983	1.650
2489.74	5.617	4.334	1.282
2491.20	5.600	4.331	1.269
2500.00	5.609	4.312	1.297
2503.70	5.624	4.304	1.320
2506.20	5.641	4.239	1.403
2507.99	5.660	4.118	1.542
2508.70	5.671	4.052	1.619
2509.96	5.684	3.928	1.756
2516.88	5.702	3.246	2.456
2518.23	5.691	3.081	2.610
2519.38	5.733	2.886	2.846
2521.88	5.800	2.299	3.501
2531.83	5.770	-0.489	6.260
2534.33	5.738	-1.101	6.839
2536.83	5.720	-1.533	7.253
2550.00	5.580	-3.342	8.921
2587.58		-8.502	
2600.00		-10.111	
2642.18		-14.126	
2650.00		-14.624	
2696.78		-16.000	
2700.00		-16.000	

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS Drafting Check -
Designer - Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE 0 2.5 5.0 7.5m
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE 0 10 20 30m

N

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

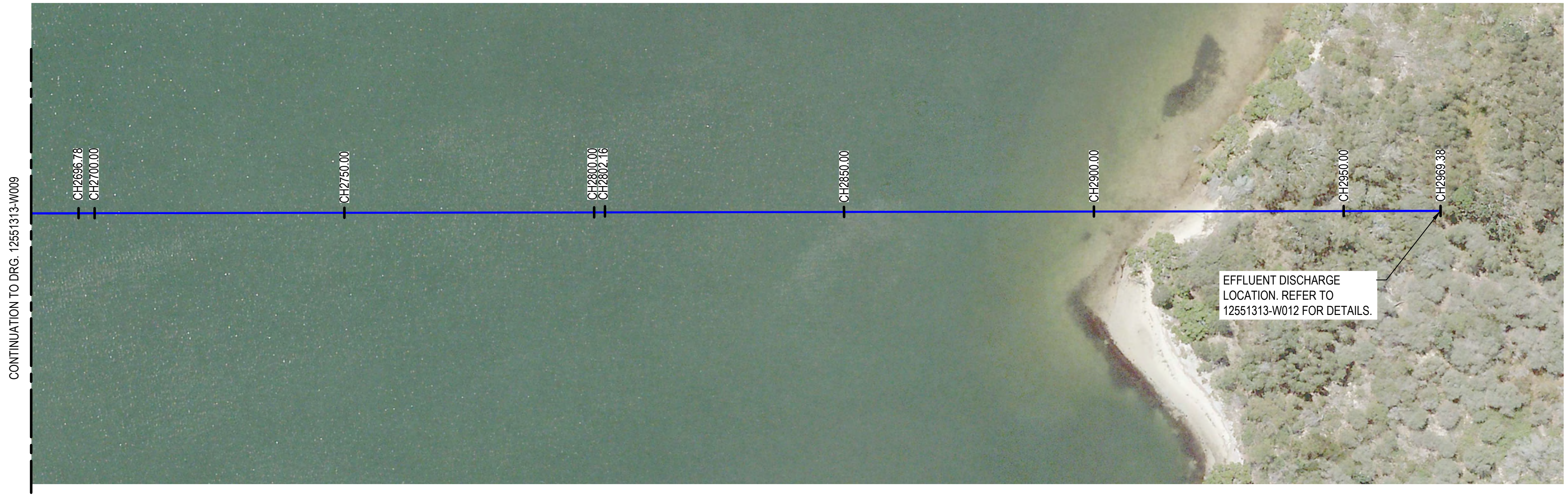
Status PRELIMINARY Status Code

Drawing Title PLAN AND LONGITUDINAL SECTION - SHEET 9 OF 10

Size A3

Drawing No. 12551313-W009 Rev B

Plot Date: 25 January 2023 - 12:35 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg

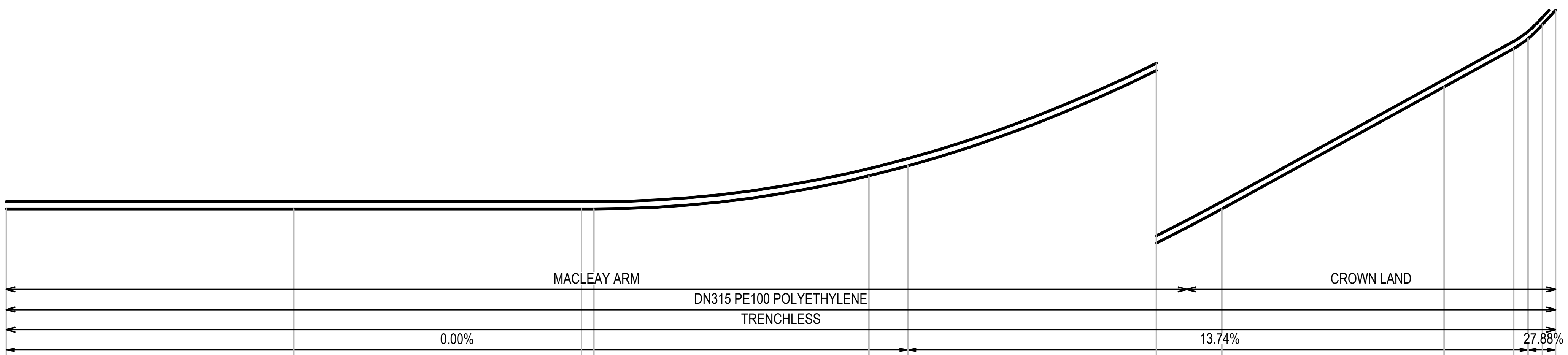


PLAN

SCALE 1:1000

LEGEND:

Symbol	Description
(blue line)	PROPOSED DN315 HDPE EFFLUENT TRANSFER PIPE
— RM — (orange)	PROPOSED DN140 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
— RM — (magenta)	PROPOSED DN160 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
— RM — (green)	PROPOSED DN200 PRESSURE SEWER RISING MAIN (DESIGN BY OTHERS)
— S — (red)	PROPOSED PRESSURE SEWER RETICULATION NETWORK (DESIGN BY OTHERS)
— / —	EXISTING FENCE
— SW —	EXISTING STORMWATER
— W —	EXISTING WATER
— S —	EXISTING SEWER
— E —	EXISTING ELECTRICAL
— C —	EXISTING COMMUNICATION
(line)	EXISTING MAJOR CONTOUR
(line)	EXISTING MINOR CONTOUR
(symbol)	TREES
(symbol)	SCOUR VALVE
(symbol)	AIR VALVE
(symbol)	ISOLATION VALVE



DATUM RL. -24.0

DATUM RL. -13.74

DEPTH TO INVERT														
PIPE INVERT LEVEL	-16.000	-16.000	-16.000	-16.000	-14.560	-14.124	-9.977	-8.497	-3.188	-1.524	-1.092	-0.483	0.150
EXISTING SURFACE													
CHAINAGE	2700.00	2750.00	2800.00	2802.16	2850.00	2856.76	2900.00	2911.36	2950.00	2962.11	2964.61	2967.11	2969.38

LONGITUDINAL SECTION

SCALE HORI. 1:1000, VER. 1:250

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS Drafting Check -
Designer - Design Check -

VERTICAL SCALE 1:250 AT ORIGINAL SIZE 0 2.5 5.0 7.5m
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE 0 10 20 30m

N

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

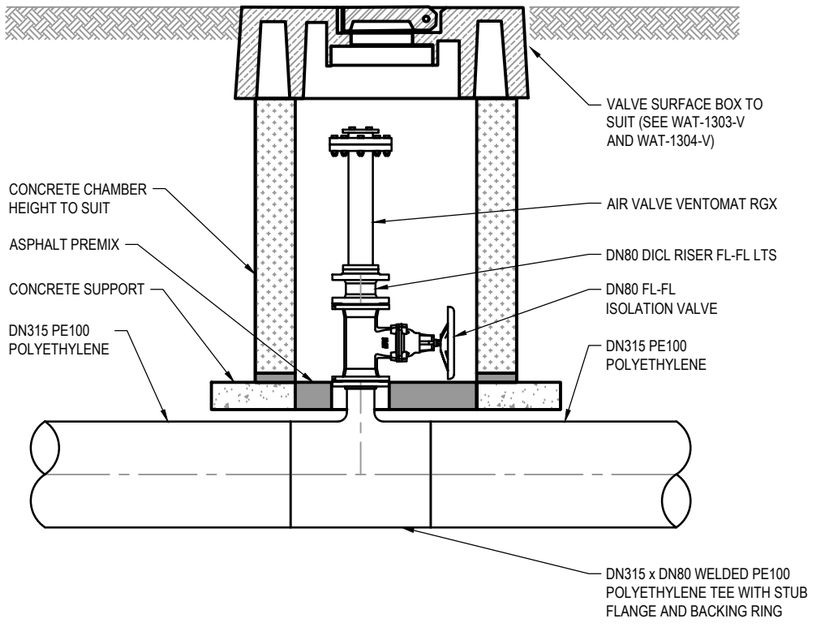
Status PRELIMINARY Status Code

Drawing Title PLAN AND LONGITUDINAL SECTION - SHEET 10 OF 10

Size A3

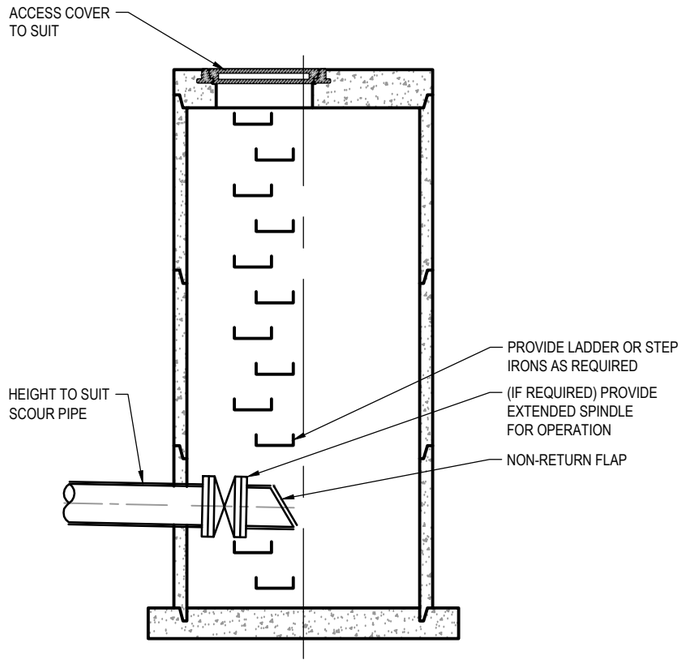
Drawing No. 12551313-W010 Rev B

Plot Date: 25 January 2023 - 12:39 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W001-W010.dwg



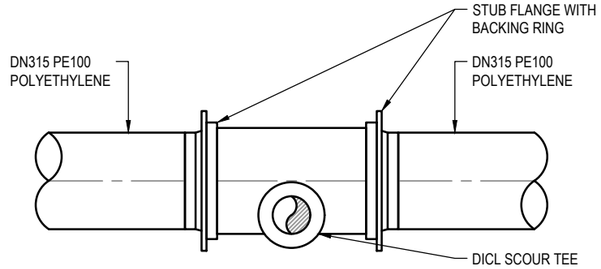
AIR VALVE TYPICAL

SCALE 1:20



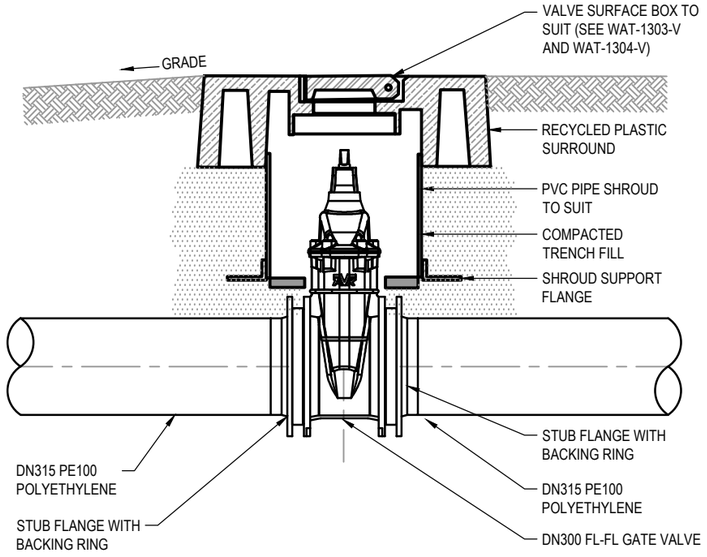
SCOUR DISCHARGE COLLECTION / PUMP-OUT SUMP

N.T.S



SCOUR PLAN

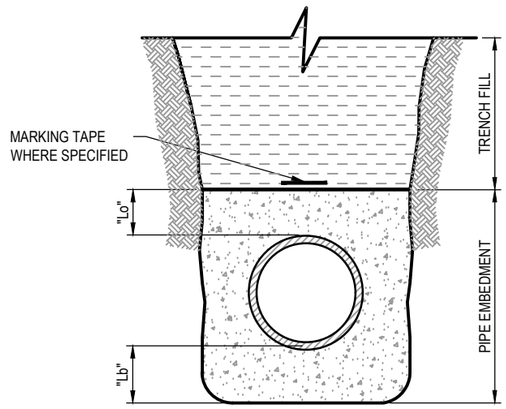
SCALE 1:20



VALVES AT STANDARD DEPTH

SCALE 1:20

NATURE STRIP INSTALLATION SHOWN



PIPE SIZE (DN)	BEDDING AND OVERLAY DEPTH	
	"Lb" (min)	"Lo"
200-450	100	150

TYPE 'B' SUPPORT

N.T.S

TRENCH STRATA OTHER THAN SAND

Rev	Description	Checked	Approved	Date
B	CONCEPT DESIGN	RJ	AF	17.01.23
A	PRELIMINARY	RJ	AF	06.12.22

Author J. REGLAMOS Drafting Check -

Designer - Design Check -

0 200 400 600mm

SCALE 1:20 AT ORIGINAL SIZE

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Project No. 12551313

Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

Status PRELIMINARY Status Code

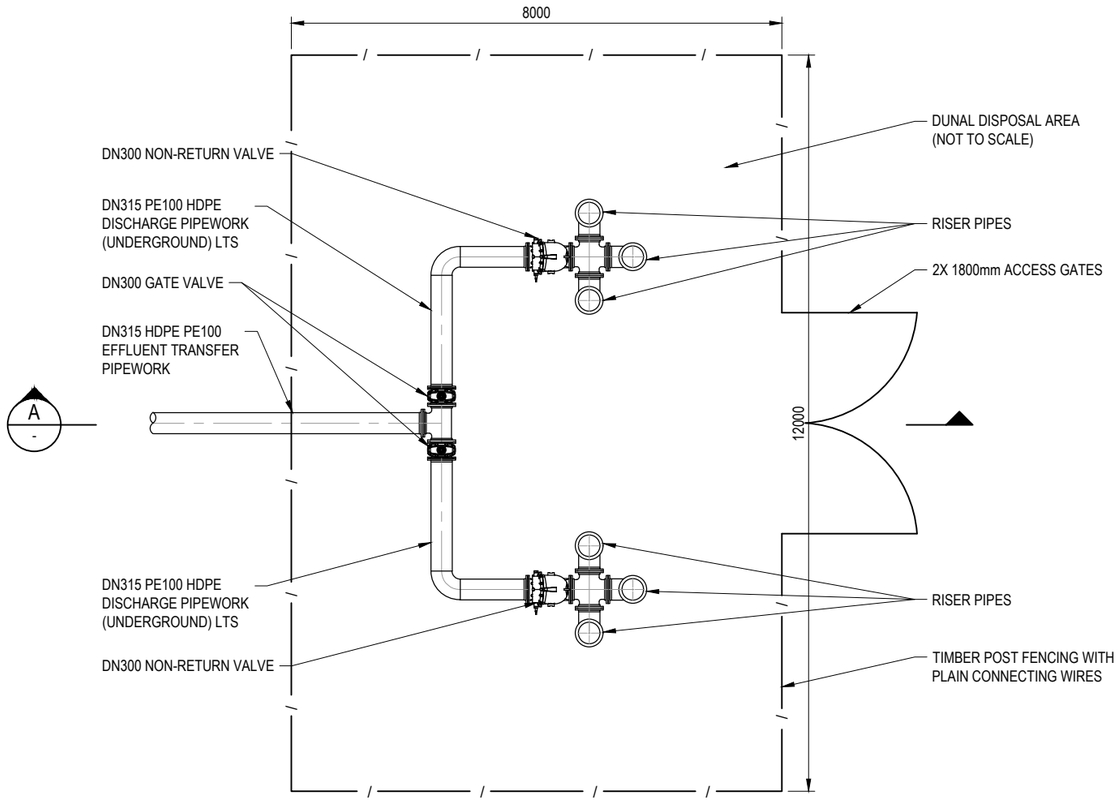
Drawing Title TYPICAL DETAILS

Size A3

Drawing No. 12551313-W011

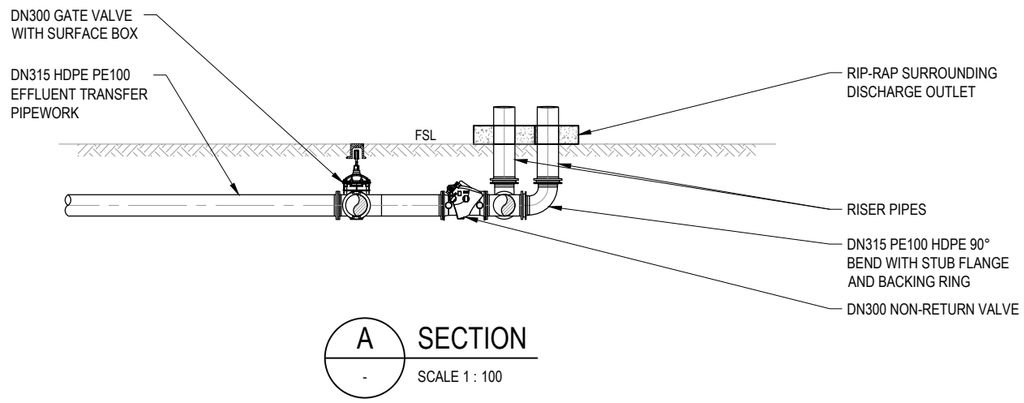
Rev B

Plot Date: 25 January 2023 - 12:40 PM Plotted by: Jeyzon Reglamos File Name: C:\12d\SW\data\P-00-12D-001\22-12551313 - SPSS_2220\CADD\Drawings\12551313-W011.dwg



PLAN

SCALE 1:100



A SECTION

A
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SCALE 1 : 100

Rev	Description	Checked	Approved	Date
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Author J. REGLAMOS **Drafting Check** -
Designer - **Design Check** -

0 1000 2000 3000mm
SCALE 1:100 AT ORIGINAL SIZE

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Client KEMPSEY SHIRE COUNCIL

Project SPSS - EFFLUENT TRANSFER AND DISPOSAL DESIGN AND INVESTIGATIONS

Status PRELIMINARY Status Code

Drawing Title DUNAL DISPOSAL AREA DISCHARGE PIPEWORK TYPICAL DETAILS

Size A3

Drawing No. 12551313-W012

Rev B

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