Appendix N

Ground Conditions Factual Report

MARINUS LINK

Ground Conditions Factual Report

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Revision no: B

Tasmanian Networks Pty Ltd
[Client reference]

Project Marinus - Heybridge Converter Station Ground Investigation
29 April 2022

Ground Conditions Factual Report

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Jacobs Group (Australia) Pty Limited

Floor 11, 452 Flinders Street
Melbourne, VIC 3000
PO Box 312, Flinders Lane
Melbourne, VIC 8009
Australia

T +61 3 8668 3000
F +61 3 8668 3001
www.jacobs.com

Important note about your report

The sole purpose of this report is to present the findings of a combined geotechnical, hydrogeological and contaminated land field investigation carried out by Jacobs for Tasmanian Networks Pty Ltd ('the Client') in connection with the Project Marinus Heybridge Converter Station ('the project'). This report was produced in accordance with and is limited to the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

This report is based on assumptions that the site conditions as revealed through sampling are indicative of conditions throughout the site. The findings are the result of standard assessment techniques used in accordance with normal practices and standards, and (to the best of Jacobs' knowledge) they represent a reasonable interpretation of the current conditions on the site.

Sampling techniques, by definition, cannot determine the conditions between the sample points and so this report cannot be taken to be a full representation of the subsurface conditions. This report only provides an indication of the likely subsurface conditions.

Conditions encountered when site work commences may be different from those inferred in this report, for the reasons explained in this limitation statement. If site conditions encountered during site works are different from those encountered during Jacobs' site investigation, Jacobs reserves the right to revise any of the findings, observations and conclusions expressed in this report.

This report and conclusions that deal with subsurface conditions are based on interpretation and judgement and as a result have uncertainty attached to them. You should be aware that this report contains interpretations and conclusions which are uncertain, due to the nature of the investigations. No study can investigate every risk, and even a rigorous assessment and/or sampling program may not detect all problem areas within a site.

The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

The contaminated land assessment was based on opportunistic sampling conducted during a geotechnical investigation at the site and therefore, the results are only intended to provide an indication of the contamination status within the proposed works area. Absence of Contaminants of Potential Concern at concentrations above relevant screening criteria for this soil contamination assessment should not be taken as absence of Contaminants of Potential Concern in soil throughout the area of the proposed works.

This report has been prepared on behalf of, and for the exclusive use of, the Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

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Appendices

1. Introduction

1.1 General

Tasmanian Networks Pty Ltd has engaged Jacobs Group (Australia) Pty Ltd to undertake an intrusive ground conditions (geotechnical, hydrogeological, contaminated land, soil electrical and thermal resistivity) investigation to establish the basis for the geotechnical design of the project and engineering recommendations at the various designated sites within the Marinus Link and North-West Transmission Developments.

The Marinus Link includes a 1500-megawatt capacity high voltage direct current electricity interconnector, to strengthen the connection between the Australian states of Tasmania and Victoria, on Australia's National Electricity Market. It involves approximately 250 km of undersea High Voltage Direct Current (HVDC) cable and approximately 90 kilometres of underground HVDC cable. Marinus Link will also incorporate significant optical fibre capacity for system control, with the remaining capacity available to strengthen telecommunications and data connectivity between the regions. As such, it includes converter stations in Tasmania and Victoria, and approximately 220 kilometres of supporting High Voltage Alternating Current (HVAC) transmission network developments in North-West Tasmania, known as the North-West Transmission Developments. Collectively, Marinus Link and the North-West Transmission Developments are known as Project Marinus.

This report aims to provide geotechnical, hydrogeological and contaminated land information to understand the subsurface ground conditions at the proposed Heybridge Converter Station and the Heybridge Landside Landfall site at the Heybridge beach area.

The site is in Heybridge, Tasmania, approximately 8 km east of the Township of Burnie. Figure 1-1 shows the extents at which ground investigations were undertaken as part of this report.

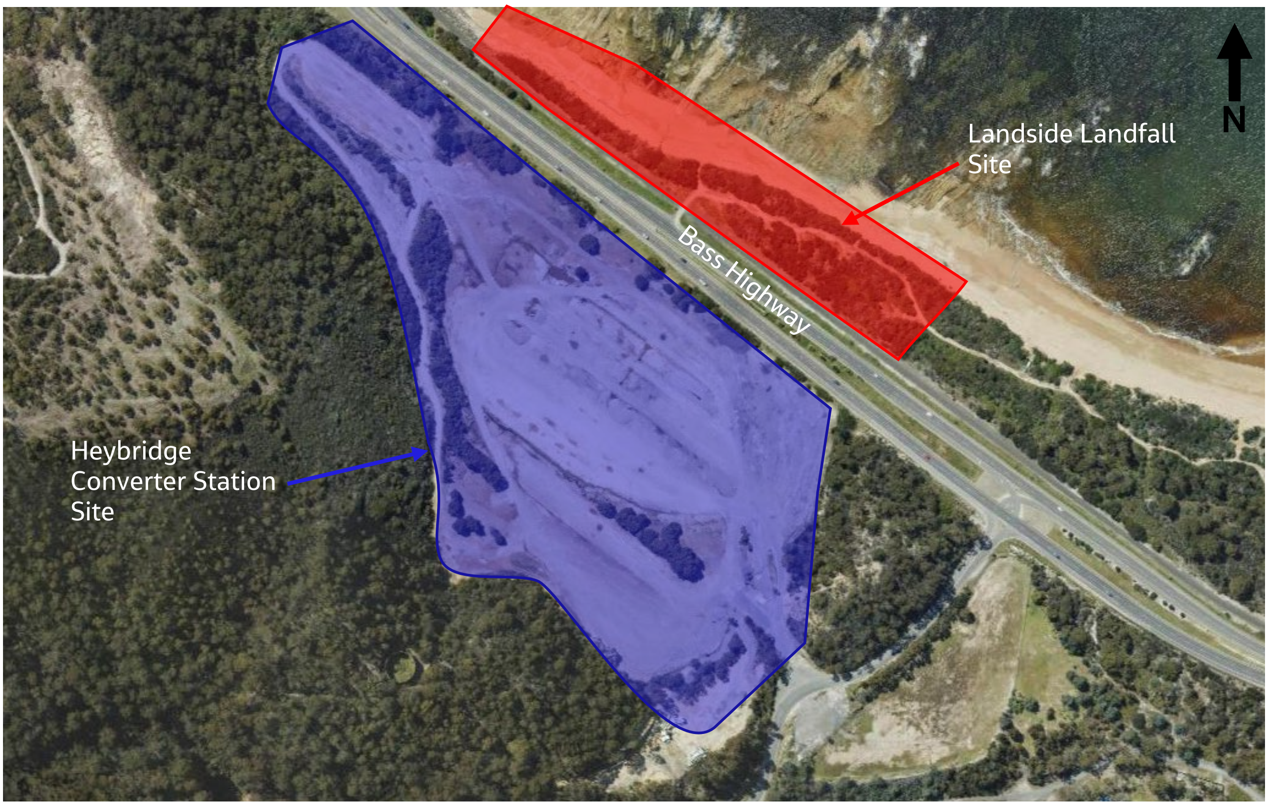

Figure 1-1. Heybridge Converter Station and Landside Landfall Sites (State of Tasmania, Maxar 2022).

The ground investigation at Heybridge Converter Station and Landside Landfall Sites were undertaken to:

- Understand the existing ground and groundwater conditions;
- Characterise the extent, thickness and strength of residual soils and the depth to rock and identifying the extent of existing fill materials on site;
- Assess rockhead levels, weathering and strength conditions of the rock (layering, joints and fractures) and the presence of clay seams;
- Identify the existing groundwater levels, groundwater chemistry and hydraulic conductivity; and
- Investigate the likelihood of, and extent to which potential contaminated land issues (specifically related to soil and groundwater) may impact on the construction of the project.

The results of this investigation will be used to inform the design and construction phase of the project, including forming part of the deliverables to contractors for the initial tender phase of the project.

1.2 Scope of Works

The site investigation was conducted in general accordance with the scope of works outlined in the Jacobs proposal ('Project Marinus – TEPM Services, Service Order No. 18 (Phase 2) Heybridge Geotech SI – Rev C'). The scope of works involved:

- Planning for the fieldwork, including Health, Safety and Environmental (HSE) plans and HAZID workshop, COVID-19 SafePlans, fieldwork permits, and review of DBYD and service plans, engagement of subcontractors for the work;
- Supervision of the buried services scanning at the proposed investigation locations;
- The ground investigation, comprising:
    - ✓ Six (6) x boreholes to 15 m depth (nominal) or 5 m into HW rock or better (with four (4) x groundwater wells within these 6 boreholes) at the Heybridge Converter Station site;
    - ✓ Two (2) x landside landfall boreholes to 30 m depth (nominal) north of Bass Highway;
    - ✓ Nine (9) x test pits to 3 m depth (nominal) at the Heybridge Converter Station site;
    - ✓ Collection of disturbed and undisturbed soil, rock and groundwater samples from boreholes and test pits for geotechnical, contamination and thermal resistivity laboratory testing;
    - ✓ Development of groundwater wells and water level gauging and in-situ permeability testing; and
    - ✓ In-situ electrical resistivity testing.
- Geophysical survey;
- Topographic survey of test locations; and
- Provision of a Ground Conditions Factual Report summarising the factual results of the site investigation (this report).
- Provision of a Ground Conditions Interpretive Report summarising the results of the interpretations of data from the geotechnical site investigation (issued as separate future report).

2. Background

2.1 Site Description

Heybridge Converter Station Site

As noted above the proposed Heybridge Converter Station site is located approximately 8km east of Burnie along the Bass Highway. Vehicular access to the site is gained through Minna Road, Heybridge. The site extent is enclosed by the Bass Highway from the north and Minna Road from the East. The site is fenced off and is not accessible to the public. The northern fence line of the site lies parallel to the Bass Hwy whilst the southern fence line is situated at the toe of a mountainous landscape. A gentle north westerly slope is observed within the overall site. Figure 2-1 shows general site photos of the Heybridge Converter Station Site.

The converter station site is currently vacant and is known as the former Tioxide Factory site, as it was previously used as a Tioxide (paint) factory and a lumber yard. There is significant history of disturbance and known contamination present at the site due to its previous land use, including naturally occurring radioactive materials (NORM). Remnants of the old paint factory such concrete footings and reinforcement is observed within majority of the site extents.

Figure 2-1. General Site Photos - Heybridge Converter Station Site.

Landside Landfall Site

The landside landfall site is situated north of the Bass Highway opposite to Heybridge Converter Station Site and south of the Tioxide Beach. Vehicular access to the site is gained from an unsealed access which runs from Bass Highway to Tioxide Beach. The access road also crosses the Western Rail Line Corridor and runs through the whole landfall site extents. The overall area, apart from the access road, is heavily vegetated. In addition, the Tioxide beach and Bass Straight shoreline is considered a nearby sensitive receptor which is approximately 100m from the access road. Figure 2-2 and Figure 2-3 shows the borehole locations HBLF-BH01-C and HBLF-BH02-C at the Landside Landfall Site respectively.

Figure 2-2. General Site Photos - Landside Landfall Site - Location of Borehole HBLF-BH01-C.

Figure 2-3. General Site Photos - Landside Landfall Site - Location of Borehole HBLF-BH02-C.

2.2 Geological Setting

The Mineral Resources Tasmania (2012) digital geological atlas map (sheet 4045) of Burnie and the Tasmanian Government Department of State Growth (2017) geological map of Northwest Tasmania (1:25,000) indicates that the project area is underlain by the following geological units:

- Aeolian Origin (Qps): older stabilised aeolian sand of predominantly coastal plain;
- Cenozoic cover sequences (Qhwr): Younger active dune and beach sand and beach gravel;
- Littoral Origin (Qh): sand of stabilised longitudinal beach ridges;
- Oonah formation (Lo): dominantly quartzwacke turbidites with interbedded slaty mudstone with localised mineralisation bands; and
- Oonah formation (Lob): Mafic vesiculate lavas.

A brief description of these geological units has been provided in Table 2-1 below and Figure 2-5 and Figure 2-5 depicts the geological units within the overall extents of the site.

Table 2-1. Summary of stratigraphic units within the project area.

Age	Geological Unit	Description
Quaternary (Recent to Pleistocene)	Quaternary Deposits - Aeolian *(Qpsa)*	Older stabilised aeolian sand of predominantly coastal plain, with underlying marine sands in places; may show relict landforms including terraces, lunettes, linear or barchan dunes, and beach ridges related to regressive strandlines of last interglacial
	Quaternary Deposits - Littoral *(Qhwr)*	Sand of stabilised longitudinal beach ridges
	Cenozoic Cover Sequences *(Qhbd)*	Younger active dune and beach sand and beach gravel
Proterozoic (Precambrian)	Oonah Formation *(Lo) – see* Figure 2-5 *(Previously defined as Burnie Formation (Po) in* Figure 2-4*)*	Undifferentiated Oonah Formation. Dominantly quartzwacke turbidites with interbedded slaty mudstone with localised mineralisation bands
	Oonah Formation *(Lob)*	Mafic vesiculate lavas

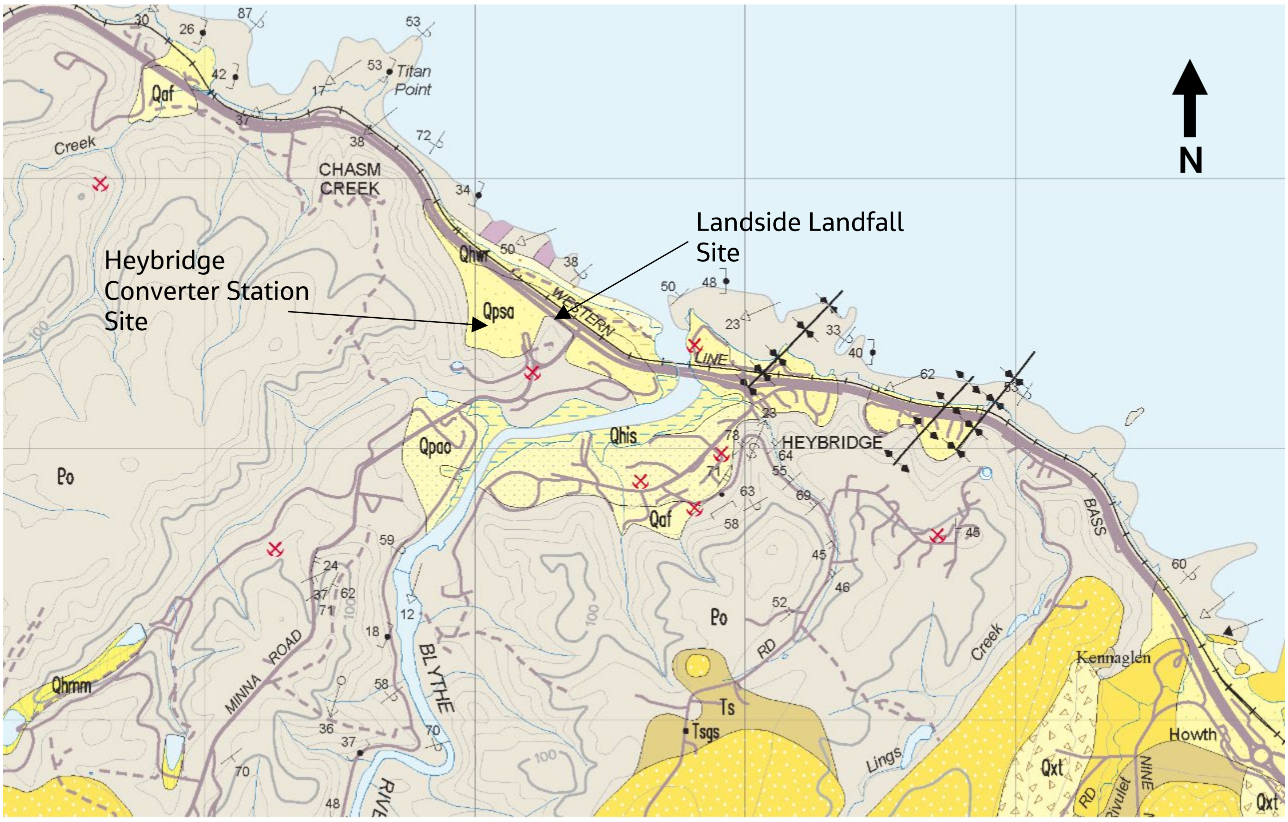

Figure 2-4. Extract from Digital Geological Atlas 1:25,000 Scale Series Burnie, Sheet 4045 (MRT, 2012).

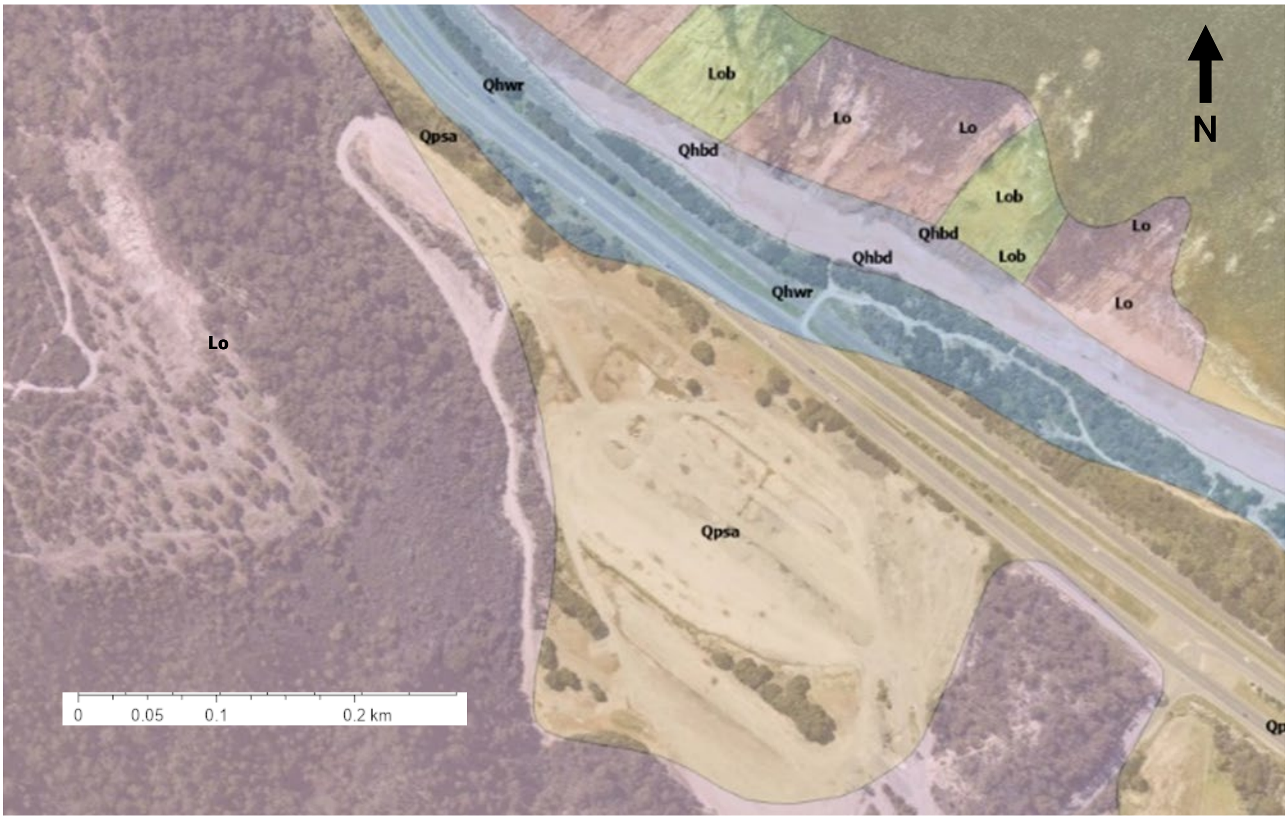

Figure 2-5. Site Geology Overlay extracted from the 1:25,000 Geological map of Northwest Tasmania (2017), Department of State Growth. Overlay map courtesy of Microsoft Corporation, TomTom (2022).

2.3 Hydrogeology

2.3.1 Aquifers

The main aquifers of relevance to this project are the unconfined Oonah Formation fractured rock aquifer and potentially shallow perched groundwater associated with the shallow soils / fill. The watertable across the project site predominantly resides within the sandstone and siltstone of the Oonah Formation. The Oonah Formation generally has low hydraulic conductivity and yields. The Northwest Tasmania Groundwater indicates that yields near Heybridge are around 0.5 to 1.5/s (Department of Infrastructure, Energy and Resources, 2006a). Low bore yields were also encountered at two bores installed as part of investigations in 2000 which suggested a fairly low bulk permeability of the fractured bedrock (Cromer, 2007).

2.3.2 Depth to water

A review of publicly available groundwater data indicates that the water levels in bores surrounding the site ranges from 5 to 12 mbgl (Figure 2-6). Within the project area three monitoring wells (GW52, GW53 and GW54) were installed in 2000 to a depth of 10-12 mbgl. Although the screened intervals are not documented, the bores immediately penetrated the Precambrian siltstone and sandstone (Cromer, 2007) and are inferred to monitor the bedrock. Groundwater levels of around 4-5 mbgl were recorded in the two northern bores the day after drilling (GW53 and GW54) and 1 mbgl in the southern bore (the ground was waterlogged at the time of measurement). Measurements taken close to drilling, particularly in low permeability formations, may not be representative of local conditions as the groundwater levels can continue recover from drilling or well development. Therefore, the groundwaters levels may be deeper or shallower than reported. Groundwater levels were not available from GW17 and GW19 which were installed in 1996; 8 and 2.1 m deep respectively.

Shallow groundwater was observed in test pits E32, E45 and E47 and AK (Cromer, 2007). Cromer suggested that the shallow groundwater may be locally separated from the deeper groundwater by clayey subsoils (Cromer, 2007).

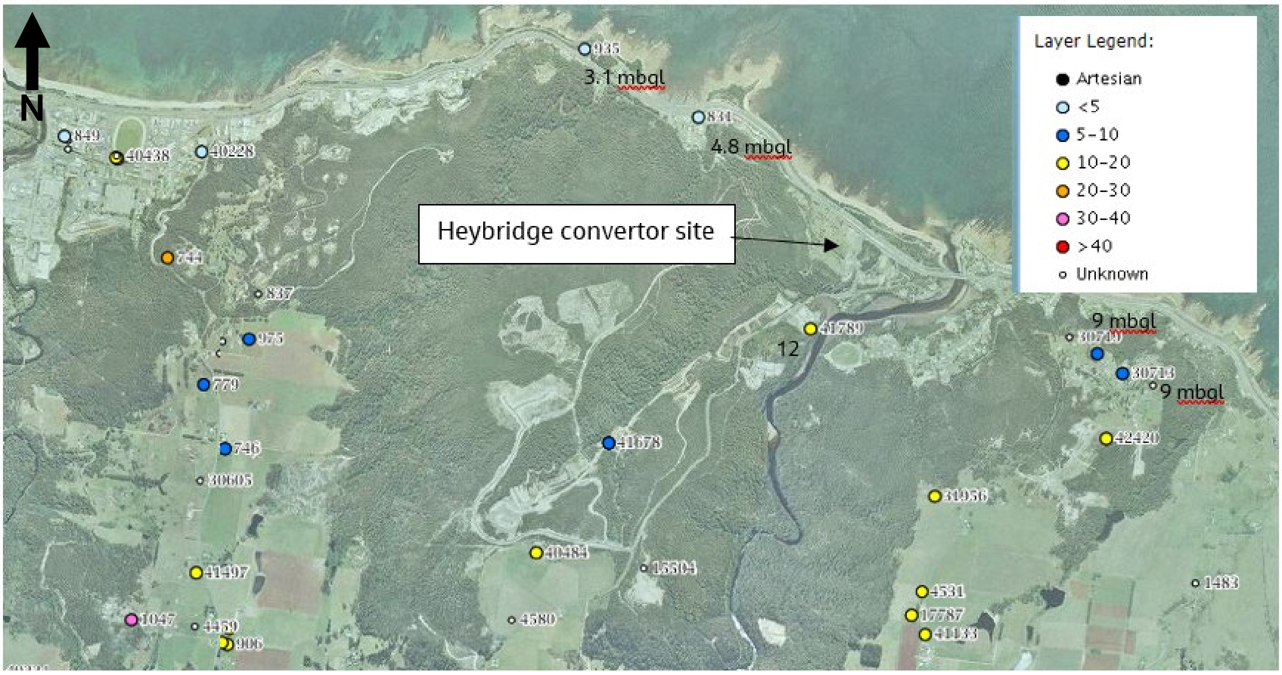

Figure 2-6. Standing water level information (DNRET, 2021)

2.3.3 Groundwater salinity / quality

Watertable salinity south of study area is expected to be fresh <500 mg/L (Department of Infrastructure, Energy and Resources, 2006b - Northwest Tasmania Groundwater Quality Map). Groundwater samples from GW17 and GW19 recorded TDS of 700 and 1,300 mg/L respectively (Cromer, 2007). Electrical conductivity (EC) in test pits ranged from 213 to 615 uS/cm (E32, E45 and E47).

Analytical results noted in Cromer 2007of testing soils, fill and groundwater have revealed that the site exhibits generally low levels of contamination, suitable for future industrial commercial use. Cromer concluded that shallow groundwater is contaminated with +C10 TPH and traces of volatiles (but no BTEX) in pits E32 and E45. It is unclear whether the contamination is laterally localised, whether the source remains, or whether the hydrocarbons are also present in any deeper groundwater which may exist.

3. Ground Conditions Investigation

3.1 Overview

The ground condition investigation was undertaken between 24 January to 16 February 2022. The investigation comprised of the following tasks:

- A site walkover to assess the general condition of the site;
- Buried services clearance works to determine the investigation locations;
- Nine (9) test pits including in-situ testing to a maximum depth of 3.0 m bgl at Heybridge Converter Station;
- Six (6) boreholes including in-situ testing to a maximum depth of 15.0 m bgl at Heybridge Converter Station and two (2) boreholes including in-situ testing to a maximum depth of 30.0 m bgl at Heybridge Landside Landfall Sites;
- Four (4) groundwater monitoring wells within the boreholes undertaken at the Heybridge Converter Station;
- Geophysical survey to a maximum depth of 22.0 m bgl;
- In-situ soil electrical resistivity testing by use of Wenner method; and
- Collection of samples for geotechnical and contamination laboratory testing.

The investigation was undertaken in the full-time presence of a geotechnical engineer from Jacobs. The investigation was undertaken in accordance with Australian Standard AS 1726-2017 Geotechnical Site Investigations and Jacobs' standard work procedures.

3.2 Buried Services Clearance

Underground utility detection and clearance was undertaken on 24 January 2022 at all intrusive test locations prior to intrusive works under the fulltime supervision of a Jacobs engineer.

Jacobs engaged AusLocations to perform the scanning for the buried services using Radio Detection (RD). Site plans were also reviewed for all locations and final test locations were selected at suitable offsets from existing services where potential services were detected. Dial Before you Dig (DBYD) plans were also assessed and available onsite during the service clearance activities.

3.3 Borehole Drilling

The borehole drilling was supervised on a full-time basis by a field geotechnical engineer from Jacobs, who was responsible for directing the borehole drilling, logging of soil and rock, photographing SPT samples and recovered core and collecting samples for subsequent laboratory testing.

Boreholes were advanced using mechanical drilling using a Hanjin D&B-8D tracked drill rig supplied and operated by Tasmanian Drilling. Auger drilling within the upper substrata was undertaken using hollow flight augers and rock coring undertaken using HQ3 diamond coring equipment.

Boreholes undertaken within the proposed Heybridge Converter Station Site were advanced to a depth between 8.5 and 15.4 m bgl. Five (5) groundwater wells were installed at the borehole locations HB-BH01-C, HB-BH02-C, HB-BH03-C and HB-BH06-C including a shallow nested borehole HB-BH06-C(S) for contaminated land and hydrogeological analysis. Boreholes undertaken at the Landside Landfall locations were advanced to a of 30.0 m bgl.

Standard penetration tests (SPTs) were generally undertaken at 1.5 m depth intervals generally starting at a depth of 1.0 m below the surface level on all boreholes. A few thin-walled tubes (U63) were also pushed in lieu of SPTs where practically possible. Samples recovered from the split spoon sampler were logged, sampled and photographed. Pocket penetrometer (PP) tests were undertaken on the SPT samples where cohesive soil was identified. Results of the SPT and PP tests are summarised in Table 4-3 and Table 4-4.

A summary of the boreholes undertaken is provided in Table 3-1. Borehole and the test pit locations are shown in Appendix A. The subsurface conditions encountered at the investigation locations are presented on the borehole and test pit logs provided in Appendix B.

Table 3-1. Summary for boreholes undertaken at Heybridge Converter Station and Landside Landfall Site.

Location	Borehole ID	**Commenced Date**	**Completed Date**	Coordinates (GDA 2020)		Surface RL (m AHD)	Termination Depth (m bgl)
				Easting (m)	Northing (m)		
Heybridge Converter Station Site	HB-BH01-C^{+}	04/02/2022	07/02/2022	413994.58	5452650.656	6.21	12.50
	HB-BH02-C^{+}	04/02/2022	04/02/2022	414106.503	5452568.214	6.59	8.50
	HB-BH03-C^{+}	03/02/2022	03/02/2022	414223.187	5452487.413	8.68	9.90
	HB-BH04-C	31/02/2022	31/02/2022	414002.478	5452548.233	7.44	9.00
	HB-BH05-C	02/02/2022	02/02/2022	414109.166	5452459.638	8.18	10.80
	HB-BH06-C^{+}	31/02/2022	01/02/2022	414058.697	5452425.869	9.42	15.40
	HB-BH06-C(S) $^{+*}$	01/02/2022	01/02/2022	414060.869	5452423.604	9.46	2.50
Landside Landfall Site	HBLF-BH01-C	08/02/2022	09/02/2022	414163.821	5452650.876	5.43	30.00
	HBLF-BH02-C	10/02/2022	11/02/2022	414287.191	5452577.034	5.11	30.00

Notes: RL - Reduced Level, bgl – Below Ground Level, AHD – Australian Height Datum. Eastings and Northings recorded using a DGPS with an anticipated accuracy of ± 25mm.

$^{+}$Groundwater Monitoring Well

*Nested shallow Groundwater Monitoring Well

3.3.1 Groundwater Well Installation

To assess the depth to groundwater and hydrogeological conditions across the site, five groundwater monitoring wells were installed within geotechnical borehole HB-BH01-C, HB-BH02-C, HB-BH03-C, HB-HB06-C and HB-BH06-C(S) during the site investigation. The wells were installed between the 1 February 2022 and 7 February 2022.

The well construction materials and construction method are listed below:

- Screen – Class 18 uPVC, machine-milled horizontal 1 mm aperture, screw join (50 mm ID and 63 mm OD);
- Casing – Class 18 uPVC screw join (50 mm ID and 63 mm OD); and
- Seals – Bentonite pellets and cement grout.
- Gravel Pack – 8/16 inch graded filter sand;

The monitoring well construction details are presented in Table 3-2. All wells, except for HB-BH06-C(S), are screened in the Quartzwacke bedrock; HB-BH06-C(S) is shallower and is screened in fill / silty sand/gravel. The monitoring wells were installed with a 50 mm diameter class 18 PVC casing and with a cover flush to the surrounding surface.

Table 3-2. Summary of Groundwater Monitoring Wells.

Location ID	Screened material	Surface elevation	Total borehole depth (m bgl)	Total casing depth	Screen interval	Filter pack interval
		RL (m AHD)		Depth (m bgl)	Depth (m bgl)	Depth (m bgl)
HB-BH01-C	Quartzwacke	6.21	12.5	12.3	5.8 – 11.8	5.3 – 12.3
HB-BH02-C	Quartzwacke	6.59	8.5	7.0	3.5 – 6.5	3.0 – 7.0
HB-BH03-C	Quartzwacke	8.68	9.9	9.9	6.5 – 9.5	6.0 – 9.9
HB-HB06-C	Quartzwacke	9.42	15.4	15	10.0 – 14.0	9.2 – 15.4
HB-BH06-C(S)	Fill / silty sand/gravel	9.46	2.5	2.0	1.0 - 2.0	0.5 – 2.5

3.3.2 Groundwater Well Development

Groundwater wells were developed via airlift (surging and purging of the screened interval) after construction Tasmanian Drilling undertook the development, supervised on site by a geotechnical engineer or hydrogeologist from Jacobs. Field water quality was recorded during development using a YSI water quality probe and development was undertaken until key field water quality parameters were observed to stabilise or until insufficient water was being produced by the well. Table 3-3 summarises the development of the wells. The water levels measured prior to development are presented in Table 3-4.

Table 3-3. Groundwater Monitoring Well Development Data.

Location ID	Date	Time (hh:mm)	Time (min)	Volume removed (L)	EC (µs/cm)	pH	T (deg °C)	Redox (mV)
HB-BH01-C	08/02/2022	07.54	16	128	1721	6.01	15.7	104.4
		07.58	4	32	1723	6.01	15.7	106.0
		08.01	3	24	1659	6.03	15.7	105.7
HB-BH02-C	07/02/2022	13.43	10	69	703	7.32	17.6	21.0
		13.46	3	20.7	706	7.04	17.5	9.50
		13.50	4	27.6	719	7.09	17.6	-22.0
		13.53	3	20.7	724	7.12	17.5	-28.9
HB-BH03-C	07/02/2022	13.10	9	5	197.0	6.93	19.4	181.0
		13.15	5	2	212.5	6.12	20.5	140.0
		13.16	1	<1	214.3	6.27	20.7	120.0
		15.41	5	5	346.0	6.52	18.6	31.2
		15.42	1	<1	342.6	6.73	19.5	23.3
		15.43	1	<1	347.5	6.78	19.6	17.0
		15.48	5	2	309.0	6.66	20.2	27.2

Location ID	Date	Time (hh:mm)	Time (min)	Volume removed (L)	EC (μs/cm)	pH	T (deg °C)	Redox (mV)
	08/02/2022	10.25	5	5	370.0	6.60	16.5	124.1
		10.27	2	<1	365.0	6.63	16.7	99.1
HB-BH06-C	03/02/2022	12:00	15	209	331.0	5.42	15.2	98.0
		12.17	2	28	346.0	5.35	15.2	109.6
		12.18	1	14	346.0	5.35	15.2	113.0
		12.20	2	14	346.0	5.34	15.2	119.0
HB-BH06-C(S)	03/02/2022	12.46	14	15	512.0	6.68	19.0	97.0
		12.53	10	20	437.0	7.02	19.1	30.9
		16.44		5	459.0	6.87	20.3	54.1
		16.48	4	10	430.6	6.78	20.3	15.4
		16.51	3	6	403.0	6.78	20.0	-2.3
		16.53	2	3.7	400.0	6.77	20.1	-2.3
		16.56	3	5.5	391.8	6.76	20.1	-6.8

Table 3-4. Water levels prior to development

Location ID	Screened material	Surface elevation RL (m AHD)	Date	Groundwater levels mbTOC
HB-BH01-C	Quartzwacke	6.21	8/02/22	1.02
HB-BH02-C	Quartzwacke	6.59	7/02/22	0.81
HB-BH03-C	Quartzwacke	8.68	7/02/22	2.83
HB-HB06-C	Quartzwacke	9.42	3/02/22	0.45
HB-BH06-C(S)	Fill / silty sand/gravel	9.46	3/02/22	1.00

3.4 Test Pitting

Test pits were excavated by Treloar Transport at nine (9) locations using a Kobelco SK135 13.5t excavator equipped with a 450mm digging bucket fitted with teeth attachments under the full-time supervision of a Jacobs field geotechnical engineer. Bulk/disturbed samples were collected from all distinctive soil layers identified within the full depth of each test pit.

Hand penetrometer testing was undertaken on fine grained soil on test pit walls up to a maximum depth of 1 m bgl.

Each test pit was supplemented with a Dynamic Cone Penetrometer (DCP) test performed directly adjacent to the test pit. The results of DCP testing were recorded as blows per 100mm of penetration and was generally terminated when blow counts exceeded three consecutive blow counts of 15 or greater, or a single blow count of 20.

Thermal resistivity and in-situ moisture content testing were undertaken within each test pit at 0.5m and 1.0m depths. Test results are summarised in Table 4-6 and Table 4-5 respectively.

Test pits were excavated to varying depths depending on the conditions encountered as described in Table 3-5. Engineering logs of the test pits are presented in Appendix B3. DCP test results are shown within the test pit logs and are separately presented in Appendix C.

Table 3-5. Summary for test pits undertaken at Heybridge Converter Station.

Test Pit ID	Commenced Date	Completed Date	Coordinates (MGA94 Zone 55H)		Surface RL (m AHD)	Termination Depth (m bgl)	Termination Criteria
			Easting (m)	Northing (m)			
HB-TP01-C	28/01/2022	28/01/2022	414073.252	5452518.778	7.29	1.6	Refusal
HB-TP02-C	28/01/2022	28/01/2022	414027.59	5452590.393	6.73	3.0	Target Depth
HB-TP03-C	31/01/2022	31/01/2022	414152.562	5452492.630	8.04	3.0	Target Depth
HB-TP04-C	31/01/2022	31/01/2022	414200.934	5452441.704	10.20	3.0	Target Depth
HB-TP05-C	28/01/2022	28/01/2022	413982.146	5452515.405	8.20	1.1	Refusal
HB-TP06-C	28/01/2022	28/01/2022	414106.510	5452387.290	11.14	3.0	Target Depth
HB-TP07-C	28/01/2022	28/01/2022	414154.107	5452362.904	13.59	3.0	Target Depth
HB-TP08-C	31/01/2022	31/01/2022	413932.077	5452687.331	7.75	3.0	Target Depth
HB-TP09-C	31/01/2022	31/01/2022	413871.184	5452741.465	9.58	1.4	Refusal

Notes: RL - Reduced Level, bgl – Below Ground Level, AHD – Australian Height Datum. Eastings and Northings recorded using a DGPS with an anticipated accuracy of ± 25mm.

3.5 Geophysical Survey

Multi-channel Analysis of Surface Waves (MASW) seismic survey was undertaken within the project area between the 07 and 11 February 2022 under the supervision of a Jacobs geotechnical engineer.

Jacobs engaged GBG Australia Pty Ltd (GBG) to provide in-situ rock depth and strength assessment via P wave velocity models of the subsurface to a maximum depth of 22 m below surface level. To this end, MASW profiling was conducted over 10 lines, and the results were analysed to produce 2D contour profiles.

The seismic data correlates well with the collected borehole data provided and indicates a relatively uniform depth to bedrock top between 3 to 5m below ground level. GBG Australia has also interpreted the top of the underlying bedrock within each MASW line. A detailed description on the seismic data collection techniques and the results of the geophysical investigation is presented in a geophysical survey report in Appendix J.

3.6 Soil Electrical Resistivity Testing

In-situ soil electrical resistivity testing was undertaken by Jacobs engineers for the Heybridge Inverter Station site on 24 January 2022. The soil conditions on the day were dry with a maximum temperature of 23°C. Three traverses were undertaken using the four electrode Wenner method at locations shown indicated in Figure 3-1.

Figure 3-1. Electrical resistivity traverse locations (indicative)

The testing was undertaken by use of the AEMC 6471 with Wenner probe spacings of up to 40 m in a straight line. Refer to Section 4.3 for the test results.

3.7 Soil Thermal Resistivity Testing

In-situ thermal resistivity testing was performed by Jacobs field geotechnical engineer within the test pits completed at the Heybridge Converter Station Site. A TEMPOS Thermal Properties Analyser was utilised to measure in-situ thermal conductivity and thermal resistivity of the materials encountered within the test pits at 0.5m and 1.0m. In addition, laboratory thermal resistivity testing was undertaken on selected bulk samples collected during the test pitting works. Results of the in-situ testing and laboratory test results are summarised in Section 4.3.

4. Ground Conditions Investigation Results

4.1 Subsurface Conditions

Sub-surface conditions identified within the Heybridge Converter Site and the Landside Landfall sites have been categorised into geological units from information obtained from the ground investigations and by assessing publicly available geological information. Subsurface conditions within the Heybridge Converter Site and the Landside Landfall sites are summarised in Table 4-1 and Table 4-2.

Table 4-1. Summary of sub-surface conditions encountered within the Heybridge Converter Site

Unit	Geological Unit	Depth to Top of Layer (m bgl)	Thickness (m)	Unit Description
HB-1	FILL	0	0.15 - 1.4	Fill material highly variable in composition, predominantly recovered as: **Silty/Clayey GRAVEL(GC/GM):** fine to coarse grained, angular to sub-angular gravel, low plasticity clay and silt, with varying amounts of fine to medium grained sand **Sandy GRAVEL/Gravelly SAND:** fine to coarse grained, angular to sub-angular gravel and fine to coarse grained sand, with angular to sub-angular cobbles and traces of low plasticity silt. **Silty SAND (SM):** fine to coarse grained sand, low plasticity silt; with varying amounts of fine to medium grained angular to sub-angular gravel. **Sandy/Gravelly CLAY (CL):** low plasticity, fine to coarse grained, angular to sub-angular, gravel, fine to coarse grained sand, with boulders up to 250mm. Remains of historic concrete footings/slabs abandoned drainage pipes and electrical/telecommunication cables. pipes
HB-2	Quaternary Deposits - Aeolian	0.5 - 1.2	0.5 – 0.9	**Silty SAND (SM):** fine to medium grained sand, low plasticity silt, trace amounts of fine grained angular to sub-angular gravel. **Sandy SILT (ML):** low plasticity, fine to medium grained sand.
HB-3	Residual Soil	0.15 – 1.8	0.65 – 2.75	Inferred residual material highly variable in composition, predominantly recovered as: **Sandy/Clayey SILT (ML- MH)**: low to high plasticity, fine to coarse grained sand, with varying amounts of fine to coarse grained, angular to sub-angular gravel. **Sandy CLAY/Silty Sandy CLAY (CL-CI):** low to high plasticity, fine to coarse grained sand, with varying amounts of fine to medium grained, angular to sub-angular gravel. **Silty/Clayey GRAVEL (GM/GC):** fine to coarse grained, angular to sub-angular gravel, low plasticity silt and clay, with varying amounts of fine to coarse grained sand. **Silty/Gravelly SAND (SM/SP):** fine to coarse grained sand, low plasticity silt, fine to medium grained, angular to sub-angular gravel.

Unit	Geological Unit	Depth to Top of Layer (m bgl)	Thickness (m)	Unit Description
HB-4a	Extremely Weathered Quartzwacke - Oonah Formation *(Lo)*	1.4 - 3.9	0.6 – 1.2	Inferred extremely weathered material variable in composition and recovered as: **Silty/Sandy GRAVEL:** fine to coarse grained, angular to sub-angular gravel, with varying amounts of low plasticity silt and fine to coarse grained sand, with angular to sub-angular boulders up to 300mm **Gravelly SILT:** low plasticity, fine to medium grained, angular to sub-angular gravel **Gravelly SAND:** fine grained to coarse sand, fine to coarse grained, angular to sub-angular gravel, low plasticity **Clayey SILT/SILT:** low plasticity, with fine to medium grained, angular to sub-angular gravel
HB-4b	Quartzwacke - Oonah Formation *(Lo)*	2.2 – 3.9	Base of unit not observed	The rock is generally highly to slightly weathered quartzwacke, low to very high strength, dark grey, pale grey, yellow brown and red brown, medium to thinly bedded, with occasional extremely weathered seams consisting of a very low strength.

Table 4-2. Summary of sub-surface conditions encountered within the Landside Landfall Site

Unit	Geological Unit	Depth to Top of Layer (m bgl)	Thickness (m)	Unit Description
HBLF-1	Quaternary Deposits - Littoral	0	1.5– 3.5	**GRAVEL (GP):** fine to coarse grained, angular to sub-angular gravel. **Silty GRAVEL (GM):** fine to medium grained, angular to sub-angular gravel, low plasticity silt. **Gravelly SAND (SP):** fine to coarse grained sand, fine to medium grained, rounded to sub-angular, trace plasticity silt **SAND (SP):** fine to medium grained sand
HBLF-2	Quartzwacke - Oonah Formation *(Lo)*	1.5 - 3.5	Base of unit not observed	The rock is generally highly to slightly weathered quartzwacke, low to extremely high strength, dark grey, pale grey, yellow brown and red brown, medium to very thinly bedded, with occasional extremely weathered seams consisting of a very low strength. Interbedded slaty mudstone with localised mineralisation bands, medium to low in strength, black. (Encountered between 22.40 – 30.00m within HBLF-BH01-C and between 26.48 – 29.00m within HBLF-BH02-C)

4.2 Geotechnical In-situ soil testing

4.2.1 Standard Penetration Tests (SPT)

A total of twelve (12) Standard Penetration Tests (SPT) were undertaken. A summary of the in-situ SPT results is provided in Table 4-3.

Table 4-3. Summary of SPT test results undertaken during borehole drilling works.

Location	Borehole ID	Top Depth (m)	Geology	SPT result (N Value)	Remarks
Heybridge Converter Station	HB-BH01-C	1.0	Quaternary Deposits - Aeolian	6	2, 2, 4 N = 6
		1.5[2]		-	-
	HB-BH02-C	2.0	Residual Soil	37	13, 18, 19 N = 37
		3.0		R[1]	13 / 95mm N = R[1]
	HB-BH04-C	1.0	Fill	13	3, 5, 8 N = 13
		2.5	Residual Soil	R[1]	15, 16, 22/80mm N = R[1] (HDB)
	HB-BH05-C	1.0	Fill	5	4, 2, 3 N = 5
		2.5	Residual Soil	5	4, 6, 9 N = 15
	HB-BH06-C	1.0	Fill	R[1]	8/65mm N = R[1] (HDB)
		1.5	Residual Soil	54	14, 25, 29 N = 54
Landside Landfall Site	HBLF-BH01-C	1.0	Quaternary Deposits - Littoral	5	2, 2, 3 N = 5
		2.5		27	3, 10, 17 N = 27
	HBLF-BH02-C	1.0	Quaternary Deposits - Littoral	R[1]	3, 23/130 N = R[1]

Note 1. R = SPT Refusal

Note 2. U63 Push Tube Sample

4.2.2 Pocket Penetrometer Tests (PP)

Pocket penetrometer (PP) tests were conducted on the samples recovered within the SPT split spoon sampler and at the base of the U63 sample recovered during borehole drilling works. PP tests were also undertaken within test pits up to a maximum depth of 1.0 m bgl. A summary of the pocket penetrometer test results is provided in Table 4-4.

Table 4-4. Summary of PP test results undertaken during borehole drilling and test pitting works.

Location	Borehole ID	Test Depth (m)	Geology	PP result (kPa)
Heybridge Converter Station – Borehole Works	HB-BH01-C	1.2	Quaternary Deposits - Aeolian	150
		1.4		210
		1.8[1]		>600
	HB-BH05-C	1.45	Fill	400
		2.6	Residual Soil	>600

Location	Borehole ID	Test Depth (m)	Geology	PP result (kPa)
Heybridge Converter Station – Test pitting Works	HB-TP01-C	0.5	Fill	350
		1.0	Quaternary Deposits - Aeolian	>600
	HB-TP02-C	0.5	Residual Soil	>600
		1.0		>600
	HB-TP03-C	0.5	Fill	>600
		1.0		>600
	HB-TP04-C	0.5	Fill	100
		1.0		>600
	HB-TP05-C	0.5	Fill	350
		1.0	Extremely Weathered Quartzwacke	>600
	HB-TP06-C	0.5	Fill	>600
		1.0		200
		1.5[2]	Residual Soil	350
		1.8[2]		350
	HB-TP07-C	0.5	Fill	>600
		1.0	Quaternary Deposits - Aeolian	300
	HB-TP08-C	0.5	Residual Soil	120
		1.0		180
	HB-TP09-C	0.5	Residual Soil	>600
		1.0	Extremely Weathered Quartzwacke	>600

Note 1. U63 Push Tube Sample

Note 2. PP testing undertaken on clumps of relatively undisturbed cohesive soil obtained from the excavator bucket

4.2.3 Dynamic Cone Penetrometer Tests (DCP)

As noted previously, DCP tests were undertaken adjacent to all test pit locations at the Heybridge Converter Station Site. DCP test results are shown within the test pit logs and are separately presented in Appendix C.

4.2.4 In-situ Moisture Content Testing

In-situ moisture content testing was performed within the test pit completed at the Heybridge Converter Station Site. A ProCheck handheld moisture content reader was utilised to measure in-situ volumetric moisture content of the materials encountered within the test pits at 0.5m and 1.0m. A summary of the in-situ moisture content test results is provided in Table 4-5.

Table 4-5. Summary of in-situ moisture content testing results.

Borehole ID	Test Depth (m)	Geology	Volumetric Moisture Content (%)
HB-TP01-C	0.5	Fill	11.6
	1.0	Quaternary Deposits - Aeolian	12.5
HB-TP02-C	0.5	Residual Soil	12
	1.0		7.2
HB-TP03-C	0.5	Fill	6.6
	1.0		7.5
HB-TP04-C	0.5	Fill	0.6
	1.0		6.4
HB-TP05-C	0.5	Fill	9.4
HB-TP06-C	0.5	Fill	2.3
	1.0		10.5
HB-TP07-C	0.5	Fill	2.0
	1.0	Quaternary Deposits - Aeolian	3.7
HB-TP08-C	0.5	Residual Soil	40.4
	1.0		39
HB-TP09-C	0.5	Residual Material	13.1
	1.0	Extremely Weathered Quartzwacke	6.7

4.3 Thermal Resistivity Testing

In-situ thermal resistivity testing was performed within the test pits completed at the Heybridge Converter Station Site. A TEMPOS Thermal Properties Analyser was utilised to measure in-situ thermal conductivity and thermal resistivity of the materials encountered within the test pits at 0.5m and 1.0m. A summary of the thermal resistivity test results taken at in-situ moisture content testing points is provided in Table 4-6.

Table 4-6. Summary of in-situ thermal conductivity and resistivity testing results.

Test Location	Test Depth (m)	Moisture Content (%)	Thermal Conductivity (W/m*K)	Thermal Resistivity (^{0}C*m/W)
HB-TP01-C	0.5	11.6	0.261	3.831
	1.0	12.5	0.745	1.243
HB-TP02-C	0.5*	12	0.098	10.197
	1.0	7.2	2.334	0.459
HB-TP03-C	0.5*	6.6	0.074	13.547
	1.0	7.5	1.737	0.576

Test Location	Test Depth (m)	Moisture Content (%)	Thermal Conductivity (W/m*K)	Thermal Resistivity (°C*m/W)
HB-TP04-C	0.5	0.6	0.350	2.850
	1.0*	6.4	0.021	46.929
HB-TP05-C	0.5	9.4	0.121	8.267
HB-TP06-C	0.5*	2.3	0.059	16.970
	1.0	10.5	0.629	1.591
HB-TP07-C	0.5	2.0	0.274	3.649
	1.0	3.7	1.090	0.918
HB-TP08-C	0.5	40.4	1.358	0.736
	1.0	39	0.808	1.238
HB-TP09-C	0.5*	13.1	0.059	17.018
	1.0	6.7	0.121	8.237

One (1) sample taken from HB-TP03-C was sent to Geotherm Australasia for laboratory testing in accordance with ASTM D5334. Summary of the test results are provided in Table 4-7.

Table 4-7. Thermal Resistivity Laboratory Test Result.

Test Location	Test Depth (m)	Moisture Content (%)	Compacted Dry Density (t/m^3)	Thermal Conductivity (W/m*K)	Thermal Resistivity (°C*m/W)
HB-TP03-C	2.0 – 2.50	0	1.84	0.39	2.59
		0.4		0.45	2.10
		1.3		0.53	1.90
		12.5		1.71	0.58

4.4 Groundwater

4.4.1 Groundwater levels

Groundwater levels were measured in all groundwater wells during development and slug testing and sampling. Recorded groundwater levels are provided in Table 4-8.

Groundwater levels are known to and expected to fluctuate seasonally and in response to rainfall events. As such, conditions encountered during project works may differ from that presented in this report.

Table 4-8. Summary of groundwater levels

Location ID	Screened material	Surface elevation	Date	Groundwater levels	Approximate groundwater evaluation
		RL (m AHD)		mbTOC	mAHD
HB-BH01-C	Quartzwacke	6.21	14/02/22	1.12	5.09
HB-BH02-C	Quartzwacke	6.59	14/02/22	0.96	5.63

Location ID	Screened material	Surface elevation RL (m AHD)	Date	Groundwater levels mbTOC	Approximate groundwater evaluation mAHD
HB-BH03-C	Quartzwacke	8.68	14/02/22	3.05	5.63
HB-HB06-C	Quartzwacke	9.42	14/02/22	0.68	8.74
HB-BH06-C(S)	Fill / silty sand/gravel	9.46	14/02/22	0.74	8.72

4.4.2 Aquifer permeability testing

Slug testing was completed at HB-BH02-C, HB-BH03-C and HB-HB06-C on the 15th February 2022. HB-BH06-C(S) was not tested as there was insufficient water column for testing and the tests from HB-BH01-C were not suitable for analysis.

Testing was undertaken using a solid PVC slug to displace water in the bore and a groundwater level logger to record the change in groundwater head. Falling head tests were undertaken on all bores with a suitable level of standing water, with an additional rising head test where possible. Change in water level data recorded during the tests was processed using the Aqtesolv software package to estimate hydraulic conductivity (K) for the screened section of aquifer at each well. The determination of a Kvalue for each test was undertaken using a visual match on a log-log displacement/time curve using the Bouwer and Rice (1976) analytical solution for unconfined aquifers. A hydraulic conductivity anisotrophy ratio ($K_{vertical}/K_{horizontal}$) of 0.1 was used in all analyses. Where multiple tests at each well were undertaken, the best test/s were adopted for analysis and where multiple tests were analysed an average of the resulting estimates of K was used to give an overall estimate of hydraulic conductivity for the tested interval. The curve fitting graphs undertaken as part of this analysis are included in Appendix I and the full results of the testing is presented in Table 4-9. The range in hydraulic conductivity is typical of fractured rock aquifers.

Table 4-9. Summary of hydraulic testing

Location ID	Screened material	Effective screened interval (m) [1]	Test type	Estimated hydraulic conductivity (m/d)
HB-BH02-C	Quartzwacke	4.0	FHT RHT	0.89 0.90 (avg 0.9) 0.009
HB-BH03-C	Quartzwacke	3.9	FHT	0.009
HB-HB06-C	Quartzwacke	4.8	FHT	13.2

Note: [1] Effective screen is length of gravel pack of well.

4.5 Soil Electrical Resistivity Test Results

The raw soil electrical resistivity test results for the three traverses are tabulated below in Table 4-10.

Table 4-10. Raw Soil Electrical Resistivity Test Results.

Spacings (m)	Traverse 1		Traverse 2		Traverse 3	
	Resistivity (Ωm)	Resistance (Ω)	Resistivity (Ωm)	Resistance (Ω)	Resistivity (Ωm)	Resistance (Ω)
0.5	53.0	16.9	96.4	30.7	113	36.0
1	41.6	6.62	118	18.8	164	26.1

Spacings (m)	Traverse 1		Traverse 2		Traverse 3	
	Resistivity (Ωm)	Resistance (Ω)	Resistivity (Ωm)	Resistance (Ω)	Resistivity (Ωm)	Resistance (Ω)
2	53.7	4.27	93.7	7.46	218	17.4
4	58.7	2.34	84.1	3.35	242	9.63
8	74.7	1.49	93.3	1.86	321	6.40
12	136	1.80	111	1.47	223	2.96
16	147	1.46	109	1.09	224	2.22
20	164	1.31	123	0.98	239	1.90
24	145	0.96	142	0.94	239	1.59
28	155	0.88	160	0.91	268	1.52
32	141	0.70	172	0.85	308	1.53
36	126	0.56	192	0.85	324	1.43
40	149	0.59	207	0.82	352	1.40

4.6 Geotechnical Laboratory Testing

Soil and rock samples retrieved from the geotechnical investigation were submitted to laboratories accredited by the National Association of Testing Authorities (NATA) for testing to assess the engineering characteristics of the material. Lab testing of soil samples was completed by Ground Science Pty Ltd and the rock testing completed by Bamford Rock Testing. A summary of the geotechnical testing is outlined in Table 4-11 below with full test results presented in Appendix E.

Table 4-11. Summary of geotechnical testing on both soil and rock samples.

Soil	Australian Standard; Clause	No. of Tests
Moisture Content	AS 1289.2.1.1	30
Atterberg Limits	AS 1289.3.1.1, 3.2.1, 3.3.1, 3.4.1	10
Particle Size Distribution (sieving)	AS 1289.3.6.1	6
Particle Size Distribution & Hydrometer – Clay Content	AS 1289.3.6.3	11
Emerson Class Number	AS 1289.3.8.1	3
Triaxial – Undrained Unconsolidated	AS 1289.6.4.1	1
Direct Shear Test	AS1289.6.2.2	1
Aggressivity Suite	Chloride – LTM-INO-4090 Conductivity-LTM-INO-4030 pH-LTM-GEN-7070 Sulphate (as SO4)-LTM-INO-4110 Moisture-LTM-GEN-7070	1

Soil	Australian Standard; Clause	No. of Tests
Rock	**Australian Standard; Clause**	**No. of Tests**
Moisture Content	AS 4133.1.1.1	19
Point Load Index (PLI)	AS 4133.4.1	44
Uniaxial Compressive Strength (UCS)	AS 4133.4.2.2	18
CERCHAR Abrasivity Index	ASTM D7625-10	4

4.6.1 Geotechnical Soil Testing

Selected soil samples retrieved from boreholes and test pits were submitted to Ground Science laboratories for Particle Size Distribution (with hydrometer for fine particles), Atterberg Limits and Moisture Content testing. The test results are summarized in Table 4-12, with the corresponding laboratory test certificates presented in Appendix E.

Table 4-12. Summary of standard soil classification testing results.

Test Location	Sample depth (m)	Material description	Grading (%)				MC(%)	Atterberg limit			
			Fine		Coarse						
			Clay	Silt	Sand	Gravel		LL(%)	PL (%)	PI(%)	LS (%)
HB-TP01-C	0.9 – 1.1	Silty SAND (SM)	-	-	-	-	9.1	-	-	-	-
HB-TP02-C	0.8 – 1.0	Silty CLAY (CL)	-	-	-	-	12.3	26	20	6	1.5
	2.4 – 2.5	Sandy GRAVEL (GP)	4	3	26	67	9.7				
HB-TP03-C	2.0 – 2.5	Clayey Sandy SILT (ML)	17	46	33	4	12.3	23	17	6	2.0
HB-TP04-C	1.5 – 1.9	Gravelly SAND (SP)	-	-	-	-	7	-	-	-	-
	2.8 – 3.0	Sandy CLAY (CL)	-	-	-	-	11.1	30	23	7	2.0
HB-TP05-C	0.5 – 0.7	Silty SAND (SM) Gravelly CLAY/SILT (GC)	-	-	-	-	17.4	-	-	-	-
HB-TP06-C	1.8 -1.9	Sandy SILT (ML)	9	43	36	12	16.4	33	24	9	2
	2.7 – 2.8	Sandy SILT (ML)	-	-	-	-	10.0	-	-	-	-
HB-TP07-C	0.35 – 0.5	Clayey GRAVEL (GC)	17	11	26	46	7.0	25	17	8	2.5
	1.8 – 2.0	Gravelly SAND (SP)	12	4	53	31	19.7	-	-	-	-
HB-TP08-C	1.0 – 1.2	Silty CLAY (CH)	56	32	12	0	57.5	76	38	38	11
	1.8 - 2.0	Silty CLAY (CH)	-	-	-	-	45.2	68	36	32	10
	2.8 - 3.0	Clayey SILT (MH)	-	-	-	-	38.2	54	31	23	6
HB-TP09-C	0.4 – 0.6	Silty Sandy CLAY (CI)	35	15	36	14	14	36	17	19	4.5
HB-BH01-C	1.0 – 1.45	Sandy SILT (CL)	46	42	12		16.3	-	-	-	-

Test Location	Sample depth (m)	Material description	Grading (%)				MC(%)	Atterberg limit			
			Fine		Coarse						
			Clay	Silt	Sand	Gravel		LL(%)	PL (%)	PI(%)	LS (%)
	1.5 – 1.80	CLAY (CL)	-	-	-	-	11.1	30	18	12	3.0
	2.0 -2.2	Sandy GRAVEL (GP)	12	8	39	41	11.2	-	-	-	-
HB-BH02-C	1.50 - 2.00	Silty CLAY (CL)	54		19	27	14.9	-	-	-	-
HB-BH04-C	2.5 – 2.88	Clayey Gravelly SAND (SP)	14	7	43	36	11.9	-	-	-	-
HB-BH05-C	1.0 – 1.45	Silty Sandy GRAVEL (GM)	15		39	46	7.2	-	-	-	-
HB-BH06-C	0.5 – 0.65	Silty GRAVEL (GM)	-	-	-		15.3	-	-	-	-
	1.5 – 1.95	Silty SAND (SP)	15		72	13	6.3	-	-	-	-
HBLF-BH01-C	0.5 – 0.75	SAND (SP)	0	1	99	0	4.3	-	-	-	-
	1.0 – 1.45	SAND (SP)	0		100	0	4.1	-	-	-	-
	2.5 – 2.95	Gravelly SAND (SP)	4		59	37	10.9	-	-	-	-
HBLF-BH02-C	0.5 – 0.75	SAND (SP)	0	1	99	0	4.6	-	-	-	-
	1.0 – 1.28	SAND (SP)	-	-	-		3.8	-	-	-	-

In addition to the standard classification testing additional specialist testing (i.e. Emerson Class number, CBR , triaxial (unconsolidated undrained), Direct Shear testing and aggressivity testing) were undertaken within the boreholes and test pits. The results of these tests are summarised in Table 4-13, Table 4-14 Table 4-14, Table 4-15, Table 4-16 and Table 4-17 respectively.

Table 4-13. Summary of Emerson Class Number test results.

Test Location	Sample Depth (m bgl)	Material Description	Emerson Class Number
HB- TP03-C	2.00 – 2.50	Clayey Sandy SILT (ML)	1
HB-TP06-C	1.80 – 1.90	Sandy SILT (ML)	1
HB-TP08-C	1.00 – 1.20	Silty CLAY (CH)	5

Table 4-14. Summary of CBR test results.

Test Location	Sample Depth (m bgl)	Material Description	Moisture Content (%)	CBR (%)	Maximum Dry Density (MDD) (%)	Swell (%)
HB- TP01-C	0.90 – 1.10	Silty GRAVEL (GP)	9.1	60	2.02	0.00
HB-TP02-C	0.80 – 1.00	Silty CLAY (CI)	12.3	20	1.79	0.00
HB-TP03-C	2.00 – 2.50	Clayey Sandy SILT (ML)	12.3	8	1.88	0.50

Test Location	Sample Depth (m bgl)	Material Description	Moisture Content (%)	CBR (%)	Maximum Dry Density (MDD) (%)	Swell (%)
HB-TP04-C	1.50– 1.90	Gravelly SAND (SP)	7.0	30	1.92	0.00
HB-TP05-C	0.50 – 0.70	Gravelly CLAY/SILT (CL-CI)	17.4	17	1.77	0.50
HB-TP06-C	1.80 – 1.90	Sandy SILT (ML)	16.4	4.5	1.88	2.50
HB-TP07-C	1.80 – 2.00	Gravelly SAND	19.7	60	1.64	0.00
HB-TP08-C	1.00 – 1.20	Silty CLAY (CH)	57.5	2.5	1.14	0.50
HB-TP09-C	0.40 – 0.60	Silty Sandy CLAY (CI)	14	7	1.75	1.00

Table 4-15: Summary of Triaxial (Unconsolidated Undrained) testing.

Test Location	Sample Depth (m bgl)	Material Description	Undrained Cohesion (S_u) kPa
HB-BH01-C	1.50 – 1.80	Clayey Sandy SILT (ML)	166

Table 4-16: Summary of Direct Shear testing.

Test Location	Sample Depth (m bgl)	Material Description	Cohesion (kPa)	Friction Angle (φ)
HB-TP02-C	0.90 – 1.10	Silty SAND	2.7	36.2
HB-TP04-C	1.50 – 1.90	Gravelly SAND	-1.7*	36.9
HB-TP07-C	1.80 – 1.20	Gravelly SAND	7.3	40.3
Note: *As reported in laboratory test certificates in Appendix E.				

Table 4-17: Summary of aggressivity testing.

Borehole ID	Sample Depth (m bgl)	Material Description	Electrical Conductivity (µS/cm)	pH	Chloride (Cl^-)	Sulphate (SO_4^{2-})	Moisture Content (%)	Resistivity (ohm*m)
HBLF-BH01-C	1.0 – 1.28	SAND (SP)	10	5.3	5.2	<30	4.4	320

4.6.2 Geotechnical Rock Testing

Rock samples collected during the field investigation were tested by Bamford Rock Testing Services (BRTS) laboratories for the measurements of moisture content, uniaxial compressive strength (UCS), Cerchar Abrasivity Index testing -and point load strength index (Is_{50}). Results of the outlined rock testing are summarised in Table 4-18, Table 4-19, and Table 4-20 with the corresponding laboratory test certificates also presented in Appendix E.

Table 4-18: Summary of rock UCS testing.

Borehole ID	Sample Depth (m bgl)	Rock Moisture Content (%)	Uniaxial Compressive Strength (MPa)	Rock Strength Class to AS1726-2017
HB-BH01-C	5.18 – 5.28	2.0	65.8	VH
	8.50 – 8.65	4.0	6.9	M
HB-BH02-C	4.60 – 4.77	1.5	4.6	L
HB-BH03-C	5.70 – 5.82	1.0	48	H
	9.37 – 9.47	1.2	6.6	M
HB-BH04-C	4.29 – 4.39	1.7	6.9	M
HB-BH05-C	8.24 – 8.41	2.0	14	M
HB-BH06-C	8.03 – 8.20	0.9	15	M
	11.15 – 11.32	0.4	15	M
HBLF-BH01-C	7.20 - 7.34	0.9	110	VH
	12.29 - 12.32	1.2	-	-
	16.40 - 16.54	1.3	12	M
	21.52 - 21.63	1.0	11	M
	29.28 - 29.45	1.2	9.0	M
HBLF-BH02-C	4.03 - 4.16	2.9	2.2	L
	11.06 - 11.18	3.1	14	M
	13.22 - 13.33	1.2	14	M
	23.82 - 23.95	2.1	14	M
	29.55 - 29.72	3.0	9.5	M

Refer to laboratory test results contained in Appendix E to assess the failure mode for each of the UCS test results undertaken on the samples listed in the table above.

Table 4-19: Summary or CERCHAR Abrasiveness Index (CAI) testing.

Borehole ID	Sample Depth (m bgl)	Mohs Hardness	CERCHAR Abrasivity Index (CAI)	Sandvik Mining Test Classification of CAI (2007)	ASTM D7625-10 Classification of CAI (2010)
HBLF-BH01-C	13.41 -13.46	5.5	5.5 ± 0.2	Extremely Abrasive	Extremely Abrasiveness
HBLF-BH01-C	25.97 – 26.02	3.8	1.0 ± 0.1	Moderately Abrasive	Medium Abrasive
HBLF-BH02-C	17.60 – 17.66	5.4	4.8 ± 0.1	Extremely Abrasive	Extremely Abrasiveness
HBLF-BH02-C	29.77 – 29.83	4.4	1.9 ± 0.1	Abrasive	Medium Abrasiveness

Table 4-20: Summary of Point Load Index (PLI) testing.

Borehole ID	Sample Depth (m bgl)	Diametral I_{s50} (MPa)	Axial I_{s50} (MPa)	Rock Strength Class (Diametral) to AS1726-2017	Rock Strength Class (Axial) to AS1726-2017
HB-BH01-C	3.77 – 3.83	1.4	-	H	-
	5.94 – 5.99	-	1.9	-	H
	6.07 – 6.12	-	0.35	-	M
	7.88 – 7.94	0.94	-	M	-
	11.14 – 11.19	-	0.59	-	M
HB-BH02-C	6.29 – 6.34	-	4.07	-	M
	6.34 – 6.40	0.28	-	L	-
	7.12 – 7.17	-	0.15	-	L
	8.39 – 8.45	1.0	-	M	-
HB-BH03-C	1.12 – 1.17	-	0.32	-	M
	2.40 – 2.46	1.4	-	H	-
	6.80 – 6.85	-	4.6	-	VH
	7.54 – 7.60	1.3	-	H	-
	8.17 – 8.22	-	1.9	-	H
HB-BH04-C	4.78 – 4.83	-	0.66	-	M
	8.64 – 8.69	-	1.4	-	H
HB-BH05-C	5.35 – 5.41	1.4	-	H	-
	7.40 – 7.45	-	0.13	-	L
	10.05 – 10.10	-	0.96	-	M
	10.10 – 10.16	1.0	-	M	-
HB-BH06-C	4.90 - 4.95	-	1.9	-	H
	6.60 – 6.65	-	3.2	-	VH
	13.07 – 13.12	-	4.0	-	VH
	15.29 – 15.34	-	3.7	-	VH
HBLF-BH01-C	6.90 – 6.95	-	6.9	-	VH
	9.38 – 9.43	-	5.0	-	VH
	12.32 – 12.37	-	12	-	EH
	16.84 – 16.90	0.6		M	-
	18.75 – 18.80	-	3.1	-	VH

Borehole ID	Sample Depth (m bgl)	Diametral I_{s50} (MPa)	Axial I_{s50} (MPa)	Rock Strength Class (Diametral) to AS1726-2017	Rock Strength Class (Axial) to AS1726-2017
	19.81 -19.86	-	0.36	-	M
	19.86 – 19.92	1.7		H	-
	25.77 – 25.87	0.42*		M	
	26.71 – 26.76	-	0.64	-	M
	27.32 – 27.37	-	4.0	-	VH
HBLF-BH02-C	3.90 – 3.95	-	2.1	-	H
	8.24 – 8.29	-	2.3	-	H
	10.82 – 10.87	-	7.2	-	VH
	16.05 – 16.10	-	4.9	-	VH
	17.30 – 17.36	1.3		H	-
	18.43 – 18.48	-	2.2	-	H
	24.17 – 24.22	-	0.77	-	M
	27.80 – 27.85	-	0.37	-	M
	28.68 – 28.74	0.35	-	L	-
	29.72 – 29.77	-	1.0	-	M

Notes:

Point Load Index Strength Classification (AS 1726-2017)

Very Low (VL): Is(50) = 0.03 MPa – 0.1MPa
Low (L): Is(50) = 0.1 MPa – 0.3 MPa
Medium (M): Is(50) = 0.3 MPa – 1.0MPa
High (H): Is(50) = 1.0 MPa – 3 MPa
Very High (VH): Is(50) = 3 MPa – 10 MPa
Extremely High (EL):Is(50) = >10 MPa

*Irregular point load test undertaken

5. Contaminated Land Investigation

This section details the works and results of a targeted contaminated land investigation undertaken at the Heybridge Converter Site. This investigation focused on the converter site at locations collocated with the geotechnical investigation test pits and boreholes Appendix A. The land fall site was not investigated as part of this study as it was considered as part of the historic operations on the converter sit and as such a low contamination risk.

Nine test pits were excavated using a Kobelco SK135 13.5t excavator equipped with a 450mm digging bucket fitted with teeth attachments at nine (9) locations. Soil samples were collected at each test pit at predetermined depths of 0.1, 1, 1.5, 2 and 3 mbgl. The exception being test pits HB-TP01-C, HB-TP05-C, and BH-TP09-C where refusal was met at 1.6, 1.1, and 1.4 mbgl. Test pits logs are presented in Appendix B.

Boreholes were advanced using mechanical drilling using a Hanjin D&B-8D tracked drill rig supplied and operated by Tasmanian Drilling. Auger drilling within the upper substrata was undertaken using hollow flight augers and rock coring undertaken using HQ3 diamond coring equipment. The boreholes were advanced to depths between 8.5 and 15.4 m bgl. Five (5) groundwater wells were installed at the borehole locations HB-BH01-C, HB-BH02-C, HB-BH03-C and HB-BH06-C including a shallow nested borehole HB-BH06-C(S) for contaminated land and hydrogeological analysis. Borehole logs are presented in Appendix B

Soil samples were collected during the investigation directly from test pit walls where safely accessible. Where not safely accessible, samples were collected from the excavator bucket when the appropriate depth was achieved. Samples were collected utilising a hand trowel while wearing disposable nitrile gloves changed between collection of each. Hand tools were also cleaned with Lquinox PFAS free decontamination solution. Samples were placed directly into laboratory supplied jars and bags as required.

Soil samples during borehole advancement were collected from the auger or from the U63 tube utilising a hand trowel while wearing disposable nitrile gloves changed between collection of each. Hand tools were also cleaned with Lquinox PFAS free decontamination solution. Samples were placed directly into laboratory supplied jars and bags as required.

All soil samples were sealed and placed on ice in portable coolers in the field and were submitted to the laboratory under chain-of-custody protocols.

Australian Laboratory Services (ALS) was selected as the primary laboratory to conduct soil analysis for the contamination investigation. ALS is accredited by the National Association of testing Authorities (NATA) for the analyses undertaken. Quality Assurance/Quality Control (QA/QC) procedures were applied during the investigation, and the QA/QC results are discussed in Section 5.7 below. Eurofins was selected as the secondary laboratory for analysis of inter laboratory samples.

Excavated material from the test pits was screened for the presence of volatile organic compounds using a photoionisation detector (PID). Screening was performed on freshly excavated material using an extension fitting provided with the PID. In addition to this radiation screening was also carried out utilising calibrated radiation detectors. The PID and radiation detector calibration certificates are provided in Appendix G

In addition to soil sampling five groundwater samples were collected from boreholes HB-BH01-C, HB-BH02-C, HB-BH03-C, HB-BH06-C and HB-BH06-C(S). Samples were collected post well development with purge volumes recorded for each well on the well development forms Appendix D. Following well development, hydrasleeves were deployed and left-over night to collect water from the screen interval. The hydrasleeves were collected with the sample water decanted into laboratory supplied containers for dispatch and analysis. Field measurements were collected using a calibrated YSI multiprobe.

5.1 Adopted Assessment Criteria

5.1.1 Onsite Soil Retention / Exposure to Workers

The following on-site soil retention/exposure to workers screening criteria were adopted for the investigation:

- Health Investigation Level (HIL) D (Commercial/Industrial), sourced from NEPM Schedule B1 Table 1A(1)
- Health Screening Level (HSL) D (Commercial/Industrial), for Sand, sourced from NEPM Schedule B1 Table 1A(3)
- CRC CARE Technical Report No.10: Health screening levels for petroleum hydrocarbons in soil and groundwater, sourced from Friebel & Nadebaum (2011) Tables A.3 and A.4
- Ecological Investigation Level (EIL) – (Commercial/Industrial), aged contamination, generic values sourced from NEPM Schedule B1 Table 1B(1-5)
- Ecological Screening Level (ESL) – (Commercial/Industrial) coarse textured soil, applicable from 0-2 m depth, sourced from NEPM Schedule B1 Table 1B(6)
- Management Limits (ML) – (Commercial/Industrial), coarse textured soil, sourced from NEPM Schedule B1 Table 1B(7).
- Health Investigation level (HIL) D – (Commercial/Industrial) PFAS, sourced from PFAS NEMP 2020 Table 2
- EPA Tasmania IB105, Table 2, Fill Material (Lvl 1) Max Total Conc.
- EPA Tasmania IB105, Table 2, Low Lvl Contam Soil (Lvl 2) Max TCLP Leach Concentration
- EPA Tasmania IB105, Table 2, Low Lvl Contam Soil (Lvl 2) Max Total Conc.

The NEPM (2013) does not designate investigation criteria specifically applicable for short-duration exposures to contaminants in soils (by direct contact, ingestion or inhalation) for construction workers including during intrusive and excavation works. Both sand and clay soils were identified across the site therefore coarse textured soil/sand were adopted as a conservative approach.

Jacobs have adopted investigation levels for commercial/industrial premises (HIL D) for the purpose of screening for potential health risk to construction workers. Jacobs considers HILs D, which assumes an exposure period of 30 years, may be conservative (considering works are unlikely to be undertaken continuously for 30 years) and reasonably applied as Tier 1 screening levels (comparison of site data against generic investigation levels and/or screening levels for the protection of human health) for assessing potential health risk to construction workers.

The NEPM (2013) does not designate investigation criteria specifically applicable for short-duration exposures to contaminants in soils (by direct contact, ingestion or inhalation) for construction workers including during intrusive and excavation works. With respect to petroleum hydrocarbons, HSLs have been developed for to assessing human health risk via the inhalation and direct contact pathways. The HSLs depend on specific soil physio-chemical properties, land use scenarios, and the characteristics of building structures. They apply to different soil types, and depths below surface to >4 metres. Both sand (coarse grained) and clay (fine grained) soils were identified across the site. As a conservative measure, coarse textured soil HSLs have been adopted.

Health Screening Levels (HSLs) for vapour intrusion and direct contact exposure pathways to intrusive maintenance worker (shallow trench) from Tables A.3 and A.4 of CRC CARE Technical Report No.10: Health screening levels for petroleum hydrocarbons in soil and groundwater (Friebel & Nadebaum 2011) have also been adopted for screening purposes to assess the potential health risk to on-site workers during construction.

Ecological investigation levels (EIL) and ecological screening levels (ESL) for commercial/industrial premises from NEPM (2013) were adopted to identify potential risks to terrestrial ecosystems should the soil be reused onsite.

Management Limits (MLs) are maximum values that should remain on a site following evaluation of human health and ecological risks and risks to groundwater resources. MLs apply to all soil depths based on site-specific considerations which consider the formation of phase separated hydrocarbons, fire and explosion risks, damage to buried infrastructure and aesthetics. ML were adopted from NEPM (2013).

5.1.2 Asbestos

The NEPM (2013) provides health based screening levels for different forms of asbestos contamination in soil. To apply these screening levels, significant investigations, excavation and sample volumes are required to assess the volume of asbestos relative to soil. Jacobs have adopted a high level criterion to assess the presence / absence of asbestos in soil samples and to determine whether additional investigations are required to assess the risk to site users. The high level criterion adopted by Jacobs is no detectable asbestos in soil samples and/or no potential asbestos in any form observed on surface soils and in excavated materials.

5.1.3 Acid Sulfate Soils (ASS)

Jacobs have adopted the Acid Sulfate Soils Management Advisory Committee (ASSMAC) assessment guidelines for the purpose of evaluating analytical results and quantitative analysis conducted for ASS/PASS. The ASSMAC criteria (1998) outlines the best practice in assessing the impacts of proposed works in areas which are considered to potentially contain ASS. Jacobs have provided a conservative approach to implementing the action criteria by assuming a soil disturbance of greater than 1000 tonnes. The criteria is defined as:

- ASSMAC Table 4.4 Action Criteria Based on ASS Soil Analysis for Three Broad Texture Categories, 1998

5.1.4 Groundwater

The following criteria was adopted as a part of the groundwater assessment:

- ANZG (2018) Marine water 95% toxicant DGVs

The ANZG Water Quality Guidelines (2018) provide authoritative guidance on the management of water quality for natural and semi-natural water resources in Australia and New Zealand. Jacobs has adopted the 95% Marine water criteria based on the proximity and anticipated groundwater flow direction towards the ocean.

5.2 General Site Information

The following information is based on site observations made during the field investigation program undertaken between 24 January to 16 February 2022. Vehicular access to the site is gained through Minna Road, Heybridge. The site extent is enclosed by the Bass Highway form the north and Minna Road from the east. The site is fenced off and is not accessible to the public. Located in the northern-eastern section of the site as well as the access road running north-south down its center (i.e. the proposed location of the Oily Wastewater Management System). The northern fence line of the site lies parallel to the Bass Hwy whilst the southern fence line is situated at the toe of a mountainous landscape. A gentle north westerly slope is observed within the overall site.

Table 5-1: General Site Information/ Site Inspection

Item	Details
Site Layout	The converter station site is currently vacant and is known as the former Tioxide Factory site as it was previously used as a Tioxide (paint) factory and a lumber yard. There is significant history of disturbance and potential contamination present at the site due to its previous land use, including naturally occurring radioactive materials (NORM). The general site area is cleared with remnants of roadways and previous infrastructure e.g concrete footings.
Surface condition	The investigation area is surfaced predominantly with compacted gravelly clayey sand fill material with minor paved sections. There are minor vegetated areas on the site and towards the norther western site boundary, there is a small approximately 10 – 20 cubic meter water detention pond.
Other observations	▪ The site is situated directly opposite the Bass Highway to the north, and is bound by the steeply rising terrain to the south and west. ▪ A minor water diversion drain /channel was present at the site. Water was directed to an old unlined detention pond. ▪ Groundwater was encountered at approximately 1 to 5 mbgl.
Evidence of soil disturbance	The entire surface of investigation area was observed as being overlain by fill material. No stockpiling of fill or other materials was observed on site.
Evidence of contamination	▪ There is significant history of disturbance and potential contamination present at the site due to its previous land use, including naturally occurring radioactive materials (NORM). Remnants of the old paint factory such as concrete footings and reinforcement was observed within the site.

5.3 Soil Investigation Locations

Thirteen (13) targeted soil sampling locations were identified to target the proposed construction footprint. This includes a combination of four (4) boreholes and nine (9) test pits at the site. The positions of the sample locations are provided in Appendix B.

The soil investigation program involved collection of soil samples from the sampling locations. Details of the soil samples collected (location and depth) are provided in Table 5-2 below.

Table 5-2: Sample location and sample depth

		Sample Collection Depth (mbgl)					
	Locations	**0.1**	**0.5**	**1**	**1.5**	**2**	**3**
Boreholes	BH01	x	x			x	
	BH04	x		x	x	x	
	BH05	x	x	x			
	BH06		x	x		x	
Test Pits	TP01	x	x	x			
	TP02	x	x	x		x	
	TP03	x	x	x			x
	TP04	x	x	x			x
	TP05	x	x	x			
	TP06	x	x	x			
	TP07	x	x	x			
	TP08	x	x	x			x
	TP09	x	x				

Details of the soil sampling analysis suite, with an accompanying legend, is provided in Table 5-3 below.

Table 5-3: Sample location and scheduled analytical suite

		Sample Collection Depth (mbgl)					
	Locations	**0.1**	**0.5**	**1**	**1.5**	**2**	**3**
Boreholes	BH01	A,D,G	B,C,G			A	
	BH04	A,G		G	A,C,F	A,B,C,F	
	BH05	C,G	A,E	A,B,G			
	BH06		C,G	A		A,B,G	
Test Pits	TP01*	A,B,D,G	C,F,G	A,E			
	TP02	G	A,B	C,F,G		A	HOLD
	TP03	C,G	G	A,E		F	A,B
	TP04*	A,G	C	F,G			A,B
	TP05	G	A,B,E	C,G			
	TP06	C,G	F,G	A,B		HOLD	HOLD
	TP07	A,B,E,G	C	G		HOLD	HOLD
	TP08	G	A,G	C		F	B

Sample Collection Depth (mbgl)							
	TP09*	C,F,G	HOLD	A,B			

*QAQC parent sample

Note: Potential Asbestos Containing Materials (PACM) samples include TP01, TP02 and TP09

Table 5-4 – Soil Analytical Suite Key

Key	Analytes
A	Metals: ▪ Arsenic, Boron, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Manganese, Nickel, Lead, Selenium, Titanium, Vanadium, Zinc, Mercury Hydrocarbon compounds: ▪ Total Recoverable Hydrocarbons (TRH), Polycyclic Aromatic Hydrocarbons (PAH), Benzene, Toluene, Ethylbenzene, Xylene (BTEX)
B	▪ pH, chloride, sulfate, electrical conductivity, resistivity
C	▪ Total cyanide, Volatile Organic Compounds (VOCs), semi-Volatile Organic Compounds (sVOCs), Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS), Organochlorine Pesticides (OCPs), Polychlorinated biphenyls (PCBs), total Phenols
D	▪ pH, cation exchange capacity, % clay
E	▪ Leachable Metals, Polycyclic Aromatic Hydrocarbons (PAH), Organochlorine Pesticides (OCPs), Polychlorinated biphenyls (PCBs), total Phenols and total Cyanides - (TCLP/ASLP)
F	▪ Laboratory pH, Oxidised pH, SPOCAS
G	▪ Asbestos

5.4 Groundwater Investigation Locations

Four (4) of the soil bores were converted into groundwater wells and further groundwater sampling and analysis was conducted. These locations include BH01, BH02, BH03 and BH06. BH06 was installed as a nested well site, with BH06-C(S) being the shallow well. The shallow well was installed at this location to capture shallow water in the clay profile. The positions of the sample locations are provided in Appendix AF.

The groundwater investigation program involved collection of samples from the monitoring wells. Identical analysis suites were completed for all the groundwater samples collected. The groundwater analytical suite comprised the following:

- pH, Total Dissolved Solids (TDS), major cations and anions
- Ammonia, nitrite, nitrate, total nitrogen
- Total cyanide, free cyanide
- Sulfate, sulfide
- Dissolved metals (Arsenic, Boron, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Manganese, Nickel, Lead, Selenium, Titanium, Vanadium, Zinc)
- Volatile Organic Compounds (VOCs), semi-Volatile Organic Compounds (sVOCs)
- Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS),
- Corrosivity (including electrical conductivity and resistivity).

5.5 Field Observations

The surface fill material observed across the site during the investigation comprised predominantly of brown, medium to coarse grained, subangular, dense, slightly moist gravelly clayey sand. After 0.1mbgl the clay content of this fill material increased, changing to a pale brown, medium to coarse grained, subangular, dense, dry, clayey sand with gravel. The residual weathered material differed in the north-eastern portion of the site (an area absent of infrastructure), was overlain with a silty sand topsoil that was dark brown with rootlets and gravel, fine to coarse grained, angular, loose and moist. No visual or olfactory indicators were observed in the soil samples collected or in the materials excavated from the investigation locations.

Natural soils were reached across the site at depths ranging between 0.3 - 1.5mbgl. The geological unit was identified as being weathered clays and siltstone; the shallower of these included fine to coarse grained, subangular, moist clayey and silty sands of variable colours, as well as grey, very stiff, moist to wet, low plasticity silts with clay and sand. Deeper soils within the profile (>1.7mbgl) were mostly clays, identified initially as being a yellow-brown mottled grey, low to medium plasticity, very soft to soft, moist sandy clay. Deeper into the profile this material gradually decreased in sand content, increased in plasticity and stiffness, and changed in colour to a grey mottled orange-brown.

Groundwater was encountered at approximately 1 to 3 mbgl across the site. Following development groundwater was clear with minor silty odors present in all wells. This odour is believed to be a result of the siltstone/mudstone formation the wells were screened in. with a Further information regarding groundwater and well installation is detailed in Section 4.

Detailed bore logs for all test locations can be found in Appendix B.

A fragment of asbestos containing material was found at the surface of TP09, laboratory results indicate that it was an asbestos sheeting fragment. This was likely residual left on site from historical demolition works.

5.6 Soil Vapour Screening Results

All samples collected during the investigation were screened for the presence of volatile organic compounds (VOC) and were generally accompanied with low soil vapour readings. Soil vapour readings ranged between 0 ppm to 0.4 ppm. The soil vapour field results for each investigation location are provided in the test pit logs Appendix B.

5.7 Naturally Occurring Radioactive Material (NORM)

The Heybridge site was selected in the late 1940's to host a factory producing titanium dioxide pigment from ilmenite mined in the Capel area in WA. Titanium dioxide (TiO2) was produced by the sulphate process in Burnie, with the being decommissioned in 1996 (TasNetworks Radiation Management Plan; 2021).

NORM (uranium (U238), thorium (Th232) and their decay products) occurs in titanium ore at various concentrations. As the ore is processed, U238 and Th232 is concentrated and can exceed the regulatory exemption levels in waste materials such as mineral sludges, dusts and sands from the titanium extraction process.

During test pit excavation and borehole advancement, NORM measurements were taken at regular intervals in accordance with the Radiation Management Plan 2021. Site measurements were recorded on the test pit log sheets. Background radiation levels for the site were found to range from approximately 41 nSv/hr to 73 nSv/hr. Readings from test pits and boreholes were found to be within the background radiation levels and below trigger values trigger levels were defined as > than two times background radiation levels. Specific readings recorded during test pit excavation and borehole advancement ranged from 43 nSv/hr through to 115 nSv/hr. The highest measured reading of 115nSv/hr was found in TP01 at a depth of 1 mbgl.

5.8 Acid Sulfate Soils

5.8.1.1 Field Testing

ASS samples were collected opportunistically from TP01, TP02, TP03, TP06 and BH04 with field testing analyses detailed in Table 5-5 below. Indicators of PASS / ASS are summarized as follows:

- **Field indicators of ASS presence** include a field pH of equal to or less than 4 units ($pH_{FIELD} \leq 4$);
- **Field indicators of PASS presence** include relatively neutral field pH values (pH_{FIELD} ~ 7) coupled with:
  - A pH drop ($\Delta pH = pH_{FIELD} - pH_{FOX}$) of greater than 2 units ($\Delta pH > 2$); and
  - To a much lesser extent, a Strong or Extreme reaction rate; and
- **Strong field indicators of PASS presence** include an oxidised field pH of less than or equal to 4 units ($pH_{FOX} \leq 4$).

Table 5-5 Summary of Acid Sulfate Soil Test Results

Location Code	Field ID	Sample Depth (m)	Soil Description	pH_{FIELD}	pH_{FOX}	Δ pH	Reaction Rate
TP01	HB-TP01-C-0.5	0.5	Silty CLAY	3.7	2.0	1.7	2
TP02	HB-TP02-C-1	1	Silty CLAY	4.6	2.7	1.9	3
TP03	HB-TP03-C-2	2	Clayey Sandy SILT	6.3	4.0	2.3	2
TP06	HB-TP06-C-0.5	0.5	Silty CLAY	5.6	3.0	2.6	2
BH04	HB-BH04-C-2	2	Clayey Sandy SILT	7.1	4.7	3	3

Notes: Field indicators of ASS/PASS shown in orange. Strong Field indicators of ASS/PASS shown in red.

The ASS field testing of the Heybridge site exhibits strong evidence of PASS presence through large pH reductions (upon oxidation) with no samples recording neutral or close to neutral pH_{fox} results. All samples, excluding HB-TP03-C-2 and HB-BH04-C-2, exhibit pH_{fox} values of <4. The largest pH reductions were seen in samples HB-BH04-C-2 and HB-TP06-C-0.5, which both reported pH reductions of 3 and 2.6 respectively.

5.8.1.2 SPOCAS Testing

Locations TP01, TP02, TP03, TP06 and BH04 were subjected to further SPOCAS analysis. The results of this data are summarised below in Table 5-6.

Table 5-6 SPOCAS Results

Location Code	Field ID	Sample Depth (m)	Soil Description	Net Acidity without ANCE (%S)	Liming Rates ($kgCaCO_3/t$)
TP01	HB-TP01-C-0.5	0.5	Silty CLAY	0.096	4
TP02	HB-TP02-C-1	1	Silty CLAY	-	-
TP03	HB-TP03-C-2	2	Clayey Sandy SILT	-	-
TP06	HB-TP06-C-0.5	0.5	Silty CLAY	-	-
BH04	HB-BH04-C-2	2	Clayey Sandy SILT	0.035	2

*Net acidity units converted from the reported mole H^+/t to %S using the guidance outlined in the *Acid Sulfate Soils Laboratory Methods Guidelines, 2004*

- indicates a non-detect

5.9 Soil Analytical Results

A total of thirteen (13) primary samples were selected for analysis. Results were compared to adopted assessment levels with respect to risk to human and ecological health (i.e. for consideration of onsite reuse and construction worker protection) and waste soil classification (i.e. for preliminary consideration for offsite disposal).

Soil sample results are presented with adopted assessment criteria in Appendix F. Corresponding soil laboratory analysis reports are provided in Appendix G.

5.9.1 Protection of Construction Workers/ Onsite Reuse Options for Excavated Spoil

To assess the potential for the excavated soil to be reused onsite the results were compared to the guidelines described in Section 5.1.

All soil results were below the adopted health, ecological and management limit guideline values.

All PFAS analytes which were assessed yielded concentrations below the laboratory levels of reporting (LOR) and were below the adopted NEMP (2020) screening criteria.

Asbestos was not detected in any sample submitted for laboratory asbestos identification. Synthetic mineral fibers were detected in fill material sampled from TP01 and TP02 at depths of 0.1m and 0.9m respectively. Opportunistic grab samples were also collected for suspected PACM material observed at the site. An opportunistic grab sample of PACM observed in fill material within TP09 at surface, was found to contain asbestos.

5.10 Offsite Disposal Options for Excavated Spoil

To evaluate offsite disposal options, the results of the soil samples were compared to the EPA Tasmania Material Level 1, EPA Tasmania Level 2 Max TCLP Leach concentration.

The majority of soil samples were within the publication threshold ranges for classification as ‘Fill Material’, with the exception of the following:

- Exceedances of EPA Tasmania IB105, Table 2, Fill Material (Lvl 1) Max Total Conc. for Arsenic (23mg/kg) at BH06-1, Manganese (1,640mg/kg) at TP07-0.1, Nickel (84mg/kg) at BH01-01, Zinc (230mg/kg) at TP05-0.5 and TPH C10-C36 Sum of Total (1050mg/kg) at BH01-01

All other soil results were below the Fill Material Level1 maximum soil concentration.

With reference to ASS/PASS, there are two minor exceedances of the net acidity (excluding ANCE) ASSMAC 1998 action criteria, as detailed below.

- HB-TP01-C-0.5 (0.096 %S)
- HB-BH04-C-2 (0.035 %S)

While these are identified as an exceedance, they are considered conservative as this result is derived from the SPOCAS analysis.

Organic matter is usually present in ASS materials, ranging from minor amounts in some sands to extremely high levels in peats. The presence of organic sulfur in many ASS materials represents a potential interference to some of the analytical methods. Organic sulfur compounds are generally not considered to pose a significant environmental acidity hazard in contrast to RIS compounds such as pyrite. It has long been established that concentrated H2O2 can extract organic sulfur. The non-specificity of this reaction in the SPOS method for estimating soil RIS content can lead to overestimation of pyrite concentrations in ASS materials (for example Sullivan et al. 1999).

5.11 Groundwater Analytical Results

A total of four (5) primary samples were selected for analysis. Results were compared to adopted assessment levels with respect to risk to the ANZG marine water 95% toxicant DGVs.

Groundwater sample results are presented with adopted assessment criteria in Appendix F. Corresponding laboratory analysis reports are provided in Appendix G.

The majority of groundwater samples were within the publication ANZG Marine Water guidelines, with the exception of the following:

Table 5-7: Groundwater Exceedances

Location	ANZG (2018) Marine Water 95% Toxicant DGVs Exceedance	Cobalt ug/L	Copper ug/L	Zinc ug/L
HB-BH01-C	Cobalt, Zinc	18		50
HB-BH02-C	Cobalt, Copper, Zinc	5	8	34
HB-BH03-C	Cobalt, Zinc	13		22
HB-BH06-C	Cobalt, Copper, Zinc	13	5	57
BH-BH06-C (s)	Cobalt, Copper, Zinc	2	3	48

The field parameter results, recorded at the time of sampling, for each groundwater well are presented in Table 2-1 below.

Table 5-8: Field Parameters

Location	Temperature (C)	pH	DO (%)	ORP (mV)	EC (uS/cm)
HB-BH01-C	22.2	5.49	16.2	78	1291
HB-BH02-C	22.9	6.55	23.9	375.9	756
HB-BH03-C	20.5	5.76	36	298	359
HB-BH06-C	21.1	5.6	52	284.3	369.4

Field parameter results indicate that the shallow groundwater is mildly acidic, the positive ORP measurements found in all wells show that the water has an oxidising potential. The recorded EC values are relatively fresh to brackish with the highest EC value recorded in well HB-BH01-C, the closest well to the ocean. This may indicate that there is possible ocean and groundwater interaction.

5.12 Quality Assurance Quality Control

It is considered that the QAQC program was in general accordance with recommended good practice (e.g. Australian Standard AS4482.1-2005). Overall, the program was adequate considering the scope and nature of the overall assessment program undertaken. The data is considered sufficiently reliable for the purpose for which it has been obtained and used.

All reasonable effort was made to limit potential smearing, cross contamination, or loss of volatile contaminants during this sampling. The selective and targeted nature of this (or any other investigation program) where limited sampling is conducted, means that there is a degree of uncertainty in the conclusions drawn from the data obtained.

Assessment of data quality is summarised in Table 5-9.

Table 5-9: Investigation Data Validation

Requirement	Samples
Quality Assurance/Quality Control (QA/QC) field samples	Five duplicate samples and 4 triplicate samples were collected in the field for soil samples. One Water sample duplicate. All RPD values reported below the acceptable criteria with the exceptions of lead, mercury and manganese in selected samples. The elevated RPD is assumed to be related to the heterogenous nature of the fill and that duplicate samples cannot be homogenised in order to maintain the volatile components of the respective sample. The elevated RPD is considered to not affect the useability of the data set. The collected QA/QC samples meet the >5% criteria.
Sample preservation	The selection of appropriate sample containers, preservation procedures, storage requirements and holding times were in accordance with those recommended within Australian Standards (AS/NZS 5667.1:1998; AS 4482.1 and AS 4482.2). During sampling, soil jars were filled as reasonably practicable to minimise headspace.
Sample temperature	The samples were delivered to the primary laboratory in one batch (laboratory work order EM2202101and EM2202619 and to the secondary laboratory in a separate batch (laboratory work order 836467) and were received at 4.75°C and with ice present.
Samples delivered to laboratory within holding times	Holding time breaches occurred for work order EM2202101 theses breaches meant samples analysed for TPH, PCB, Pesticides, Nutrients, Organics pH and EC were outside of laboratory recommended holding times. Holding time breaches were also recorded for EM2202619 with analysis of pH, EC, VOC semi volatile TRH fractions analysed outside of laboratory recommended holding time. While there were exceedances in holding times with respect to the analytes noted above, the reported results are considered applicable for use. This is due concurrent field observations and measurements taken at the time of sampling. PID values were measured in only minor concentrations. No olfactory indicators where noted. Field measurements of groundwater at the site did not record pH and EC values outside of an expected range.
Laboratory QA/QC	The following results were recorded: No Method Blank value outliers occurred No Laboratory Control outliers occurred No Matrix Spike outliers occurred No Quality Control Sample Frequency outlier existed

Based on the data validation results described in Table 5-9, the data collected during the soil sampling and laboratory analysis is considered suitable for assessment of site contamination (to the limit of this investigation). QAQC checklist results are provided in Appendix F.

5.13 Conclusion

While all samples were below the adopted health, ecological and management limit guideline values, a surface fragment of asbestos sheeting found at TP09. This fragment was considered non friable given this positive find, there is the potential that further fragments may be exposed during intrusive site works, as such an unexpected finds procedure is recommended to developed covering site works. As a minimum an unexpected find procedure would address the following:

- Requirement for additional samples may be collected from strata identified as potentially contaminated based on visual or olfactory evidence.
- Any suspected asbestos fragments will be collected to determine the presence/absence of asbestos contamination at the investigation area. Soil grab samples (approximately 50 g) and fragments will be placed into individual laboratory supplied bags and labelled accordingly for analysis.

While indicators of ASS were found at the site in low to moderate concentrations, these values may be overestimated due to the reporting method extracting organic sulfur. The presence of organic sulfur in many

ASS materials represents a potential interference to some of the analytical methods. Organic sulfur compounds are generally not considered to pose a significant environmental acidity hazard in contrast to compounds such as pyrite. Pending final excavation volumes, development of an Acid Sulfate Soil Management Plan may be required.

6. References

- Cromer, William C., 2007, Contamination Assessment, former Tioxide factory site, Heybridge
- Department of Infrastructure, Energy and Resources (DIER), 2006a, Northwest Tasmania Groundwater Map, https://nre.tas.gov.au/Documents/NW-groundwater-map.pdf
- Department of Infrastructure, Energy and Resources (DIER), 2006b, Northwest Tasmania Groundwater Quality Map, https://nre.tas.gov.au/Documents/NW-groundwater-map---quality.pdf
- Department of Natural Resources and Environment Tasmania (DNRET), The Groundwater Information Access Portal, accessed October 2021, https://wrt.tas.gov.au/groundwater-info/
- Mineral Resources of Tasmania (MRT), 2012, Digital Geological Atlas 1:25 000 Scale Series Burnie, Sheet 4045 https://www.mrt.tas.gov.au/mrtdoc/map_catalogue/map_public/898079_2/burnie25.pdf
- Site Geology Overlay extracted from the 1:25,000 Geological map of Northwest Tasmania (2017), Department of State Growth. Overlay map courtesy of Microsoft Corporation, TomTom (2022).
- Standards Australia, 2017. AS1726-2017: Geotechnical Site Investigations
- Standards Australia, 2003. AS1289.5.1.1-2003: Methods of testing soils for engineering purposes

Appendix A. Figures

Appendix A1. Site location Plan

Layer

GI Locations

⊕	Completed Geotechnical and Contaminated Land Borehole
⊕	Completed Geotechnical Borehole
●	Completed Groundwater Well
●	Completed Geotechnical and Contaminated Land Borehole/Completed Groundwater Wells
■	Completed Geotechnical and Contaminated Land Test Pit

N

GDA2020 MGA Zone 55
A3 Scale: 1:2,000

0 20 40 60 80
m

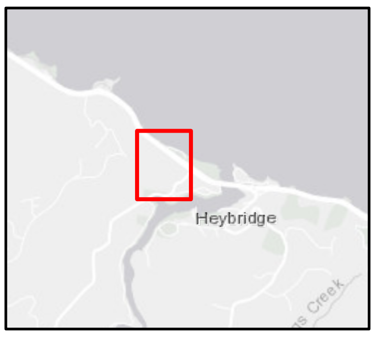

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Fig 1 Site Location Plan

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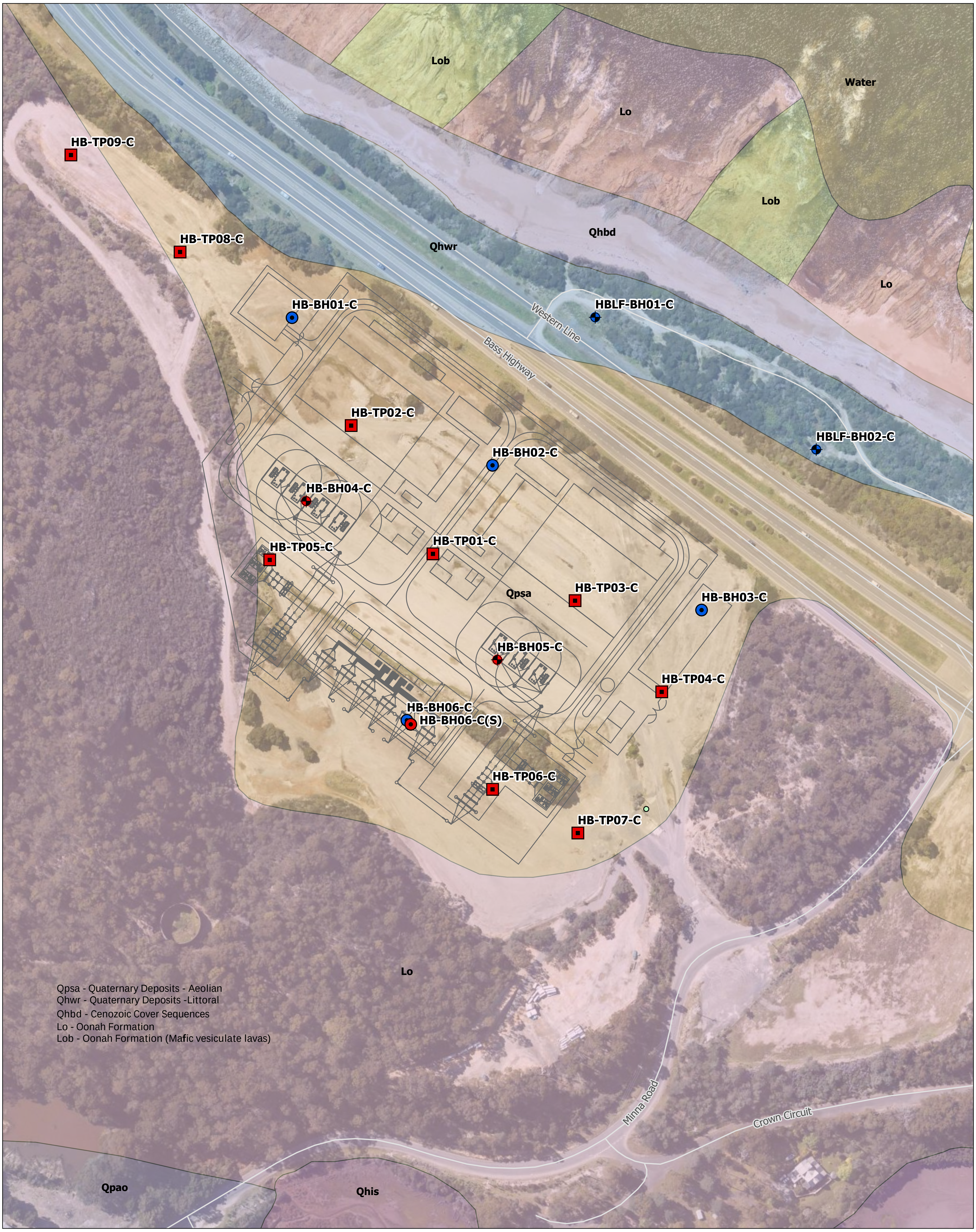
21/03/2022 3:51 PM CallosJG \\ausyd0vs01\GISProj\TAS_IS360304_Marinus\SO_44_NWTD_Geotechnical_Investigation\Apps\ArcPro\Figures\Heybridge\SFig1.aprx

Appendix A2. Site Geology Plan



Layer

GI Locations

⊕	Completed Geotechnical and Contaminated Land Borehole
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N

GDA2020 MGA Zone 55
A3 Scale: 1:2,000

0 20 40 60 80
m

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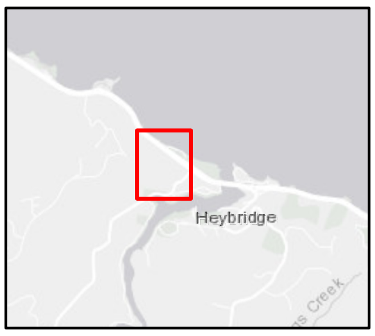

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Fig 2 Regional Geology

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Appendix B. Engineering Logs

Appendix B1. Explanatory Notes

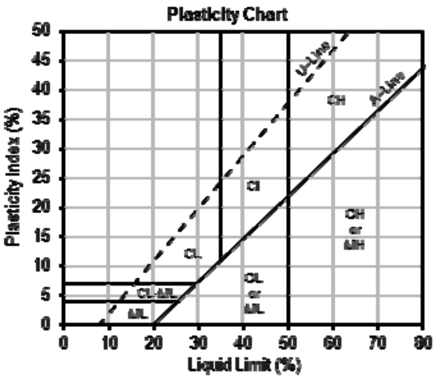
Soil Description

MATERIAL DESCRIPTION

Soil description is based on an assessment of disturbed samples, as recovered from boreholes and excavation, and from undisturbed materials as seen in excavation and exposures or in undisturbed samples.

CLASSIFICATION

Soils are described in general accordance with AS1726-2017 and the Unified Soil Classification (USC) as shown below.

<table>
<tr><th colspan="5">Field Identification procedures
(Excluding particles larger than 63 mm and basing fractions on estimated mass)</th><th>Code</th><th>Typical Names</th><th>Describing Soils</th><th colspan="4">Laboratory Classification Criteria</th></tr>
<tr><td rowspan="8">COARSE GRAINED SOILS
More than 65% of material less than 63 mm is larger than 0.075 mm</td><td rowspan="4">GRAVELS More than 50% of coarse fraction is larger than 2.36 mm</td><td rowspan="2">CLEAN GRAVELS
(Little or no fines)</td><td colspan="2">Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength</td><td>GW</td><td>Well graded gravels, gravel-sand mixtures, little or no fines</td><td rowspan="8">Give typical name, symbol, indicate approximate % of sand and gravel, maximum size, angularity, surface condition, and strength of coarse grains: colour, amount plasticity of fine component.
For undisturbed soils add information on moisture content, degree of compactness, stratification, cementation, and odour.
Give local and other pertinent descriptive information.
Example:
SILTY SAND (SM), fine to coarse, light grey, about 20% strong angular gravel particles – 10mm max. size, rounded and sub-angular sand, about 12% non-plastic fines, moist, dense alluvial sand.</td><td rowspan="17">Use grain size curve in identifying the fractions as given under field identification</td><td rowspan="8">Determine percentages of gravel and sand from grain size curve
Depending on percentage smaller than 0.075 mm size coarse grained soils are classified as follows:
Less than 5%
GW, GP, SW, SP
More than 12%
GM, GC, SM, SC
5% to 12%
Borderline cases requiring use of dual symbols</td><td colspan="2">Greater than 4 Between 1 & 3
$c_u = \frac{D_{60}}{D_{10}}$ $c_c = \frac{(D_{30})^2}{D_{10} x D_{60}}$</td></tr>
<tr><td colspan="2">Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength</td><td>GP</td><td>Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels</td><td colspan="2">Not meeting all gradation requirements for GW.</td></tr>
<tr><td rowspan="2">GRAVELS WITH FINE
(Appreciable fines)</td><td colspan="2">‘Dirty’ materials with excess of non-plastic fines, zero to medium dry strength</td><td>GM</td><td>Silty gravels, gravel-sand-silt mixtures</td><td>Atterberg limits below ‘A’ line or PI less than 4</td><td rowspan="2">Above ‘A’ line with PI between 4 and 7 are borderline cases requiring use of dual symbols.</td></tr>
<tr><td colspan="2">‘Dirty’ materials with excess of plastic fines, medium to high dry strength</td><td>GC</td><td>Clayey gravels, gravel-sand-clay mixtures</td><td>Atterberg limits above ‘A’ line with PI greater than 7</td></tr>
<tr><td rowspan="4">SANDS More than 50 % of coarse fraction is smaller than 2.36 mm</td><td rowspan="2">CLEAN SANDS
(little or no fines)</td><td colspan="2">Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength</td><td>SW</td><td>Well graded sands, gravelly sands, little or no fines</td><td colspan="2">Greater than 6 Between 1 & 3
$c_u = \frac{D_{60}}{D_{10}}$ $c_c = \frac{(D_{30})^2}{D_{10} x D_{60}}$</td></tr>
<tr><td colspan="2">Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength</td><td>SP</td><td>Poorly graded sands and gravelly sands; little or no fines, uniform sands</td><td colspan="2">Not meeting all gradation requirements for SW</td></tr>
<tr><td rowspan="2">SANDS WITH FINES
(Appreciable fines)</td><td colspan="2">‘Dirty’ materials with excess of non-plastic fines, zero to medium dry strength</td><td>SM</td><td>Silty sands, sand-silt mixtures</td><td>Atterberg limits below ‘A’ line or PI less than 4</td><td rowspan="2">Above ‘A’ line with PI between 4 and 7 are borderline cases requiring use of dual symbols</td></tr>
<tr><td colspan="2">‘Dirty’ materials with excess of plastic fines, medium to high dry strength</td><td>SC</td><td>Clayey sands, sand-clay mixtures</td><td>Atterberg limits above ‘A’ line with PI greater than 7</td></tr>
<tr><td rowspan="8">FINE GRAINED SOILS
More than 35% of material less than 63 mm is smaller than 0.075 mm</td><td colspan="6">IDENTIFICATION PROCEDURES ON FRACTIONS < 0.075 mm</td><td rowspan="9">Give typical name, symbol, and indicate degree and character of plasticity, colour, amount and size of coarse grains.
For undisturbed soils add information on moisture content, consistency, structure, stratification, and odour.
Give local or geologic name and other pertinent descriptive information.
Example:
CLAYEY SILT (ML), brown, low plasticity, trace sand, firm, dry, numerous vertical root holes.</td><td colspan="3" rowspan="6"> </td></tr>
<tr><td rowspan="4">SILTS AND CLAYS
Low -Medium Plasticity, Liquid limit <50</td><td>DRY STRENGTH</td><td>DILATANCY</td><td>TOUGHNESS</td><td></td><td></td></tr>
<tr><td>None to low</td><td>Quick to slow</td><td>None</td><td>ML</td><td>Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit</td></tr>
<tr><td>Medium to high</td><td>None to very slow</td><td>Medium</td><td>CL</td><td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays</td></tr>
<tr><td>Low to medium</td><td>Slow</td><td>Low</td><td>OL*</td><td>Organic silts and organic silt-clays of low to medium plasticity</td></tr>
<tr><td rowspan="3">SILTS AND CLAYS
High Plasticity, Liquid limit >50</td><td>Low to medium</td><td>Slow to none</td><td>Low to medium</td><td>MH</td><td>Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit</td></tr>
<tr><td>High to very high</td><td>None</td><td>High</td><td>CH</td><td>Inorganic clays of high plasticity</td><td colspan="3" rowspan="3">Laboratory:
MC Moisture Content MDD Maximum Dry Density
LL Liquid Limit OMC Optimum Moisture Content
PL Plastic Limit PSD Particle Size Distribution
PI Plasticity Index UU Undrained Unconsolidated
LS Linear Shrinkage CU Consolidated Undrained
ρ_p Particle Density CD Consolidated Drained
ρ_b Bulk Density $I_{s(50)}$ Point Load Index
ρ_d Dry Density UCS Uniaxial Compressive Strength</td></tr>
<tr><td>Medium to high</td><td>None to very slow</td><td>Low to medium</td><td>OH*</td><td>Organic clays of high plasticity</td></tr>
<tr><td colspan="2">HIGHLY ORGANIC SOILS</td><td colspan="3">Readily identified by colour, odour, spongy feel and frequently by fibrous texture</td><td>Pt*</td><td>Peat and other highly organic soils</td></tr>
</table>

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

* effervesces with H_2O_2

DESCRIPTION OF A SOIL

i. Colour
ii. Plasticity or particle characteristics of soil
iii. Secondary components name
iv. Estimated proportion
v. Secondary component plasticity or particle characteristics
vi. Other minor soil components
vii. Structure of soil, geological origin
viii. Consistency / density
ix. Moisture condition

Term		Grain Size	Shape and Texture	Field Guide
CLAY		< 2 µm	Shiny	Not visible under 10x
SILT		7 – 75 µm	Dull	Visible under 10x
SAND	Fine	0.075 – 0.2 mm	Angular / sub -angular / sub -rounded / rounded	Visible by eye
	Medium	0.2 – 0.6 mm		Visible at < 1 mm
	Course	0.6 – 2.36 mm		Visible at < 3 mm
GRAVEL	Fine	2.36 – 6 mm		Visible at < 5 mm
	Medium	6 – 20 mm		Road Gravel
	Course	20 – 63 mm		Rail ballast
COBBLES		63 – 200 mm		Beaching
BOULDERS		> 200 mm		

COLOUR

The colour of a soil should be described using simple terns, such as black, white, grey, red, brown, orange, yellow green or blue. These may be modified as necessary by 'pale', 'dark' or 'mottled'. Borderline colours may be described as a combination of these colours (e.g. orange brown). Where a soil consists of a primary colour with a secondary mottling it should be described as (primary colour) mottled (first colour) and (secondary colour). Where a soil consists of two colours presented in roughly equal proportions the colour description should be mottled (first colour) and (secondary).

PARTICLE CHARACTERISTICS – COARSE GRAINED SOILS

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

ANGULARITY – COARSE GRAINED SOILS

PLASTICITY

Liquid limit (%)	Description
≤ 35	Low plasticity
>35 to ≤ 50	Medium plasticity
> 50	High plasticity

DESCRIPTIVE TERMS FOR SECONDARY AND MINOR COMPONENTS

Element	Coarse Grained Soils				Fine Grained Soils	
	% Fines	Term	% Access. Coarse	Term	% Coarse	Term
Minor	≤ 5	'trace clay or silt'	≤ 15	'trace sand or gravel'	≤ 15	Use 'trace'
	>5 to ≤12	'with clay or silt' as applicable	>15, ≤ 30	'with sand or gravel' as applicable	>15, ≤ 30	'with sand or gravel' as applicable
Secondary	> 12	Prefix 'clayey or silt' as applicable	>30	Prefix 'sandy' or 'gravelly' as applicable	> 30	Prefix 'sandy or gravelly' as applicable

CONSISTENCY TERMS – COHESIVE SOILS

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

CONSISTENCY TERMS – NON COHESIVE SOILS

Term	Density Index (%)	SPT (N) Blow Count	Field Guide to Density
Very Loose (VL)	< 15	0 – 4	Ravels
Loose (L)	15 – 35	4 – 10	Shovels easily
Medium Dense (MD)	35 – 65	10 – 30	Shovelling very difficult
Dense (D)	65 – 85	30 – 50	Pick required
Very Dense (VD)	> 85	50 -100	Pick difficult

MOISTURE

Term (Symbol)	Description
Dry	Looks and feels dry, cohesive soils hard, friable or powdery
Moist	Soil feels cool, darkened in colour, can be remoulded &/or adhere
Wet	Soil feels cool, darkened in colour, sticks, free water on remoulding
M < Wp	Moist, moisture content well below plastic limit
M = Wp	Moist, moisture content near plastic limit
M > Wp	Moist moisture content well above plastic limit

STRUCTURE

Term	Description	
Zoning	Soils may consist of separate zones different in colour, grain size or other properties. Thickness, orientation & any distinguishing features of the zone should be described i.e. gradational or distinct boundaries. The patterns of these zones may be described using layer (zone is continuous), lens (a discontinuous layer of different material, with lenticular shape) or pocket (irregular inclusion of different materials).	
Defects	Term	Definition
	Parting	A surface or crack (open/closed) with little or no tensile strength. Parallel or sub parallel to layering (e.g. bedding).
	Fissure	A surface or crack (open/closed) with little or no tensile strength not parallel or subparallel to layering; includes desiccation cracks
	Sheared Seam	Zone in clayey soil roughly parallel near planar, curved or undulating boundaries containing closely, smooth or slickensided, curved intersecting fissures dividing mass into lenticular/wedge blocks.
	Sheared Surface	A near planar, curved or undulating smooth, polished or slickensided surface in clayey soil.
	Softened Zone	A zone in clayey soil, usually adjacent to a defect in which the soil has higher moisture content.
	Tube	Tubular cavity occurring as one of a large number of separate or interconnected tubes. Walls often coated with clay/strengthened by denser packing of grains. May contain organic matter. Origins include root holes, animal burrows, tunnel erosion.
	Tube cast	An infilled tube with uncemented or weakly cemented soil or have rock properties.
	Infilled Seam	Sheet/wall like body of soil with roughly planar to irregular near parallel boundaries cutting through mass. Open defect infilling.
Cementing	Soils or defects within soils may be cemented together by various agencies. The nature of the cementing agent should be identified if possible, strength, reaction to acid and the like. Weakly cemented – If the cementing agent allows the particle aggregation to be easily fractured by hand when the soil is saturated. Strongly cemented – If the cementing agent prevents fracturing by hand when the soil is saturated (use strength classification as per rock)	

ADDITIONAL OBSERVATIONS

Geological origin

Term	Description
Topsoil	Mantle of surface &/or near surface, often high levels of organics
Weathered in place soils	Extremely weathered soil - Structure and fabric of parent rock visible
	Residual soil - Structure and fabric of parent rock not visible
Transported soils	Aeolian soil - Deposited by wind and ash falls
	Alluvial soil - Deposited by streams and rivers
	Colluvial soil -Deposited on slopes (transported down slope by gravity)
	Lacustrine soil – Deposited in freshwater lakes
	Marine soil - Deposited in ocean, bays, beaches and estuaries
Fill materials	Soil Fill - Describe soil type, UCS symbol and add 'FILL'
	Rock Fill - Rock type, degree of weathering, and word 'FILL'
	Domestic Fill - Percent soil or rock, whether putrescible or not
	Industrial Fill - Percent soil, whether contaminated, particle size & type of waste product, i.e. – brick, concrete, metal

ORGANIC OR ARTIFICIAL MATERIALS

Preferred Terms	Secondary Description
Organic matter	Fibrous peat, charcoal, wood fragments, roots (greater than 2 mm diameter), root fibres (less than 2 mm diameter), Night soil
Waste fill	Domestic refuse, oil, bitumen, brickbats, concrete rubble, fibrous plaster, wood pieces, wood shavings, saw dust, iron filings, drums, steel bars, steel scrap, bottles, broken glass, leather, tyres, slag

Rock Description

ROCK TYPE

Composition of the rock material i.e. colour, grain size, structure, texture, fabric, mineral composition, hardness alteration, cementation etc. as applicable. Condition of the material i.e. estimated strength, weathering and moisture condition. Rock mass properties i.e. structure of rock, defects – type, orientation spacing, roughness, waviness and continuity and weathering (of the rock mass).

GRAIN SIZE

Particle size scales depends on rock type. For sedimentary rocks, the following descriptors can be used:

- Sand terms for sandstone
- Gravel terms for conglomerates and breccias
- No description of grainsize is required for claystone, siltstone, shale and mudstone etc.

For metamorphic and igneous rocks, record the typical grain size in millimetres

COLOUR

The colour of a rock should be described using simple terms, such as black, white, grey, red, brown, orange, yellow, green or blue. These may be modified as necessary by ‘pale’, ‘dark’ or ‘mottled’. Borderline colours may be described as a combination of these colours (e.g. grey green).

STRUCTURE

Terms typically used to describe the structure of a rock mass where possible include:

- Sedimentary rocks – bedded, laminated
- Metamorphic – foliated, banded, cleaved
- Igneous rocks – massive, flow banded.

The spacing or thickness of these structural features should be given as described in the table below:

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

TEXTURE

Type	Definition
Massive	Effectively Homogeneous and isotropic. Bulky or equidimensional and elongated or tabular grains uniformly distributed.
Distinct	Bedded, foliated, cleaved – effectively homogeneous with planar anisotropy. Elongated or tabular grains or pores in a layered arrangement. The arrangement of grains, referred to as the rock fabric, may show a preferred orientation.

STRENGTH

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

1. These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considered weaker due to the effect of rock defects.
2. The field guide visual assessment of rock strength may be used for preliminary assessment or when point load testing is not available.
3. Anisotropy of rock material samples may affect the field assessment of strength

WEATHERING CLASSIFICATION

Degree of weathering		Definition
Residual soil (RS)		Soil developed from weathering of rock in-situ. The mass structure and substance fabric are no longer evident, but soil not significantly transported
Extremely weathered rock (XW)		Rock is weathered to such an extent that it has soil properties. It disintegrates or can be remoulded in water. It shows a rock fabric but is described as a soil.
Highly weathered rock (HW)	Distinctly weathered (DW)*	The whole of the rock material is discoloured, usually by iron staining or bleaching so that the original rock colour is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals.
Moderately weathered rock (MW)		The whole of the rock material is discoloured, usually by iron staining or bleaching so that the original rock colour is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered rock (SW)		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh rock (F)		Rock shows no sign of decomposition or individual minerals or colour changes.

*Distinctly Weathered indicates a distinct change in colour, hardness and/or friability and not distinguishable into HW or MW

DESCRIPTION OF A DISCONTINUITY

- Depth
- Dip
- Infill material
- Aperture observation
- Planarity
- Small scale roughness
- Aperture measurement (mm)
- Remark
- Roughness Class

INFILL MATERIAL

Code	Description
CA	Calcite
Clay	Clay
Fe	Iron oxide
Fe Clay	Iron oxide clay
KT	Chlorite
MS	Secondary mineral
MU	Unidentified mineral
Qz	Quartz
X	Carbonaceous

APERTURE OBSERVATION

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

PLANARITY

Code	Description
CU	Curved
DIS	Discontinuous
IR	Irregular
PR	Planar
ST	Stepped
UN	Undulating

SMALL SCALE ROUGHNESS

Code	Description
POL	Polished
RF	Rough
S	Smooth
SL	Slickensided
VR	Very rough

ROUGHNESS CLASS

Code	Description
I	Rough or irregular, stepped
II	Smooth, stepped
III	Slickensided, stepped
IV	Rough or irregular, undulating
IX	Slickensided, planar
V	Smooth, undulating
VI	Slickensided, undulating
VII	Rough or irregular, planar

TYPE OF DISCONTINUITY

Term	Code	Description	
Bedding	BP	Generally no micro fractures	Arrangement in layers, of mineral grains of similar sizes or composition, and/or arrangement of elongated to tabular minerals near parallel to one another, and/ or to the layers.
Foliation	FL	Discontinuous micro fractures may be present, near parallel to the layering	
Cleavage	CL		
Schistosity	SH		
Contact	CO	A contact is the surface along which one rock touches another.	
Joint	JT	A discontinuity or crack, planar, curved, irregular, across which the rock usually has little tensile strength. The joint may be open (filled with air or water) or filled by soil substance or by rock substance or rock substance which acts as a cement, joint surface may be rough, smooth or slickensided	
Sheared Zone	SZ	Zone, with roughly parallel planar boundaries of rock material intersected by closely spaced (generally <50 mm) joints and/ or microscopic fractures (cleavage) planes. The joints are at small angles to the zone boundaries. They are usually slightly curved and divide the mass into blocks of lenticular or wedge space.	
Sheared Surface	SS	A near planar, curved or undulating surface which is usually smooth, polished or slickensided	
Crushed seam/ zone	CS CZ	Zone with roughly parallel planar boundaries, composed of disoriented, usually angular fragments of the host rock substance. The fragments may be of clay, silt, sand or gravel size, or mixtures of any of these. Some minerals maybe altered or decomposed but this is not necessarily so.	
Decomposed zone	DZ	Zone of any shape, but commonly with roughly parallel boundaries in which the rock material is discoloured and usually weakened. The boundaries with fresh rock are usually gradational.	
Seam	SM	Thin clay or extremely weathered seam caused by complete weathering within the rock mass.	
Infill seam/ zone	IS	Seam or zone of any shape, but commonly with roughly parallel boundaries composed of soil substance. The infill is caused by migration of soil and into open joints. May show layering roughly parallel to the zone boundaries. Geological structures in the adjacent rock do not continue into the infill substance.	
Vein	VN	vein is a distinct sheet like body of crystallized minerals within a rock	
Dyke	DK	Dykes are sheet-like bodies of igneous rock that cut across sedimentary bedding or foliations in rocks. They may be single or multiple in nature.	
Sill	SI	A sill is an intrusion of magma that spreads underground between the layers of another kind of rock	
Void	VO	A completely empty space.	

Refer to Table 22 in AS1726-2017

DRILLING / EXCAVATION METHOD

Code	Description
AD/V	Auger drilling V-bit
AD/T	Auger drilling with TC-bit
AS	Auger screwing
AT	Air track
B	Bulldozer
BH	Backhoe bucket
DB	Washbore drag bit
CT	Cable Tool
DT	Diatube
CA	Casing advancer
E	Excavator
EH	Excavator with hammer
HA	Hand auger
NMLC	NMLC core barrel
HMLC	HMLC core barrel
NQ3	Wire line NQ core barrel
HQ3	Wire line HQ core barrel
PQ3	Wire line PQ core barrel
PT	Push tube
R	Ripper
RR	Rock roller
WB	Washbore
X	Existing excavation
N	Natural exposure

WATER/ DRILLING FLUID

Symbol	Description
◁	Water loss: partial
◀	Water loss: complete
▶—	Water inflow
—◀	Water outflow
▽	Water level: drilling
▼	Water level: standing

DRILLING PENETRATION

Ease of penetration in non-core drilling

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

SAMPLES AND FIELD TEST

Code	Description
B	Bulk disturbed sample
BLK	Block sample
DS	Small disturbed sample
ES	Soil sample for environmental testing
EW	Water sample for environmental testing
LB	Large bulk disturbed sample
P	Piston sample
SPT	Standard Penetration Test
VS	Vane shear test
HP	Hand penetrometer test
U	Undisturbed push in sample

BACKFILL / WELL DETAIL

Symbol	Description
░	Cement seal
▩	Grout backfill
◫	Blank pipe
▤	Slotted pipe
⁘	Filter pack: sand filter
▨	Bentonite seal
▦	Backfill – excavated material

Appendix B2. Borehole Logs and Photos

Jacobs

Engineering Log - Excavation

HB-BH01-C

Project: Heybridge Converter Station
Page: 1 of 3
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	413994.6 m	**Elevation:**	6.21 m	**Started:**	04/02/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452650.7 m	**Datum:**	AHD	**Finished:**	07/02/2022
Logged By: MW	**Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples & SPT Data	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
HA				FILL: Silty GRAVEL: fine to coarse grained, black, low plasticity; with fine to coarse sand	D	MD		FILL 0.10 : ES, PID = 1.2 PPM
			D	FILL: SILT: low plasticity, black; with fine to medium grained sand, trace fine grained gravel	M <Wp	F-St		0.50 : ES, PID = 0.9 PPM
				FILL: Sandy GRAVEL: fine to medium grained, sub-angular to sub-rounded, orange brown; with red and grey mottling, fine to coarse grained sand, low plasticity silt	D-M	MD		
		▼	SPT N=6 2,2,4	Sandy SILT: low plasticity, orange brown, fine to medium grained sand	M =Wp	F		AEOLIAN DEPOSITS 1.00 : PID = 0.0 PPM
					M <Wp	St		1.20 : PP = 150 kPa
			U	*1.60m: colour becoming pale grey with minor white mottling*		VSt-H		1.40 : PP = 210 kPa 1.80 : PP > 600 kPa
			D	Sandy GRAVEL: fine to medium grained, sub-angular to angular, pale grey with minor yellow mottling, fine to coarse grained sand; with low plasticity clay; trace silt		VD		EXTREMELY WEATHERED MATERIAL
				Continued as cored hole from 2.20m				

RL (m): 6, 5, 4, 3, 2, 1, 0, -1

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal
VE F H VH

GROUNDWATER
▼ = Water level (static)
▶ = Water inflow

SAMPLES & FIELD TESTS

D Disturbed Sample	HP Hand Penetrometer
B Bulk Sample	HV Hand Vane Shear
SPT SPT Sample	(P: Peak Su R: Residual Su)
U Undisturbed Sample	
E Enviro Sample	
W Water Sample	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (SU) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

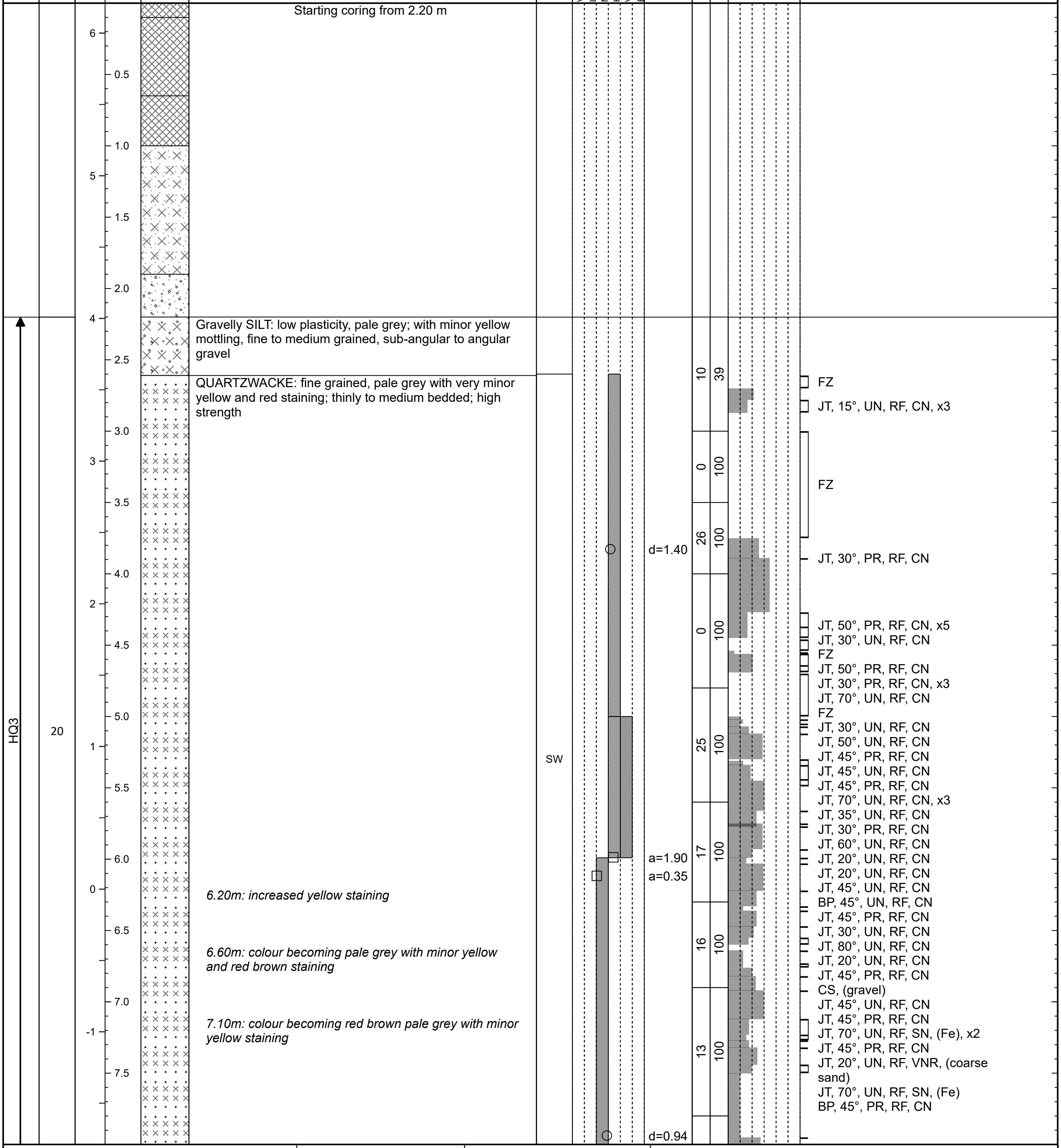
Jacobs Engineering Log - Cored Borehole

HB-BH01-C

Project:	Heybridge Converter Station	**Page:**	2 of 3
Client:		**Location:** Heybridge Converter Station Site, Heybridge TAS	**Project No:** IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	413994.6 m	**Elevation:**	6.21 m	**Started:**	04/02/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452650.7 m	**Datum:**	AHD	**Finished:**	07/02/2022
Logged By:	MW **Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A

DRILLING				MATERIAL SUBSTANCE				ROCK MASS DEFECTS					
Method	Groundwater/ Water Loss (%)	RL (m)	Depth (m)	Graphic Log	**Description of Strata** ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type)	Weathering	Estimated Strength Is(50) (MPa) ☐ - Axial ○- Diametral VL 0-1 L 0-3 M 1 H 3 VH 10 EH	Point Load Strength Index Is(50) (MPa)	RQD (%)	TCR (%)	Defect Spacing (mm) 20 60 200 600 2000	Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other)	General



Starting coring from 2.20 m

Gravelly SILT: low plasticity, pale grey; with minor yellow mottling, fine to medium grained, sub-angular to angular gravel

QUARTZWACKE: fine grained, pale grey with very minor yellow and red staining; thinly to medium bedded; high strength

6.20m: increased yellow staining

6.60m: colour becoming pale grey with minor yellow and red brown staining

7.10m: colour becoming red brown pale grey with minor yellow staining

RQD (%)	TCR (%)
10	39
0	100
26	100
0	100
25	100
17	100
16	100
13	100

Point Load Strength Index Is(50) (MPa):
d=1.40
a=1.90
a=0.35
d=0.94

FZ
JT, 15°, UN, RF, CN, x3
FZ
JT, 30°, PR, RF, CN
JT, 50°, PR, RF, CN, x5
JT, 30°, UN, RF, CN
FZ
JT, 50°, PR, RF, CN
JT, 30°, PR, RF, CN, x3
JT, 70°, UN, RF, CN
FZ
JT, 30°, UN, RF, CN
JT, 50°, UN, RF, CN
JT, 45°, PR, RF, CN
JT, 45°, UN, RF, CN
JT, 45°, PR, RF, CN
JT, 70°, UN, RF, CN, x3
JT, 35°, UN, RF, CN
JT, 30°, PR, RF, CN
JT, 60°, UN, RF, CN
JT, 20°, UN, RF, CN
JT, 20°, UN, RF, CN
JT, 45°, UN, RF, CN
BP, 45°, UN, RF, CN
JT, 45°, PR, RF, CN
JT, 30°, UN, RF, CN
JT, 80°, UN, RF, CN
JT, 20°, UN, RF, CN
JT, 45°, PR, RF, CN
CS, (gravel)
JT, 45°, UN, RF, CN
JT, 45°, PR, RF, CN
JT, 70°, UN, RF, SN, (Fe), x2
JT, 45°, PR, RF, CN
JT, 20°, UN, RF, VNR, (coarse sand)
JT, 70°, UN, RF, SN, (Fe)
BP, 45°, PR, RF, CN

DRILLING		WEATHERING		ROCK STRENGTH (Is50 MPa)		DEFECT ABBREVIATIONS				
NMLC NMLC Coring	TCR % core run recovered					TYPE		COATING	PLANARITY	ROUGHNESS
NQ NQ Coring	RQD % core run > 100mm long	RS	residual soil	0.03-0.1	Very Low (VL)	BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
HQ HQ Coring	(sound rock fraction only measured)	XW	extremely weathered	0.1-0.3	Low (L)	JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
PQ PQ Coring		HW	highly weathered	0.3-1.0	Medium (M)	SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
GROUNDWATER SYMBOLS		DW	distinctly weathered	1.0-3.0	High (H)	CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
▼ = Water level (static)		MW	moderately weathered	3.0-10	Very High (VH)	CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
▶ = Water inflow		SW	slightly weathered	> 10	Extremely High (EH)	SZ Shear Zone	HB Handling Break		DIS Discontinuous	
		FR	fresh							

Engineering Log - Cored Borehole

HB-BH01-C

Project: Heybridge Converter Station
Page: 3 of 3
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

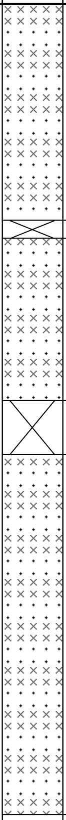
Contractor:	Tasmanian Drilling	**Easting:**	413994.6 m	**Elevation:**	6.21 m
Started:	04/02/2022	**Plant:**	Hanjin D&B 8-D	**Northing:**	5452650.7 m
Datum:	AHD	**Finished:**	07/02/2022	**Logged By:**	MW
Checked By:	AC	**Grid:**	GDA2020	**Inclination:**	-90°
Orientation:	N/A				

DRILLING · MATERIAL SUBSTANCE · ROCK MASS DEFECTS

RL (m): -2, -3, -4, -5, -6, -7, -8, -9

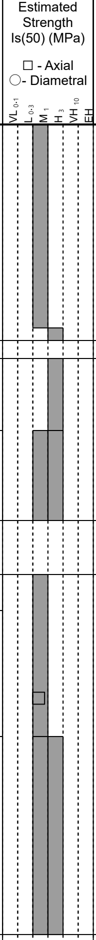
Depth (m): 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5

Graphic Log

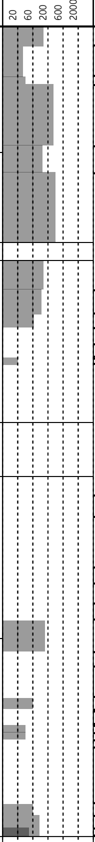


Method	Groundwater/ Water Loss (%)	Description of Strata ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type)	Weathering	Point Load Strength Index Is(50) (MPa)	RQD (%)	TCR (%)	Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other)	General
HQ3	20	QUARTZWACKE: fine grained, pale grey with very minor yellow and red staining; thinly to medium bedded; high strength *8.75m: colour becoming yellow brown pale grey*	SW		67 0	100 100	JT, 30°, UN, RF, CN BP, 45°, PR, RF, CN, x6 JT, 45°, UN, RF, CN JT, 30°, UN, RF, VNR, (clay) JT, 30°, UN, RF, SN, (Fe)	
		CORELOSS						
		QUARTZWACKE: fine grained, red brown-pale grey with yellow staining; thinly to medium bedded; medium strength *9.40m: colour becoming red brown-pale grey with yellow staining* *9.70m: increased red brown staining*	SW SW		0	89	JT, 30°, UN, RF, SN, (Fe) JT, 20°, UN, RF, SN, (Fe) FZ BP, 45°, PR, RF, SN, (Fe), x3	
		CORELOSS						
		QUARTZWACKE: fine grained, pale grey with yellow and orange brown staining; very thinly to thinly bedded; medium to high strength; slightly weathered *10.70m: colour becoming pale grey with yellow and orange brown staining*	MW SW-MW SW	a=0.59	0 0	67 100	BP, 30°, PR, RF, CN FZ FZ JT, 70°, PR, RF, SN, (Fe) FZ JT, 20°, UN, RF, Filled, (sand) FZ JT, 45°, PR, RF, CN JT, 45°, PR, RF, CN JT, 45°, UN, RF, CN FZ JT, 45°, PR, RF, SN, (Fe), x2 JT, 45°, PR, RF, Filled, (clay)	
		Exploratory hole terminated at 12.50 m Target depth						

Estimated Strength Is(50) (MPa) ☐ - Axial ○- Diametral



Defect Spacing (mm)



DRILLING		WEATHERING		ROCK STRENGTH (Is50 MPa)	
NMLC NMLC Coring	TCR % core run recovered	RS	residual soil	0.03-0.1	Very Low (VL)
NQ NQ Coring	RQD % core run > 100mm long	XW	extremely weathered	0.1-0.3	Low (L)
HQ HQ Coring	(sound rock fraction only measured)	HW	highly weathered	0.3-1.0	Medium (M)
PQ PQ Coring		DW	distinctly weathered	1.0-3.0	High (H)
		MW	moderately weathered	3.0-10	Very High (VH)
		SW	slightly weathered	> 10	Extremely High (EH)
		FR	fresh		

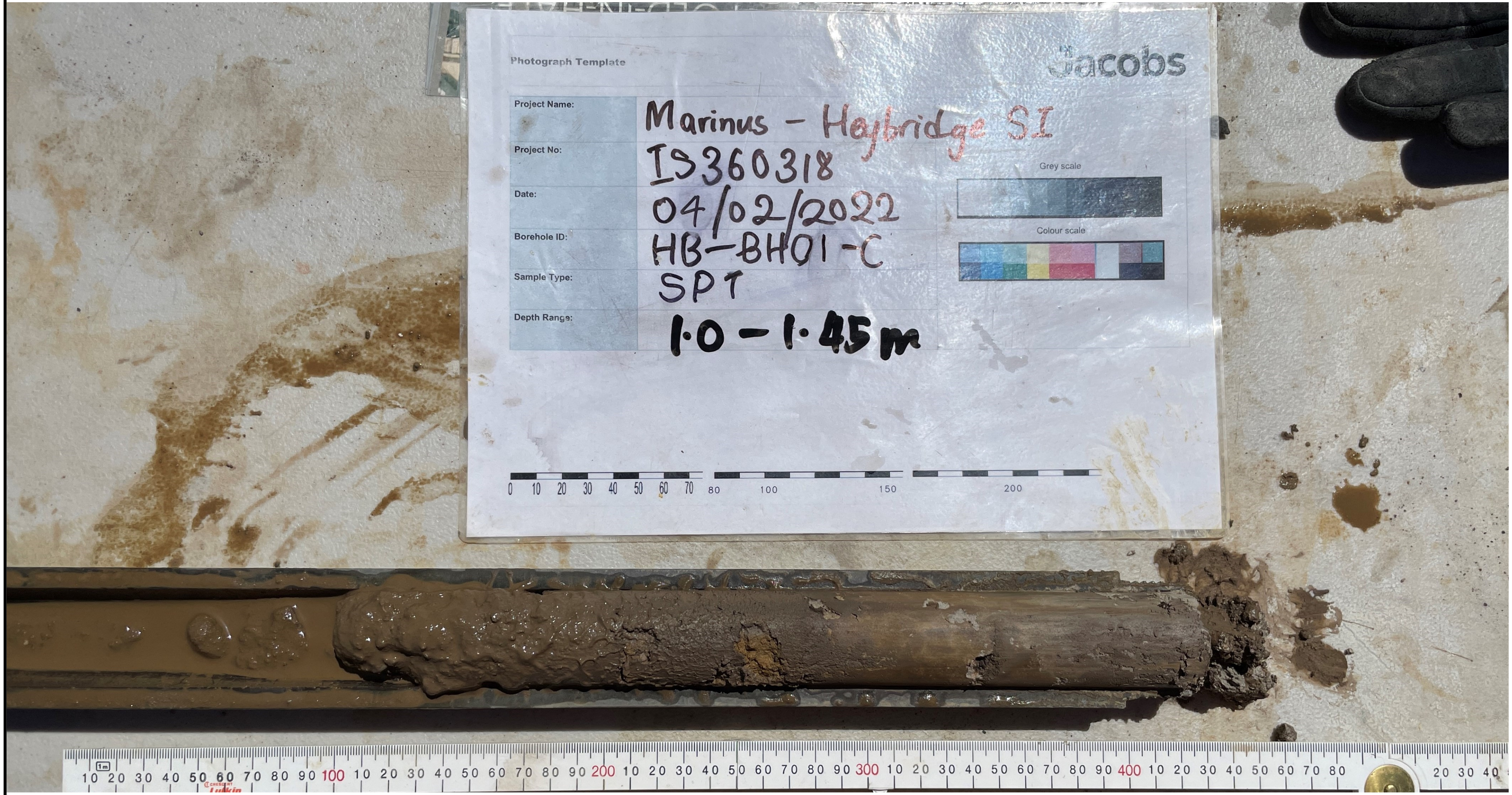
GROUNDWATER SYMBOLS

▼ = Water level (static)

▶ = Water inflow

DEFECT ABBREVIATIONS

TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	



Photograph Template

Jacobs

Project Name: Marinus - Heybridge SI

Project No: IS360318

Date: 04/02/2022

Borehole ID: HB-BH01-C

Sample Type: SPT

Depth Range: 1.0 - 1.45m

Multiple

Jacobs

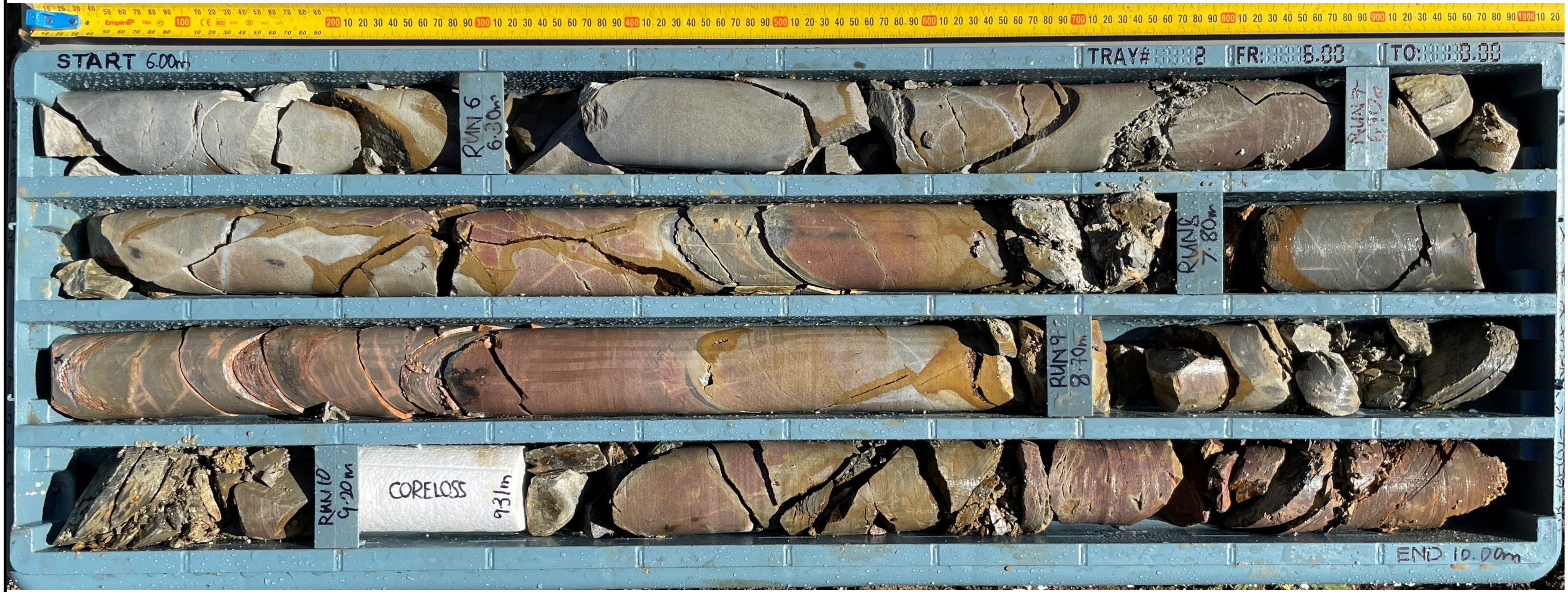
Client:	Tasmanian Networks		
Project:	Project Marinus - Heybridge SI		
Drawn:	MW	**Checked:**	

Title:	HB-BH01-C		
Scale:	NTS	**Drawing Number:**	1/4

This figure was created for Jacobs' client. Jacobs accepts no responsibility for any reliance on this information by third parties.

Multiple

Client:	Tasmanian Networks
Project:	Project Marinus - Heybridge SI
Drawn: MW	**Checked:**
Title:	HB-BH01-C
Scale: NTS	**Drawing Number:** 2/4



Multiple

Client:	Tasmanian Networks		
Project:	Project Marinus - Heybridge SI		
Drawn:	MW	**Checked:**	
Title:	HB-BH01-C		
Scale:	NTS	**Drawing Number:**	3/4

Multiple

Client:	Tasmanian Networks			**Title:**	HB-BH01-C
Project:	Project Marinus - Heybridge SI				
Drawn:	MW	**Checked:**		**Scale:** NTS	**Drawing Number:** 4/4

Engineering Log - Excavation

HB-BH02-C

Project: Heybridge Converter Station
Page: 1 of 3
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

Contractor: Tasmanian Drilling		**Easting:** 414106.5 m	**Elevation:** 6.59 m	**Started:** 04/02/2022	
Plant: Hanjin D&B 8-D		**Northing:** 5452568.2 m	**Datum:** AHD	**Finished:** 04/02/2022	
Logged By: MW	**Checked By:** AC	**Grid:** GDA2020	**Inclination:** -90°	**Orientation:** N/A	

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
HA		Not Observed				FILL: Silty GRAVEL: fine to coarse grained, angular to sub-angular, pale brown grey, low plasticity silt; with fine to medium grained sand	D	D		FILL 0.10 : ES (potential asbestos fragments observed) 0.30 : ES (concrete slab/ footing with reinforcement encountered)
HA				6	0.5 1.0	CONCRETE				
			D	5	1.5	Silty CLAY: low plasticity, yellow brown-pale grey; with fine to medium grained, sub-rounded to sub-angular gravel, with fine to medium grained sand		VD		RESIDUAL SOIL
			SPT N=37 13,18,19	4	2.0 2.5	Silty Sandy GRAVEL: fine to medium grained, subangular to angular, yellow brown, fine to coarse grained sand, low plasticity silt				2.00 : ES
				3 2 1 0 -1	3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5	Continued as cored hole from 3.00m				

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal
VE E F H VH

GROUNDWATER
▼ = Water level (static)
▶ = Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (SU) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

Jacobs Engineering Log - Cored Borehole

HB-BH02-C

Project: Heybridge Converter Station **Page:** 2 of 3
Client: **Location:** Heybridge Converter Station Site, Heybridge TAS **Project No:** IS360318 -1

Contractor: Tasmanian Drilling		**Easting:** 414106.5 m	**Elevation:** 6.59 m	**Started:** 04/02/2022	
Plant: Hanjin D&B 8-D		**Northing:** 5452568.2 m	**Datum:** AHD	**Finished:** 04/02/2022	
Logged By: MW	**Checked By:** AC	**Grid:** GDA2020	**Inclination:** -90°	**Orientation:** N/A	

DRILLING

Method | Groundwater/ Water Loss (%) | RL (m) | Depth (m)

- Method: HQ3 (from 3.00 m)
- Groundwater/Water Loss (%): 10
- RL (m): 6, 5, 4, 3, 2, 1, 0, -1
- Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5

MATERIAL SUBSTANCE

Graphic Log | **Description of Strata** ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type) | Weathering | Estimated Strength Is(50) (MPa) ☐ - Axial ○- Diametral (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)

Starting coring from 3.00 m

Silty Sandy GRAVEL: fine to medium grained, subangular to angular, yellow brown, fine to coarse grained sand, low plasticity silt

QUARTZWACKE: fine grained, red brown with yellow/ orange staining; medium bedded; high strength; moderately weathered

1.60m: colour becoming pale grey with minor white mottling

4.14m: colour becoming yellow brown
4.20m: colour becoming pale grey-red with yellow staining

4.60m: colour becoming dark grey

5.00m: colour becoming dark grey

5.22m: colour becoming pale grey-red with yellow staining

5.80m: colour becoming dark grey with minor yellow and orange strands

6.70m: yellow staining
6.80m: red and yellow staining

7.30m: colour becoming red brown with yellow staining

7.66m: quartz/calcite seam ~10mm

Weathering: HW; SW-MW; SW; MW-HW

ROCK MASS DEFECTS

Point Load Strength Index Is(50) (MPa) | RQD (%) | TCR (%) | Defect Spacing (mm) (20, 60, 200, 600, 2000) | Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other) | General

Point Load: a=0.52 d=0.28; a=0.15

RQD (%)	TCR (%)
49	100
19	100
81	100
49	100

BP, 45°, PR, RF, CN, x4
JT, 60°, PR, RF, SN, (Fe)
JT, 70°, PR, RF, SN, (Fe)
BP, 45°, RF, CN
JT, 30°, UN, RF, SN, (Fe)
JT, 60°, UN, RF, SN, (Fe), x2

FZ

JT, 30°, UN, RF, CN
FZ

BP, 45°, RF, CN
JT, 60°, PR, RF, SN, (Fe), x3
JT, 15°, UN, RF, SN, (Fe)
JT, 10°, UN, RF, Filled, (sand, quartz gravel)
BP, 50°, PR, RF, CN, disturbed by drilling
BP, 60°, PR, RF, CN, x3
BP, 50°, PR, RF, CN, x2
JT, 45°, UN, RF, SN, (Fe)
JT, 70°, PR, RF, SN, (Fe), x3
BP, 50°, PR, RF, CN, disturbed by drilling
BP, 50°, PR, RF, CN, disturbed by drilling
JT, 45°, PR, RF, CN
JT, 70°, PR, RF, SN, (Fe), x2
BP, 45°, PR, RF, CN
JT, 80°, UN, RF, SN, (Fe), x2
JT, 90°, UN, RF, SN, (Fe)
BP, 60°, PR, RF, SN, (Fe), x5

BP, 45°, PR, RF, SN, (Fe)

BP, 60°, PR, RF, SN, (Fe), x2

BP, 60°, PR, RF, CN, x2

DRILLING

NMLC NMLC Coring
NQ NQ Coring
HQ HQ Coring
PQ PQ Coring

TCR % core run recovered
RQD % core run > 100mm long (sound rock fraction only measured)

GROUNDWATER SYMBOLS
▼ = Water level (static)
▶ = Water inflow

WEATHERING

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

ROCK STRENGTH (Is50 MPa)

0.03-0.1	Very Low (VL)
0.1-0.3	Low (L)
0.3-1.0	Medium (M)
1.0-3.0	High (H)
3.0-10	Very High (VH)
> 10	Extremely High (EH)

DEFECT ABBREVIATIONS

TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Engineering Log - Cored Borehole

HB-BH02-C

Project: Heybridge Converter Station
Page: 3 of 3
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414106.5 m	**Elevation:**	6.59 m
Started:	04/02/2022	**Plant:**	Hanjin D&B 8-D	**Northing:**	5452568.2 m
Datum:	AHD	**Finished:**	04/02/2022	**Logged By:**	MW
Checked By:	AC	**Grid:**	GDA2020	**Inclination:**	-90°
Orientation:	N/A				

DRILLING | MATERIAL SUBSTANCE | ROCK MASS DEFECTS

Method	Groundwater/ Water Loss (%)	RL (m)	Depth (m)	Graphic Log	**Description of Strata** ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type)	Weathering	Estimated Strength Is(50) (MPa) ☐ - Axial ○- Diametral VL 0-1 L 0-3 M 1 H 3 VH 10 EH	Point Load Strength Index Is(50) (MPa)	RQD (%)	TCR (%)	Defect Spacing (mm) 20 60 200 600 2000	Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other)	General
HQ3	10				QUARTZWACKE: fine grained, red brown with yellow/ orange staining; medium bedded; high strength; moderately weathered	MW- HW	○	d=1.00				FZ FZ JT, 20°, UN, RF, SN, (Fe) JT, 70°, UN, RF, SN, (Fe) BP, 30°, RF, CN, x3	
			8.5		Exploratory hole terminated at 8.50 m Target depth								
		-2											
			9.0										
			9.5										
		-3											
			10.0										
			10.5										
		-4											
			11.0										
			11.5										
		-5											
			12.0										
			12.5										
		-6											
			13.0										
			13.5										
		-7											
			14.0										
			14.5										
		-8											
			15.0										
			15.5										
		-9											

DRILLING

NMLC NMLC Coring
NQ NQ Coring
HQ HQ Coring
PQ PQ Coring

TCR % core run recovered
RQD % core run > 100mm long
(sound rock fraction only measured)

GROUNDWATER SYMBOLS

▼ = Water level (static)
▶ = Water inflow

WEATHERING

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

ROCK STRENGTH (Is50 MPa)

0.03-0.1	Very Low (VL)
0.1-0.3	Low (L)
0.3-1.0	Medium (M)
1.0-3.0	High (H)
3.0-10	Very High (VH)
> 10	Extremely High (EH)

DEFECT ABBREVIATIONS

TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Photograph Template

Jacobs

Project Name:	Marinus - Heybridge SI
Project No:	IS360318
Date:	04/02/2022
Borehole ID:	HB-BH02-C
Sample Type:	SPT
Depth Range:	2.0-2.45m

Multiple

Client:	Tasmanian Networks			**Title:**	HB-BH02-C
Project:	Project Marinus - Heybridge SI				
Drawn:	MW	**Checked:**		**Scale:** NTS	**Drawing Number:** 1/4

Photograph Template

Jacobs

Project Name: Marinus – Heybridge SI

Project No: IS360318

Date: 04/02/2022

Borehole ID: HB-BH02-C

Sample Type: SPT

Depth Range: 3.0 – 3.095m

Multiple

Client:	Tasmanian Networks		
Project:	Project Marinus - Heybridge SI		
Drawn:	MW	**Checked:**	

Title:	HB-BH02-C		
Scale:	NTS	**Drawing Number:**	2/4

Multiple

Client: Tasmanian Networks

Project: Project Marinus - Heybridge SI

Drawn: MW **Checked:**

Title: HB-BH02-C

Scale: NTS

Drawing Number: 3/4

Multiple

Client:	Tasmanian Networks
Project:	Project Marinus - Heybridge SI
Drawn: MW	**Checked:**

Title:	HB-BH02-C
Scale: NTS	**Drawing Number:** 4/4

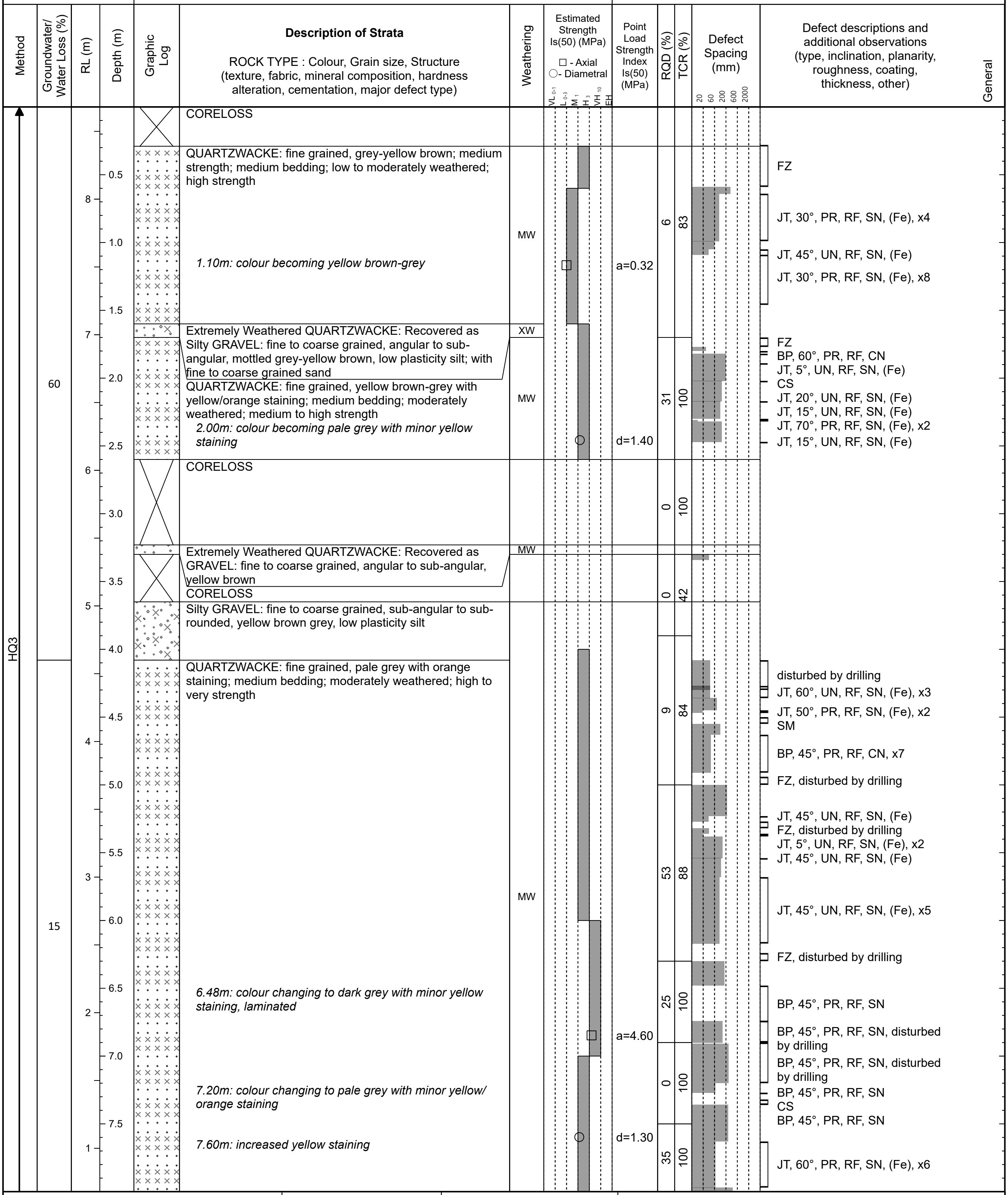
Jacobs Engineering Log - Cored Borehole

HB-BH03-C

Project: Heybridge Converter Station
Page: 1 of 2
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414223.2 m	**Elevation:**	8.68 m	**Started:**	03/02/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452487.4 m	**Datum:**	AHD	**Finished:**	03/02/2022
Logged By: MW	**Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A

DRILLING | MATERIAL SUBSTANCE | ROCK MASS DEFECTS



Description of Strata

ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type)

Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other)

CORELOSS

QUARTZWACKE: fine grained, grey-yellow brown; medium strength; medium bedding; low to moderately weathered; high strength — MW

1.10m: colour becoming yellow brown-grey

Point load: a=0.32 — RQD 6, TCR 83

- FZ
- JT, 30°, PR, RF, SN, (Fe), x4
- JT, 45°, UN, RF, SN, (Fe)
- JT, 30°, PR, RF, SN, (Fe), x8

Extremely Weathered QUARTZWACKE: Recovered as Silty GRAVEL: fine to coarse grained, angular to sub-angular, mottled grey-yellow brown, low plasticity silt; with fine to coarse grained sand — XW

QUARTZWACKE: fine grained, yellow brown-grey with yellow/orange staining; medium bedding; moderately weathered; medium to high strength — MW

2.00m: colour becoming pale grey with minor yellow staining

Point load: d=1.40 — RQD 31, TCR 100

- FZ
- BP, 60°, PR, RF, CN
- JT, 5°, UN, RF, SN, (Fe)
- CS
- JT, 20°, UN, RF, SN, (Fe)
- JT, 15°, UN, RF, SN, (Fe)
- JT, 70°, PR, RF, SN, (Fe), x2
- JT, 15°, UN, RF, SN, (Fe)

CORELOSS — RQD 0, TCR 100

Extremely Weathered QUARTZWACKE: Recovered as GRAVEL: fine to coarse grained, angular to sub-angular, yellow brown — MW

CORELOSS — RQD 0, TCR 42

Silty GRAVEL: fine to coarse grained, sub-angular to sub-rounded, yellow brown grey, low plasticity silt

QUARTZWACKE: fine grained, pale grey with orange staining; medium bedding; moderately weathered; high to very strength — MW

RQD 9, TCR 84

- disturbed by drilling
- JT, 60°, UN, RF, SN, (Fe), x3
- JT, 50°, PR, RF, SN, (Fe), x2
- SM
- BP, 45°, PR, RF, CN, x7
- FZ, disturbed by drilling

RQD 53, TCR 88

- JT, 45°, UN, RF, SN, (Fe)
- FZ, disturbed by drilling
- JT, 5°, UN, RF, SN, (Fe), x2
- JT, 45°, UN, RF, SN, (Fe)
- JT, 45°, UN, RF, SN, (Fe), x5
- FZ, disturbed by drilling

6.48m: colour changing to dark grey with minor yellow staining, laminated

Point load: a=4.60 — RQD 25, TCR 100

- BP, 45°, PR, RF, SN
- BP, 45°, PR, RF, SN, disturbed by drilling

RQD 0, TCR 100

- BP, 45°, PR, RF, SN, disturbed by drilling
- BP, 45°, PR, RF, SN
- CS
- BP, 45°, PR, RF, SN

7.20m: colour changing to pale grey with minor yellow/ orange staining

7.60m: increased yellow staining

Point load: d=1.30 — RQD 35, TCR 100

- JT, 60°, PR, RF, SN, (Fe), x6

DRILLING

NMLC NMLC Coring	TCR % core run recovered
NQ NQ Coring	RQD % core run > 100mm long
HQ HQ Coring	(sound rock fraction only measured)
PQ PQ Coring	

GROUNDWATER SYMBOLS

▼ = Water level (static)

▶ = Water inflow

WEATHERING

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

ROCK STRENGTH (Is50 MPa)

0.03-0.1	Very Low (VL)
0.1-0.3	Low (L)
0.3-1.0	Medium (M)
1.0-3.0	High (H)
3.0-10	Very High (VH)
> 10	Extremely High (EH)

DEFECT ABBREVIATIONS

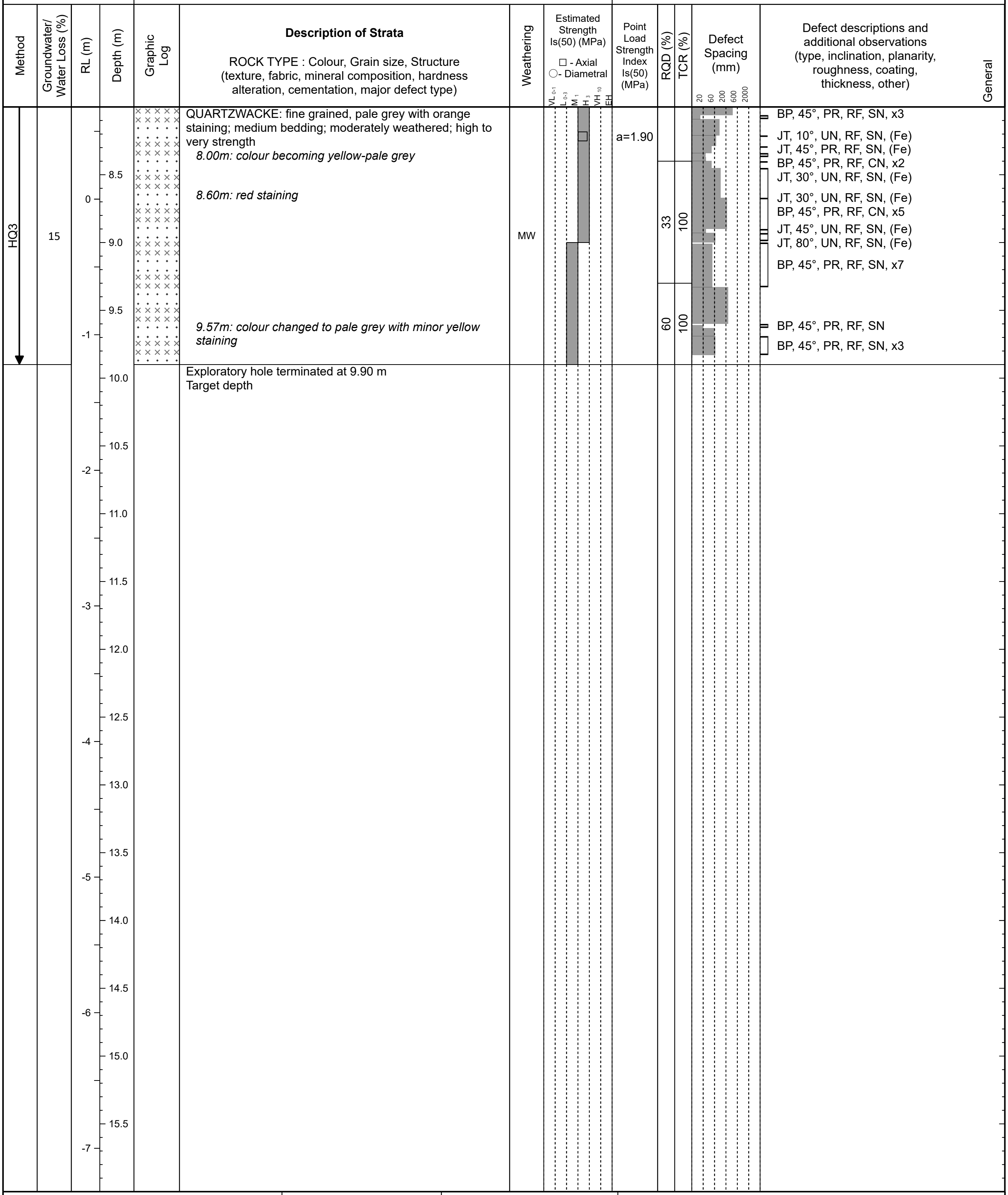
TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Engineering Log - Cored Borehole

HB-BH03-C

Project: Heybridge Converter Station
Page: 2 of 2
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

Contractor: Tasmanian Drilling		**Easting:** 414223.2 m	**Elevation:** 8.68 m	**Started:** 03/02/2022
Plant: Hanjin D&B 8-D		**Northing:** 5452487.4 m	**Datum:** AHD	**Finished:** 03/02/2022
Logged By: MW	**Checked By:** AC	**Grid:** GDA2020	**Inclination:** -90°	**Orientation:** N/A



Method	Groundwater/ Water Loss (%)	Depth (m)	Description of Strata ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type)	Weathering	Point Load Strength Index Is(50) (MPa)	RQD (%)	TCR (%)	Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other)
HQ3	15		QUARTZWACKE: fine grained, pale grey with orange staining; medium bedding; moderately weathered; high to very strength	MW	a=1.90			BP, 45°, PR, RF, SN, x3 JT, 10°, UN, RF, SN, (Fe) JT, 45°, PR, RF, SN, (Fe)
		8.00	*8.00m: colour becoming yellow-pale grey*					BP, 45°, PR, RF, CN, x2 JT, 30°, UN, RF, SN, (Fe)
		8.60	*8.60m: red staining*			33	100	JT, 30°, UN, RF, SN, (Fe) BP, 45°, PR, RF, CN, x5 JT, 45°, UN, RF, SN, (Fe) JT, 80°, UN, RF, SN, (Fe) BP, 45°, PR, RF, SN, x7
		9.57	*9.57m: colour changed to pale grey with minor yellow staining*			60	100	BP, 45°, PR, RF, SN BP, 45°, PR, RF, SN, x3
		9.90	Exploratory hole terminated at 9.90 m Target depth					

DRILLING		WEATHERING		ROCK STRENGTH (Is50 MPa)	
NMLC NMLC Coring	TCR % core run recovered	RS	residual soil	0.03-0.1	Very Low (VL)
NQ NQ Coring	RQD % core run > 100mm long	XW	extremely weathered	0.1-0.3	Low (L)
HQ HQ Coring	(sound rock fraction only measured)	HW	highly weathered	0.3-1.0	Medium (M)
PQ PQ Coring		DW	distinctly weathered	1.0-3.0	High (H)
GROUNDWATER SYMBOLS		MW	moderately weathered	3.0-10	Very High (VH)
▼ = Water level (static)		SW	slightly weathered	> 10	Extremely High (EH)
▶ = Water inflow		FR	fresh		

DEFECT ABBREVIATIONS

TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Multiple

Client: Tasmanian Networks

Project: Project Marinus - Heybridge SI

Drawn: MW

Checked:

Title: HB-BH03-C

Scale: NTS

Drawing Number: 1/3

Multiple

Jacobs

Client:	Tasmanian Networks
Project:	Project Marinus - Heybridge SI
Drawn: MW	**Checked:**

Title:	HB-BH03-C
Scale: NTS	**Drawing Number:** 2/3

Multiple

Client:	Tasmanian Networks
Project:	Project Marinus - Heybridge SI
Drawn:	MW
Checked:	
Title:	HB-BH03-C
Scale:	NTS
Drawing Number:	3/3

Engineering Log - Excavation

HB-BH04-C

Project:	Heybridge Converter Station			**Page:**	1 of 3
Client:		**Location:**	Heybridge Converter Station Site, Heybridge TAS	**Project No:**	IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414002.5 m	**Elevation:**	7.44 m	**Started:**	31/01/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452548.2 m	**Datum:**	AHD	**Finished:**	31/01/2022
Logged By:	MW **Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Groundwater Levels	Samples & SPT Data	Depth (m)	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm)	Field Test Data & Other Observations
HA			0.00 – 0.10	FILL: Silty GRAVEL: fine to medium grained, sub-angular to angular, grey brown, low plasiticity silt; with fine to coarse grained sand	D	D		FILL 0.10 : ES
	▼ (approx. 1.2)	SPT N=13 3,5,8 (1.0 – 1.45)	0.10 – 2.20	Clayey GRAVEL: fine to medium grained, sub-angular to angular, black, low plasticity clay; with fine to coarse grained sand *0.75m: plastic fragments* *0.90m: colour becoming black mottled grey* *1.00m: increased sand content, increasing moisture contents* *1.20m: increasing clay content*	D-M M M-W W	MD		RESIDUAL SOIL 1.00 : ES 2.00 : ES
			2.20 – 2.60	Silty SAND: fine to coarse grained, pale grey, low plasticity silt; with fine to medium, sub-angular to angular gravel	W	D		
		SPT N=R 15,16,22/70mm (2.5 – 2.75)	2.60 – 3.30	Extremely Weathered QUARTZWACKE: Recovered as Clayey Gravelly SAND: with fine grained sand, pale grey, fine to medium grained, angular gravel, low plasticity clay; trace low plasticity silt	M	VD		
			3.30	Continued as cored hole from 3.30m				

RL (m)	7	6	5	4	3	2	1	0
Depth (m)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0

Depth (m)	4.5	5.0	5.5	6.0	6.5	7.0	7.5

DCP: 5 10 15 20

METHOD & SUPPORT	PENETRATION	GROUNDWATER	SAMPLES & FIELD TESTS	MOISTURE	DENSITY (N-value)	CONSISTENCY (SU) {N-value}
N Natural/Existing cutting E Excavator BH Backhoe Bucket B Buldozer R Ripper	No resistance ranging to refusal VE E F H VH	▼ = Water level (static) ▶ = Water inflow	D Disturbed Sample B Bulk Sample SPT SPT Sample U Undisturbed Sample E Enviro Sample W Water Sample HP Hand Penetrometer HV Hand Vane Shear (P: Peak Su R: Residual Su)	D = Dry M = Moist W = Wet Wp = Plastic Limit Wl = Liquid Limit	VL Very Loose 0 - 4 L Loose 4 - 10 MD Medium Dense 10 - 30 D Dense 30 - 50 VD Very Dense 50 - 100	VS Very Soft < 12 kPa {0-2} S Soft 12 - 25 {2-4} F Firm 25 - 50 {4-8} St Stiff 50 - 100 {8-15} VSt Very Stiff 100 - 200 {15-30} H Hard > 200 kPa {>30}

Engineering Log - Cored Borehole

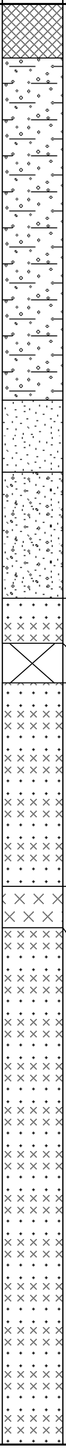
HB-BH04-C

Project:	Heybridge Converter Station			**Page:**	2 of 3
Client:		**Location:**	Heybridge Converter Station Site, Heybridge TAS	**Project No:**	IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414002.5 m	**Elevation:**	7.44 m	**Started:**	31/01/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452548.2 m	**Datum:**	AHD	**Finished:**	31/01/2022
Logged By:	MW **Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A

DRILLING | MATERIAL SUBSTANCE | ROCK MASS DEFECTS

Columns: Method; Groundwater/Water Loss (%); RL (m); Depth (m); Graphic Log; **Description of Strata** – ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type); Weathering; Estimated Strength Is(50) (MPa) ☐ - Axial ○- Diametral (VL 0-1, L 0-3, M 1, H 3, VH 10, EH); Point Load Strength Index Is(50) (MPa); RQD (%); TCR (%); Defect Spacing (mm) (20, 60, 200, 600, 2000); Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other); General



RL (m)	Depth (m)
7	0.5
	1.0
6	1.5
	2.0
5	2.5
	3.0
4	3.5
	4.0
3	4.5
	5.0
2	5.5
	6.0
1	6.5
	7.0
0	7.5

Method: HQ3 (from 3.30 m); Groundwater/Water Loss (%): 20

Description of Strata	Weathering	Point Load Strength Index Is(50) (MPa)
Starting coring from 3.30 m		
QUARTZWACKE: fine grained, pale grey with red/orange staining; thinly to medium bedded; moderately weathered; high strength	MW	
CORELOSS		
QUARTZWACKE: fine grained, pale grey with red/orange staining; thinly to medium bedded; moderately weathered; high strength *4.00m: colour becoming pale grey with minor orange red iron staining*	MW	a=0.66
Extremely Weathered QUARTZWACKE: Recovered as SILT: low plasticity, grey mottled orange; with fine to medium grained, sub-angular to angular gravel		
QUARTZWACKE: fine grained, pale grey with minor orange staining; moderately weathered; high strength *5.75m: becoming pale grey with minor orange staining* *7.00m: colour becoming pale grey with red iron staining* *7.32m: colour becoming pale grey with orange speckling*	MW	

RQD (%)	TCR (%)
0	63
20	90
0	100
43	81
0	100
35	100
17	100
0	100

Defect descriptions and additional observations:

JT, 15°, UN, RF, CT, (silt)
JT, 60°, PR, RF, SN, (Fe)
FZ
JT, 30°, PR, RF, SN, (Fe)
JT, 30°, PR, RF, SN, (Fe)
FZ
JT, 30°, PR, RF, CN
JT, 30°, PR, RF, CN
JT, 30°, PR, RF, CN, x4
FZ
JT, 45°, PR, RF, SN, x6
JT, 5°, UN, RF, SN
JT, 45°, UN, RF, CT, (fine to medium grained sand)
JT, 90°, UN, RF, SN
FZ
JT, 20°, UN, RF, VNR, (clay)
JT, 30°, PR, RF, SN, (Fe)
JT, 30°, PR, RF, SN, (Fe)
FZ
FZ
JT, 30°, UN, RF, CT, (clay)
FZ
JT, 30°, PR, RF, SN
JT, 30°, PR, RF, CN
FZ
FZ
JT, 60°, PR, RF, SN, (Fe)
JT, 60°, PR, RF, SN, (Fe)
JT, 60°, PR, RF, SN, (Fe)
JT, 60°, PR, RF, SN, 3x
FZ
FZ

DRILLING

NMLC NMLC Coring
NQ NQ Coring
HQ HQ Coring
PQ PQ Coring

TCR % core run recovered
RQD % core run > 100mm long (sound rock fraction only measured)

GROUNDWATER SYMBOLS

▼ = Water level (static)
▶ = Water inflow

WEATHERING

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

ROCK STRENGTH (Is50 MPa)

0.03-0.1	Very Low (VL)
0.1-0.3	Low (L)
0.3-1.0	Medium (M)
1.0-3.0	High (H)
3.0-10	Very High (VH)
> 10	Extremely High (EH)

DEFECT ABBREVIATIONS

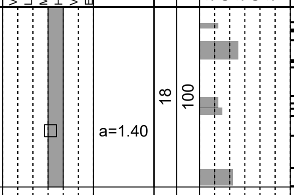
TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Engineering Log - Cored Borehole

HB-BH04-C

Project:	Heybridge Converter Station	**Page:**	3 of 3
Client:		**Location:**	Heybridge Converter Station Site, Heybridge TAS
Project No:	IS360318 -1		

Contractor:	Tasmanian Drilling	**Easting:**	414002.5 m	**Elevation:**	7.44 m	**Started:**	31/01/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452548.2 m	**Datum:**	AHD	**Finished:**	31/01/2022
Logged By:	MW **Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A



DRILLING				MATERIAL SUBSTANCE				ROCK MASS DEFECTS					
Method	Groundwater/ Water Loss (%)	RL (m)	Depth (m)	Graphic Log	**Description of Strata** ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type)	Weathering	Estimated Strength Is(50) (MPa) ☐ - Axial ○- Diametral	Point Load Strength Index Is(50) (MPa)	RQD (%)	TCR (%)	Defect Spacing (mm)	Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other)	General
HQ3	20	-1	8.5		QUARTZWACKE: fine grained, pale grey with minor orange staining; moderately weathered; high strength *8.10m: colour becoming pale grey with red staining*	MW	☐	a=1.40	18	100		FZ JT, 30°, UN, RF, SN, (Fe) FZ JT, 20°, PR, RF, SN, (Fe) JT, 80°, PR, RF, SN, (Fe) FZ JT, 15°, PR, RF, SN, (Fe) JT, 20°, PR, RF, SN, (Fe) JT, 45°, PR, RF, SN, (Fe) FZ	
			9.0		Exploratory hole terminated at 9.00 m Target depth							JT, 20°, UN, RF, VNR, (clay)	
		-2	9.5										
			10.0										
		-3	10.5										
			11.0										
		-4	11.5										
			12.0										
		-5	12.5										
			13.0										
		-6	13.5										
			14.0										
		-7	14.5										
			15.0										
		-8	15.5										

DRILLING

NMLC NMLC Coring
NQ NQ Coring
HQ HQ Coring
PQ PQ Coring

TCR % core run recovered
RQD % core run > 100mm long (sound rock fraction only measured)

GROUNDWATER SYMBOLS

▼ = Water level (static)

▶ = Water inflow

WEATHERING

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

ROCK STRENGTH (Is50 MPa)

0.03-0.1	Very Low (VL)
0.1-0.3	Low (L)
0.3-1.0	Medium (M)
1.0-3.0	High (H)
3.0-10	Very High (VH)
> 10	Extremely High (EH)

DEFECT ABBREVIATIONS

TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Photograph Template

Jacobs

Project Name:	Project Marinus-Heybridge SI
Project No:	IS360318
Date:	31/01/2022
Borehole ID:	HB- BH04-C
Sample Type:	SPT
Depth Range:	1.0 - 1.45m

Multiple

Client:	Tasmanian Networks	**Title:**	HB-BH04-C
Project:	Project Marinus - Heybridge SI		
Drawn: MW	**Checked:**	**Scale:** NTS	**Drawing Number:** 1/4

Photograph Template

Jacobs

Project Name:	Project Marinus-Heybridge SI
Project No:	IS360318
Date:	31/01/2022
Borehole ID:	HB-BH04-C
Sample Type:	SPT
Depth Range:	2.5-2.88m

Multiple

Client:	Tasmanian Networks		
Project:	Project Marinus - Heybridge SI		
Drawn:	MW	**Checked:**	

Title: HB-BH04-C

Scale: NTS

Drawing Number: 2/4

Multiple

Client: Tasmanian Networks

Project: Project Marinus - Heybridge SI

Drawn: MW

Checked:

Title: HB-BH04-C

Scale: NTS

Drawing Number: 3/4

Multiple

Client:	Tasmanian Networks		**Title:**	HB-BH04-C
Project:	Project Marinus - Heybridge SI			
Drawn:	MW	**Checked:**	**Scale:** NTS	**Drawing Number:** 4/4

Jacobs

Engineering Log - Excavation

HB-BH05-C

Project: Heybridge Converter Station
Page: 1 of 3
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

Contractor: Tasmanian Drilling
Easting: 414109.2 m
Elevation: 8.18 m
Started: 02/02/2022
Plant: Hanjin D&B 8-D
Northing: 5452459.6 m
Datum: AHD
Finished: 02/02/2022
Logged By: MW
Checked By: AC
Grid: GDA2020
Inclination: -90°
Orientation: N/A

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	**Material Description** SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
HA				8			FILL: Silty Sandy GRAVEL: fine to medium gravel, sub-angular to angular, pale brown grey, low plasticity silt, fine to coarse grained sand *0.15m: gravel becoming fine to coarse grained, cobbles sub-angular to angular of siltstone*	D D-M	D-VD		FILL 0.10 : ES
			SPT N=5 4,2,3	7	0.5 1.0		FILL: Sandy CLAY: low plasticity, black, fine to medium grained sand; with fine grained, sub-angular to angular gravel *0.85m: becoming Sandy Gravelly CLAY: low plasticity, black, fine to coarse grained sand, sub-angular to angular fine to medium grained gravel* *1.00m: colour changing to dark brown*	M <Wp	F		0.50 : ES 1.00 : ES, PID = 0.9 PPM
			SPT N=15 4,6,9	6 5	1.5 2.0 2.5 3.0		Clayey SILT: low plasticity, pale grey; trace fine to medium grained, sub-angular to angular gravel *2.00m: increasing silt content, reduced gravel content* *2.50m: reduced clay content* *3.00m: colour changed to grey mottled yellow brown*		St		RESIDUAL SOIL PP= 400 kPa, PID = 1.5 PPM 2.50 : PP > 600 kPa 3.00 : PID = 2.2 PPM, dosage = 3.0 CPS
		▼			3.5		Silty Sandy CLAY: low to medium plasticity, dark grey, fine to coarse grained sand; low plasticty silt; with fine grained, sub-angular to angular gravel *3.50m: becoming gravelly CLAY*	M >Wp	VSt		
				4 3 2 1	4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5		Continued as cored hole from 3.90m				

METHOD & SUPPORT	PENETRATION	GROUNDWATER	SAMPLES & FIELD TESTS	MOISTURE	DENSITY (N-value)	CONSISTENCY (SU) {N-value}
N Natural/Existing cutting E Excavator BH Backhoe Bucket B Buldozer R Ripper	No resistance ranging to refusal VE E F H VH	▼ = Water level (static) ▶ = Water inflow	D Disturbed Sample B Bulk Sample SPT SPT Sample U Undisturbed Sample E Enviro Sample W Water Sample HP Hand Penetrometer HV Hand Vane Shear (P: Peak Su R: Residual Su)	D = Dry M = Moist W = Wet Wp = Plastic Limit Wl = Liquid Limit	VL Very Loose 0 - 4 L Loose 4 - 10 MD Medium Dense 10 - 30 D Dense 30 - 50 VD Very Dense 50 - 100	VS Very Soft < 12 kPa {0-2} S Soft 12 - 25 {2-4} F Firm 25 - 50 {4-8} St Stiff 50 - 100 {8-15} VSt Very Stiff 100 - 200 {15-30} H Hard > 200 kPa {>30}

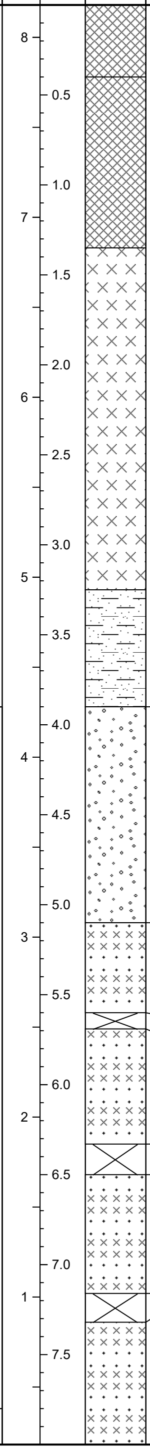
Engineering Log - Cored Borehole

HB-BH05-C

Project:	Heybridge Converter Station	**Page:**	2 of 3
Client:		**Location:** Heybridge Converter Station Site, Heybridge TAS	**Project No:** IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414109.2 m	**Elevation:**	8.18 m	**Started:**	02/02/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452459.6 m	**Datum:**	AHD	**Finished:**	02/02/2022
Logged By:	MW **Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A

DRILLING | MATERIAL SUBSTANCE | ROCK MASS DEFECTS



Method	Groundwater/ Water Loss (%)	Description of Strata ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type)	Weathering	Point Load Strength Index Is(50) (MPa)	RQD (%)	TCR (%)	Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other)
		Starting coring from 3.90 m					
HQ3	30	Extremely Weathered QUARTZWACKE: Recovered as GRAVEL: fine to coarse grained, sub-angular to angular; with low plasticity silt, with fine to coarse grained sand			0 19	57 56	
		QUARTZWACKE: fine grained, dark grey with orange staining; medium bedded; moderately weathered; high strength *5.20m: colour changing to dark grey with very minor yellow staining*	MW SW	d=1.40			FZ JT, 30°, PR, RF, CN, x2 SZ, 45°
		CORELOSS					
		QUARTZWACKE: fine grained, dark grey with minor orange staining; thinly bedded; slightly weathered; high strength	SW		0	82	FZ JT, 30°, PR, RF, CN, x6 JT, 30°, PR, RF, CN, x5 JT, 45°, ST, RF, CN
		CORELOSS			0	79	
		QUARTZWACKE: fine grained, dark grey with minor orange staining; very thinly bedded; slightly weathered; low to medium strength *6.75m: yellow staining increasing*	SW MW				SZ, 30° FZ
		CORELOSS			17	84	
	10	QUARTZWACKE: fine grained, dark grey with orange staining; thinly bedded; moderately weathered; low to medium strength *7.32m: increased orange brown staining* *7.62m: colour becoming dark grey* *7.80m: colour becoming pale grey with minor orange staining*	MW SW	a=0.13			JT, 15°, UN, RF, SN, (Fe) JT, 30°, UN, RF, SN, (Fe) FZ JT, 45°, PR, RF, CN JT, 20°, UN, RF, CN

Estimated Strength Is(50) (MPa): ☐ - Axial, ○ - Diametral; VL 0.1, L 0.3, M 1, H 3, VH 10, EH

Defect Spacing (mm): 20, 60, 200, 600, 2000

General

DRILLING

NMLC NMLC Coring
NQ NQ Coring
HQ HQ Coring
PQ PQ Coring

TCR % core run recovered
RQD % core run > 100mm long
(sound rock fraction only measured)

GROUNDWATER SYMBOLS

▼ = Water level (static)

▶ = Water inflow

WEATHERING

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

ROCK STRENGTH (Is50 MPa)

0.03-0.1	Very Low (VL)
0.1-0.3	Low (L)
0.3-1.0	Medium (M)
1.0-3.0	High (H)
3.0-10	Very High (VH)
> 10	Extremely High (EH)

DEFECT ABBREVIATIONS

TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Jacobs

Engineering Log - Cored Borehole

HB-BH05-C

Project: Heybridge Converter Station
Page: 3 of 3
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414109.2 m	**Elevation:**	8.18 m
Started:	02/02/2022	**Plant:**	Hanjin D&B 8-D	**Northing:**	5452459.6 m
Datum:	AHD	**Finished:**	02/02/2022	**Logged By:**	MW
Checked By:	AC	**Grid:**	GDA2020	**Inclination:**	-90°
Orientation:	N/A				

DRILLING | MATERIAL SUBSTANCE | ROCK MASS DEFECTS

Method	Groundwater/ Water Loss (%)	RL (m)	Depth (m)	Graphic Log	**Description of Strata** ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type)	Weathering	Estimated Strength Is(50) (MPa) ☐ - Axial ○- Diametral VL 0-1 L 0-3 M 1 H 3 VH 10 EH	Point Load Strength Index Is(50) (MPa)	RQD (%)	TCR (%)	Defect Spacing (mm) 20 60 200 600 2000	Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other)	General
		0			QUARTZWACKE: fine grained, dark grey with orange staining; thinly bedded; moderately weathered; low to medium strength							JT, 45°, PR, RF, SN, (Fe) JT, 45°, PR, RF, CN, x3	
			8.5		*8.50m: increased orange staining with minor red streaking*	SW			59	100		JT, 45°, PR, RF, SN, x2, (Fe)	
			9.0		Extremely Weathered QUARTZWACKE: Recovered as GRAVEL: fine to coarse grained, sub-angular to sub-rounded, dark grey with minor red mottling, with fine to coarse grained sand							JT, 20°, UN, RF, SN, (Fe)	
HQ3	10	-1			QUARTZWACKE: fine grained, pale grey with yellow brown staining; thinly to medium bedded; moderately weathered; high strength							JT, 60°, UN, RF, SN, x5, (Fe)	
			9.5		*9.35m: colour becoming pale grey with yellow/orange staining*	MW						FZ JT, 30°, PR, RF, SN, (Fe)	
			10.0					a=0.96 d=1.00	86	100			
		-2										JT, 20°, PR, RF, SN, x2, (Fe)	
			10.5		*10.6m: colour becoming pale grey with minor yellow staining*							CZ JT, 30°, PR, RF, SN, (Fe)	
			11.0		Exploratory hole terminated at 10.80 m Target depth								
		-3											
			11.5										
			12.0										
		-4											
			12.5										
			13.0										
		-5											
			13.5										
			14.0										
		-6											
			14.5										
			15.0										
		-7											
			15.5										

DRILLING

NMLC NMLC Coring
NQ NQ Coring
HQ HQ Coring
PQ PQ Coring

TCR % core run recovered
RQD % core run > 100mm long
(sound rock fraction only measured)

GROUNDWATER SYMBOLS

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ROCK STRENGTH (Is50 MPa)

0.03-0.1	Very Low (VL)
0.1-0.3	Low (L)
0.3-1.0	Medium (M)
1.0-3.0	High (H)
3.0-10	Very High (VH)
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DEFECT ABBREVIATIONS

TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
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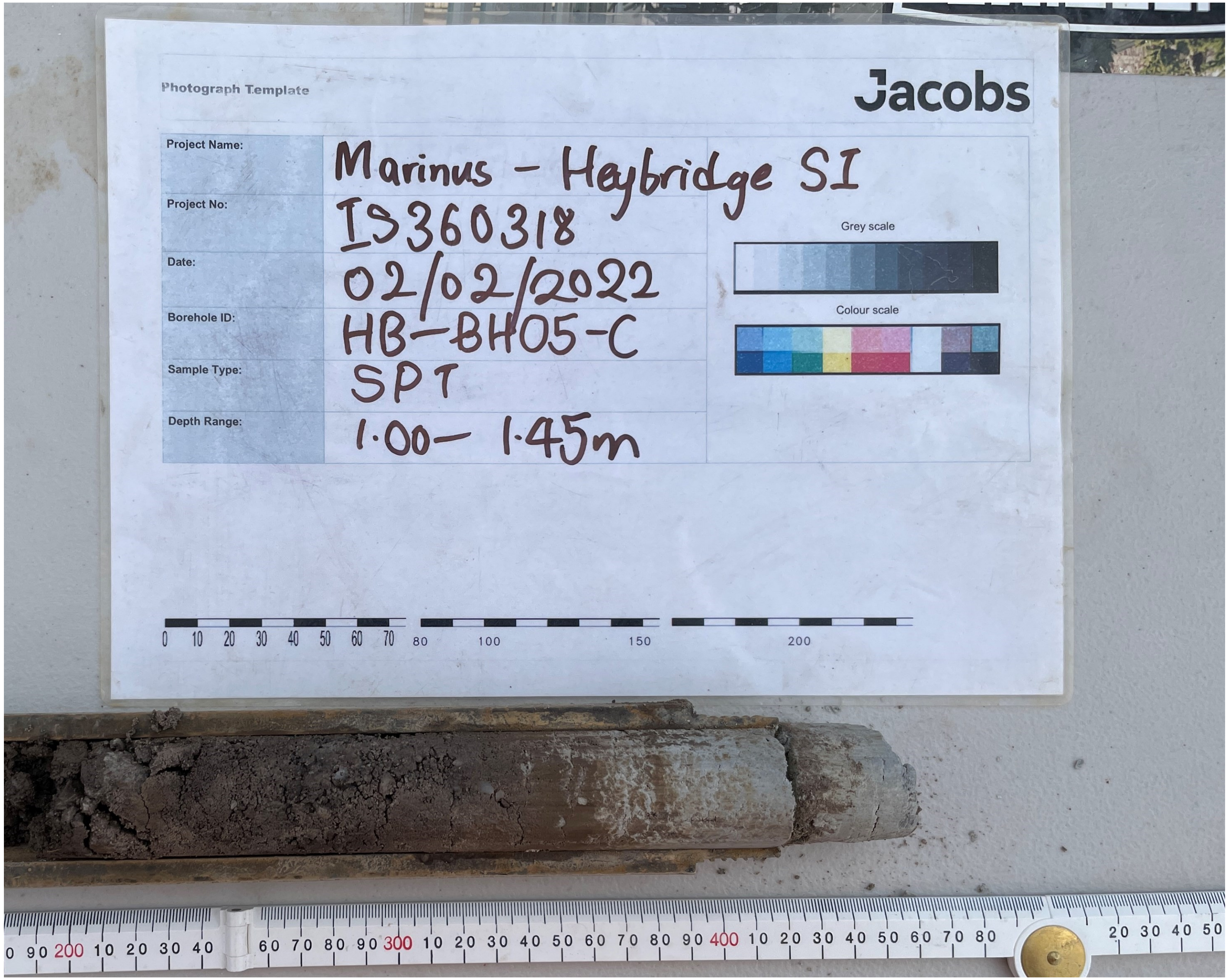
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

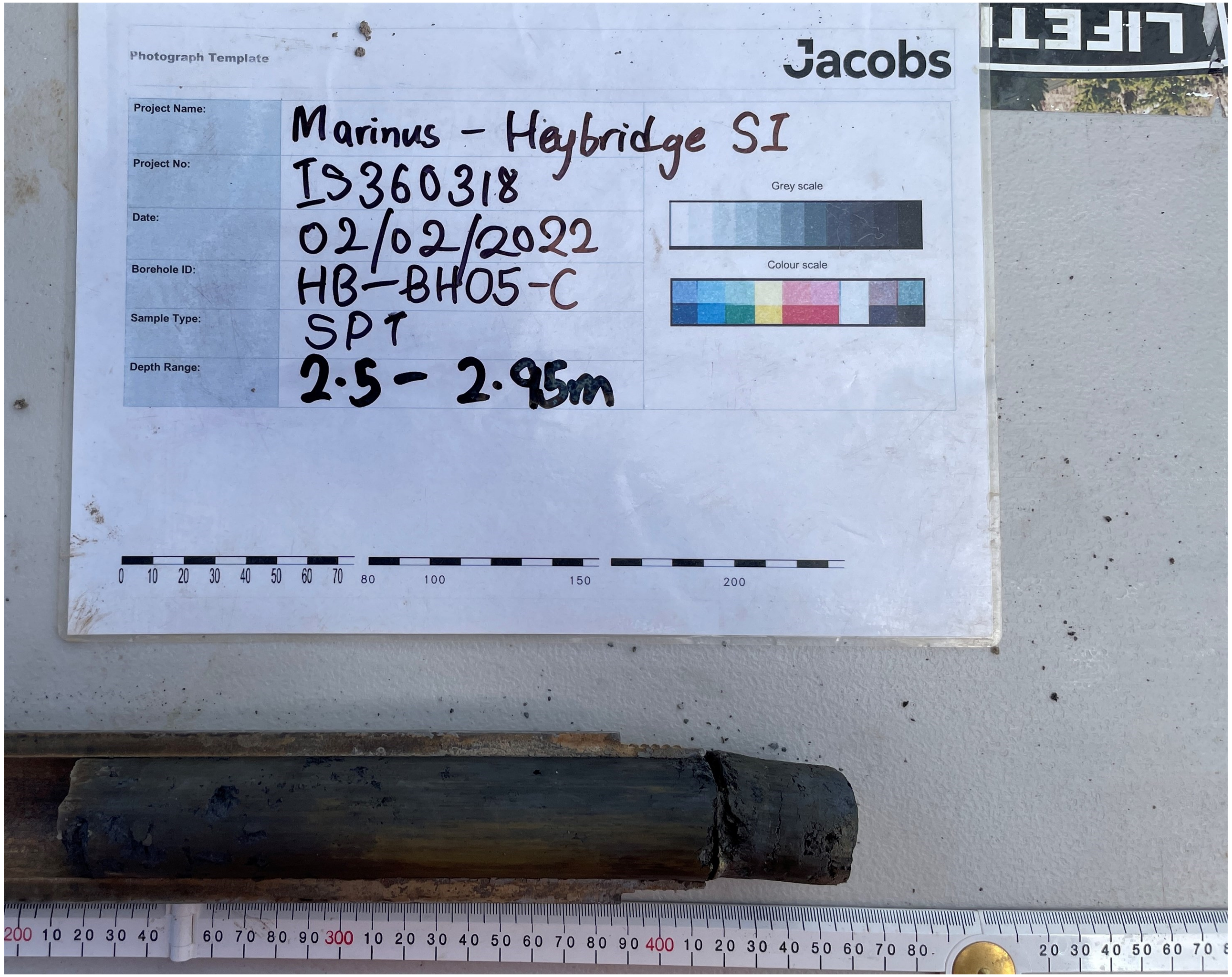


Multiple

Client:	Tasmanian Networks		
Project:	Project Marinus - Heybridge SI		
Drawn:	MW	**Checked:**	

Title:	HB-BH05-C		
Scale:	NTS	**Drawing Number:**	1/4

This figure was created for Jacobs' client. Jacobs accepts no responsibility for any reliance on this information by third parties.



Photograph Template

Jacobs

Project Name: Marinus – Heybridge SI

Project No: IS360318

Date: 02/02/2022

Borehole ID: HB-BH05-C

Sample Type: SPT

Depth Range: 2.5 - 2.95m

Multiple

Jacobs

Client: Tasmanian Networks

Project: Project Marinus - Heybridge SI

Drawn: MW **Checked:**

Title: HB-BH05-C

Scale: NTS **Drawing Number:** 2/4

Multiple

Client: Tasmanian Networks

Project: Project Marinus - Heybridge SI

Drawn: MW

Checked:

Title: HB-BH05-C

Scale: NTS

Drawing Number: 3/4

Multiple

Client: Tasmanian Networks

Project: Project Marinus - Heybridge SI

Drawn: MW **Checked:**

Title: HB-BH05-C

Scale: NTS **Drawing Number:** 4/4

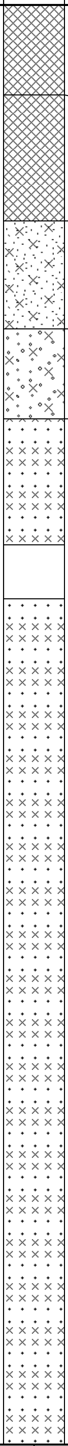
Engineering Log - Excavation

HB-BH06-C

Project:	Heybridge Converter Station			**Page:**	1 of 3
Client:		**Location:**	Heybridge Converter Station Site, Heybridge TAS	**Project No:**	IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414058.7 m	**Elevation:**	9.42 m	**Started:**	31/01/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452425.9 m	**Datum:**	AHD	**Finished:**	01/02/2022
Logged By:	MW **Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A

EXCAVATION INFORMATION | MATERIAL SUBSTANCE



Method	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm)	Field Test Data & Other Observations
HA					0.0	FILL: Clayey GRAVEL: fine to medium grained, angular to sub-angular, grey brown, low plasticity clay; with fine to coarse grained sand *0.15m: colour changing to yellow brown, gravels becoming fine to coarse grained, sub-angular to angular*	D-M	MD		FILL
			D	9	0.5	FILL: Silty GRAVEL: fine to medium grained, sub-angular to angular, black, low plasticity silt; with fine to coarse grained sand	M	D		0.50 : ES
			SPT N=R 8/85mm		1.0					1.00 : ES
						Silty SAND: fine to medium grained, brown, low plasticity silt; with fine grained, sub-angular to angular gravel				RESIDUAL SOIL
			SPT N=54 14,25,29	8	1.5			VD		
						Silty GRAVEL: fine to medium grained, sub-angular to angular, brown grey, low plasticity silt; with fine to coarse grained sand				
		▼			2.0					2.00 : ES
				7	2.5	Continued as cored hole from 2.30m				
					3.0					
				6	3.5					
					4.0					
				5	4.5					
					5.0					
				4	5.5					
					6.0					
				3	6.5					
					7.0					
				2	7.5					

DCP scale: 5 10 15 20

METHOD & SUPPORT	PENETRATION	GROUNDWATER	SAMPLES & FIELD TESTS	MOISTURE	DENSITY (N-value)	CONSISTENCY (SU) {N-value}
N Natural/Existing cutting E Excavator BH Backhoe Bucket B Buldozer R Ripper	No resistance ranging to refusal VE E F H VH	▼ = Water level (static) ▶ = Water inflow	D Disturbed Sample B Bulk Sample SPT SPT Sample U Undisturbed Sample E Enviro Sample W Water Sample HP Hand Penetrometer HV Hand Vane Shear (P: Peak Su R: Residual Su)	D = Dry M = Moist W = Wet Wp = Plastic Limit Wl = Liquid Limit	VL Very Loose 0 - 4 L Loose 4 - 10 MD Medium Dense 10 - 30 D Dense 30 - 50 VD Very Dense 50 - 100	VS Very Soft < 12 kPa {0-2} S Soft 12 - 25 {2-4} F Firm 25 - 50 {4-8} St Stiff 50 - 100 {8-15} VSt Very Stiff 100 - 200 {15-30} H Hard > 200 kPa {>30}

Engineering Log - Cored Borehole

HB-BH06-C

Project:	Heybridge Converter Station			**Page:**	2 of 3
Client:		**Location:**	Heybridge Converter Station Site, Heybridge TAS	**Project No:**	IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414058.7 m	**Elevation:**	9.42 m	**Started:**	31/01/2022
Plant:	Hanjin D&B 8-D	**Northing:**	5452425.9 m	**Datum:**	AHD	**Finished:**	01/02/2022
Logged By:	MW **Checked By:** AC	**Grid:**	GDA2020	**Inclination:**	-90°	**Orientation:**	N/A

DRILLING | MATERIAL SUBSTANCE | ROCK MASS DEFECTS

Columns: Method; Groundwater/ Water Loss (%); RL (m); Depth (m); Graphic Log; **Description of Strata** ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, major defect type); Weathering; Estimated Strength Is(50) (MPa) ☐ - Axial ○- Diametral (VL 0.1, L 0.3, M 1, H 3, VH 10, EH); Point Load Strength Index Is(50) (MPa); RQD (%); TCR (%); Defect Spacing (mm) (20, 60, 200, 600, 2000); Defect descriptions and additional observations (type, inclination, planarity, roughness, coating, thickness, other); General

RL (m): 9, 8, 7, 6, 5, 4, 3, 2

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5

Method: HQ3 — Groundwater/Water Loss (%): 30

Description of Strata	Weathering	Point Load Is(50) (MPa)	RQD (%)	TCR (%)
Starting coring from 2.30 m				
QUARTZWACKE: fine grained, dark grey with minor yellow staining; medium bedded; moderately weathered; very high strength	MW		0	100
2.75m: colour becoming pale grey with minor yellow staining	SW			
CORELOSS				
QUARTZWACKE: fine grained, pale grey with very minor yellow staining and white streaking; thinly to medium bedded; slightly weathered; high to very high strength *3.30m: colour becoming pale grey with very minor yellow staining, minor white streaking* *3.62m: quartz seam* *3.99m: quartz seam*	SW		48	75
			33	100
		a=1.90	29	100
6.00m: very minor yellow staining		a=3.20	36	100

Defect descriptions and additional observations:

FZ
JT, 40°, PR, RF, CN
JT, 40°, PR, RF, Filled, (quartz)
JT, 60°, PR, RF, VNR, (Silt)
JT, 60°, PR, RF, CT, (Silt)
FZ
SM, 45°, UN, RF, Filled, (Quartz seam)
JT, 45°, UN, RF, CN
JT, 60°, UN, RF, CN
FZ
JT, 60°, UN, RF, Filled, (quartz gravel)
FZ
JT, 30°, UN, RF, Filled, (gravel)
FZ
JT, 30°, UN, RF, CN
JT, 85°, UN, RF, CN
FZ
JT, 20°, UN, RF, CN
JT, 45°, UN, RF, CN
JT, 45°, PR, RF, CN
JT, 45°, PR, RF, CN
JT, 30°, UN, RF, CN
FZ
JT, 20°, UN, RF, CN
JT, 20°, UN, RF, CN
JT, 45°, PR, RF, CN
JT, 45°, PR, RF, CN
JT, 45°, PR, RF, CN
FZ
JT, 45°, PR, RF, CN
JT, 45°, UN, RF, CN
JT, 30°, UN, RF, CN
JT, 30°, UN, RF, CN
JT, 30°, UN, RF, CN
JT, 20°, UN, RF, CN

DRILLING

NMLC NMLC Coring
NQ NQ Coring
HQ HQ Coring
PQ PQ Coring

TCR % core run recovered
RQD % core run > 100mm long (sound rock fraction only measured)

GROUNDWATER SYMBOLS

▼ = Water level (static)
▶ = Water inflow

WEATHERING

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

ROCK STRENGTH (Is50 MPa)

0.03-0.1	Very Low (VL)
0.1-0.3	Low (L)
0.3-1.0	Medium (M)
1.0-3.0	High (H)
3.0-10	Very High (VH)
> 10	Extremely High (EH)

DEFECT ABBREVIATIONS

TYPE		COATING	PLANARITY	ROUGHNESS
BP Bedding Parting	FZ Fracture Zone	CN Clean	CU Curved	VR Very Rough
JT Joint	VN Vein	CT Coating	IR Irregular	RF Rough
SM Seam	FL Foliation	SN Stain	PR Planar	S Smooth
CS Crushed Seam	VO Void	VR Veneer	ST Stepped	POL Polished
CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Jacobs

Engineering Log - Cored Borehole

HB-BH06-C

Project: Heybridge Converter Station
Page: 3 of 3
Client:
Location: Heybridge Converter Station Site, Heybridge TAS
Project No: IS360318 -1

Contractor:	Tasmanian Drilling	**Easting:**	414058.7 m	**Elevation:**	9.42 m
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Plant:	Hanjin D&B 8-D	**Northing:**	5452425.9 m	**Datum:**	AHD
Finished:	01/02/2022				
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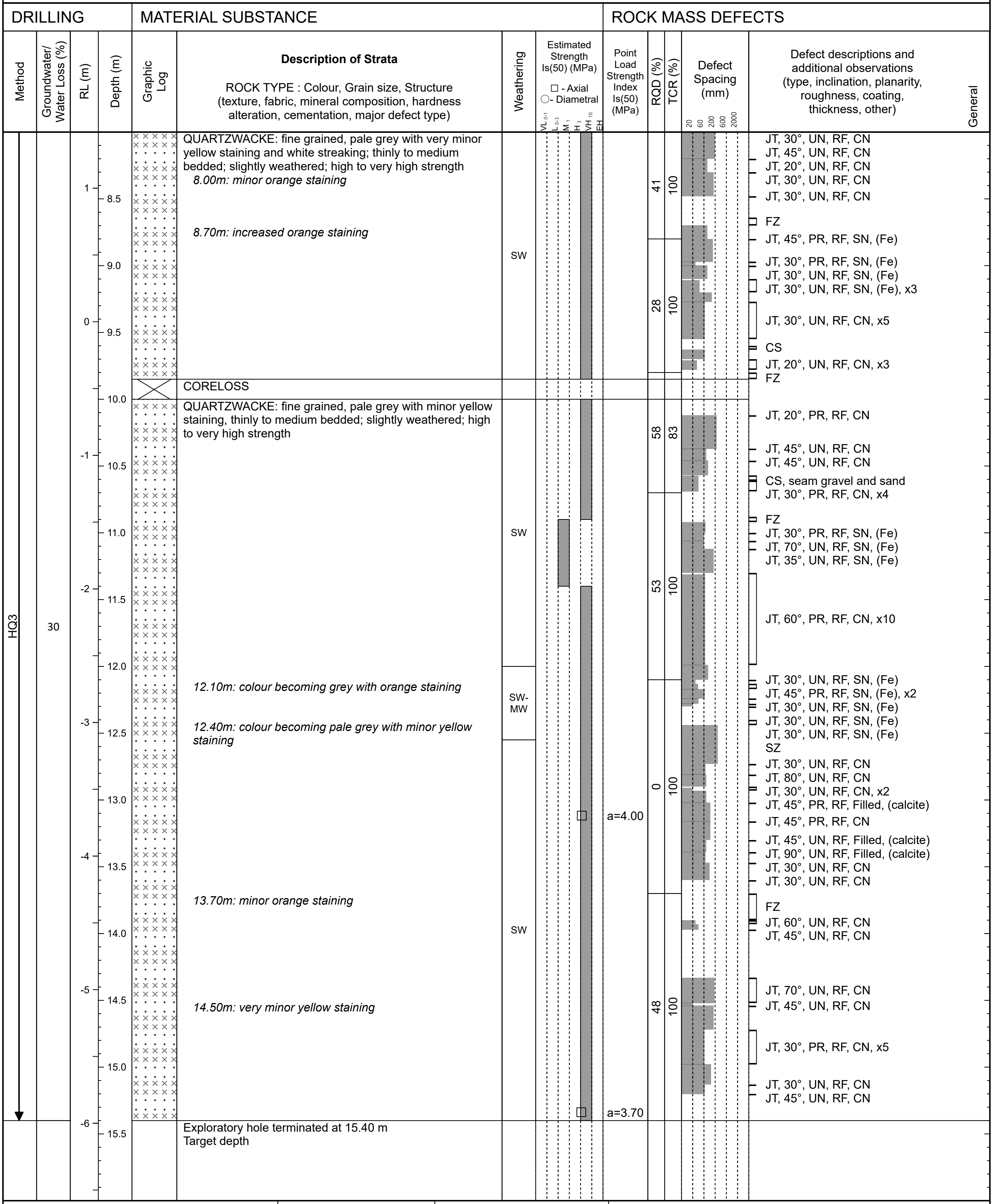
Inclination:	-90°	**Orientation:**	N/A		



DRILLING | MATERIAL SUBSTANCE | ROCK MASS DEFECTS

QUARTZWACKE: fine grained, pale grey with very minor yellow staining and white streaking; thinly to medium bedded; slightly weathered; high to very high strength

8.00m: minor orange staining

8.70m: increased orange staining

CORELOSS

QUARTZWACKE: fine grained, pale grey with minor yellow staining, thinly to medium bedded; slightly weathered; high to very high strength

12.10m: colour becoming grey with orange staining

12.40m: colour becoming pale grey with minor yellow staining

13.70m: minor orange staining

14.50m: very minor yellow staining

Exploratory hole terminated at 15.40 m
Target depth

Weathering: SW, SW, SW-MW, SW

Point Load Strength Index: a=4.00, a=3.70

RQD (%)	TCR (%)
41	100
28	100
58	83
53	100
0	100
48	100

Defect descriptions:

JT, 30°, UN, RF, CN
JT, 45°, UN, RF, CN
JT, 20°, UN, RF, CN
JT, 30°, UN, RF, CN
JT, 30°, UN, RF, CN
FZ
JT, 45°, PR, RF, SN, (Fe)
JT, 30°, PR, RF, SN, (Fe)
JT, 30°, UN, RF, SN, (Fe)
JT, 30°, UN, RF, SN, (Fe), x3
JT, 30°, UN, RF, CN, x5
CS
JT, 20°, UN, RF, CN, x3
FZ
JT, 20°, PR, RF, CN
JT, 45°, UN, RF, CN
JT, 45°, UN, RF, CN
CS, seam gravel and sand
JT, 30°, PR, RF, CN, x4
FZ
JT, 30°, PR, RF, SN, (Fe)
JT, 70°, UN, RF, SN, (Fe)
JT, 35°, UN, RF, SN, (Fe)
JT, 60°, PR, RF, CN, x10
JT, 30°, UN, RF, SN, (Fe)
JT, 45°, PR, RF, SN, (Fe), x2
JT, 30°, UN, RF, SN, (Fe)
JT, 30°, UN, RF, SN, (Fe)
JT, 30°, UN, RF, SN, (Fe)
SZ
JT, 30°, UN, RF, CN
JT, 80°, UN, RF, CN
JT, 30°, UN, RF, CN, x2
JT, 45°, PR, RF, Filled, (calcite)
JT, 45°, PR, RF, CN
JT, 45°, UN, RF, Filled, (calcite)
JT, 90°, UN, RF, Filled, (calcite)
JT, 30°, UN, RF, CN
JT, 30°, UN, RF, CN
FZ
JT, 60°, UN, RF, CN
JT, 45°, UN, RF, CN
JT, 70°, UN, RF, CN
JT, 45°, UN, RF, CN
JT, 30°, PR, RF, CN, x5
JT, 30°, UN, RF, CN
JT, 45°, UN, RF, CN

DRILLING

NMLC NMLC Coring
NQ NQ Coring
HQ HQ Coring
PQ PQ Coring

TCR % core run recovered
RQD % core run > 100mm long
(sound rock fraction only measured)

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CZ Crushed Zone	DB Drilling Break	FILLED Filled	UN Undulated	SL Slickensided
SZ Shear Zone	HB Handling Break		DIS Discontinuous	

Photograph Template

Project Name:	Project Marinus-Heybridge SI
Project No:	IS360318
Date:	31/01/2022
Borehole ID:	HB-BH06-C
Sample Type:	SPT
Depth Range:	1.0-1.065m

Multiple

Client:	Tasmanian Networks	**Title:**	HB-BH06-C
Project:	Project Marinus - Heybridge SI		
Drawn: MW	**Checked:**	**Scale:** NTS	**Drawing Number:** 1/6

Photograph Template

Jacobs

Project Name: Project Marinus-Heybridge SI

Project No: IS360318

Date: 31/01/2022

Borehole ID: HB-BH06-C

Sample Type: SPT

Depth Range: 1·5-1·95m

Multiple

Client: Tasmanian Networks

Project: Project Marinus - Heybridge SI

Drawn: MW

Checked:

Title: HB-BH06-C

Scale: NTS

Drawing Number: 2/6