Consulting Geotechnical Engineers

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ACN 005 777 060

GIPPSLAND PORTS

BULLOCK ISLAND, LAKES ENTRANCE

LEFL UNLOADING FACILITY DEVELOPMENT

PROPOSED REPLACEMENT JETTY

GEOTECHNICAL INVESTIGATION

INTERPRETIVE REPORT NO V2206R1
DECEMBER 2022

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DOCUMENT INFORMATION

project number:	V2206
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name of client:	Gippsland Ports
name / address of project:	Bullock Island, Lakes Entrance. Proposed replacement of the LEFL south unloading jetty.
document version:	R1

version	date issued	reviewed by	issued to
R1	22/12/2022	George Black	Damian Crozier, Gippsland Ports DamianC@gippslandports.vic.gov.au

version	version description/comments
R1	first issue

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This document presents the conditions encountered at the time of the fieldwork and is not intended to be a complete and exhaustive statement of all conditions present. The information in this document is limited by the investigation scope and/or extent, as well as other information provided to, or obtained by, Black Geotechnical.

Site conditions and legal requirements may change over time from various influences, including (but not limited to) anthropogenic, climatic and regulatory variations, which may invalidate recommendations provided in this document.

Conditions may differ between investigation points or below investigation depths, which may invalidate recommendations provided in this document.

CONTENTS

1.0 GENERAL

1.1 Purpose of investigation

This report presents the results of a geotechnical investigation performed at the site of the proposed replacement of the Lakes Entrance Fishing Limited (LEFL) south unloading jetty on Bullock Island, Lakes Entrance.

A locality plan is shown in below in Image 1.

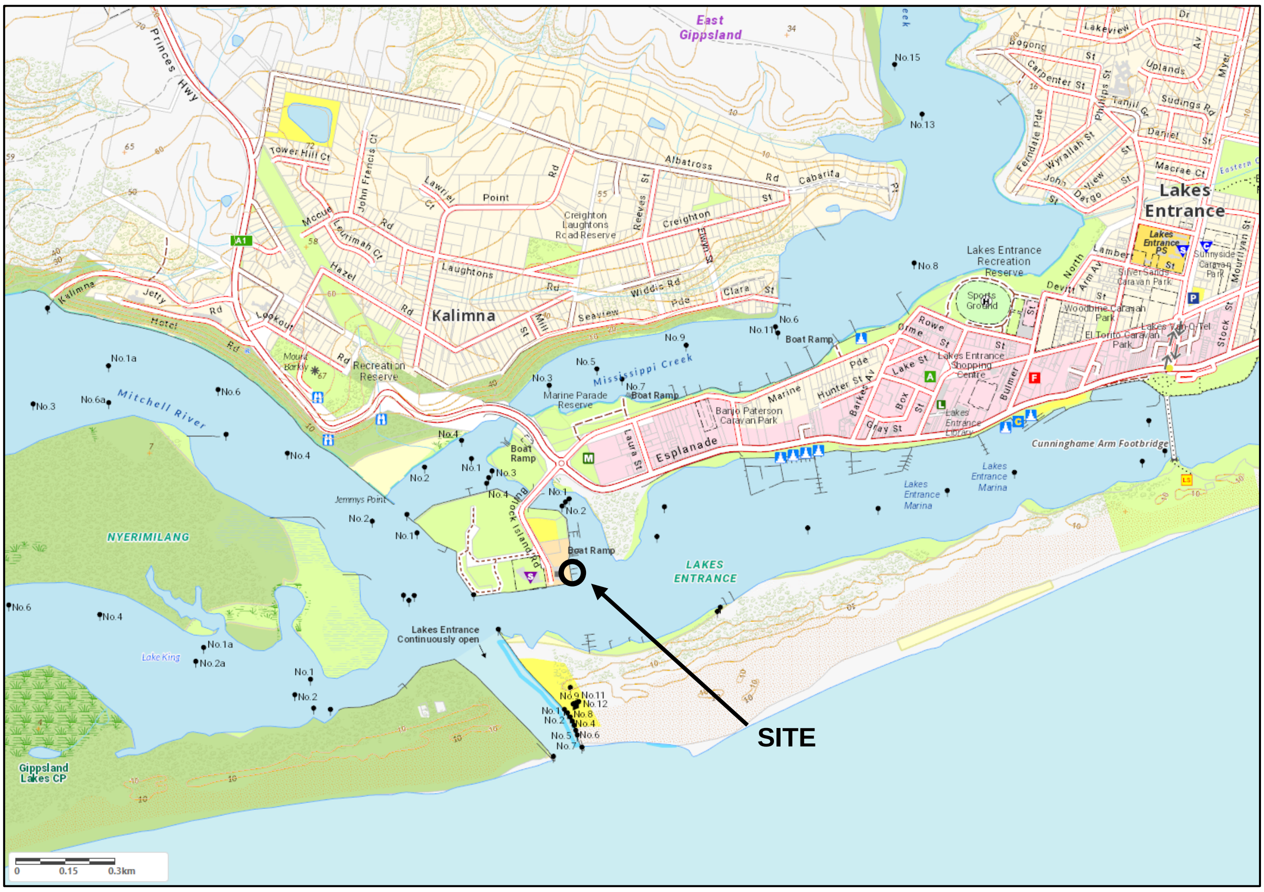

Image 1 - Locality plan. Source Victoria Mapshare.

The purpose of the investigation was to:

- Determine the sub-surface conditions at the site.
- Provide an earthquake sub-soil class in accordance with AS 1170.4 – 2007.
- Provide recommendations on footing type, depth, capacity (axial and lateral) and testing.
- Provide estimates of footing settlement.
- Discuss construction.

1.2 Proposed jetty

It is understood it is proposed to replace the existing jetty with a 27 m long and 5 m wide jetty on the same alignment.

It is understood the proposed jetty will be supported on driven piles. The preferred pile is steel CHS with 355 mm diameter and 9.5 mm thickness. Driven concrete and steel piles are discussed in this report. It is understood the jetty will have three piles at each pier location.

It is understood the maximum ULS axial load is about 300 kN.

It is understood the estimated maximum lateral load is 300 kN, however, the exact lateral load is not known at this stage. A lateral load range of 75-300 kN has been evaluated in Section 3 of this report to allow for any changes from the current estimated lateral load.

It is understood that the proposed jetty will have a concrete superstructure, including a 100 mm thick cast in-situ concrete deck, 300 mm deep precast beam planks and 300 mm deep x 600 mm wide precast concrete crossheads. As the proposed structure is relatively rigid, it is reasonable to assume the lateral load will be distributed amongst the three piles in a single pile group in the event of a significant lateral load caused by an impact perpendicular to the jetty. It is assumed the buffer piles will prevent an impact from occurring at the end of the jetty.

An extract from the proposed jetty layout and elevation, provided by Gippsland Ports, is shown below in Image 2.

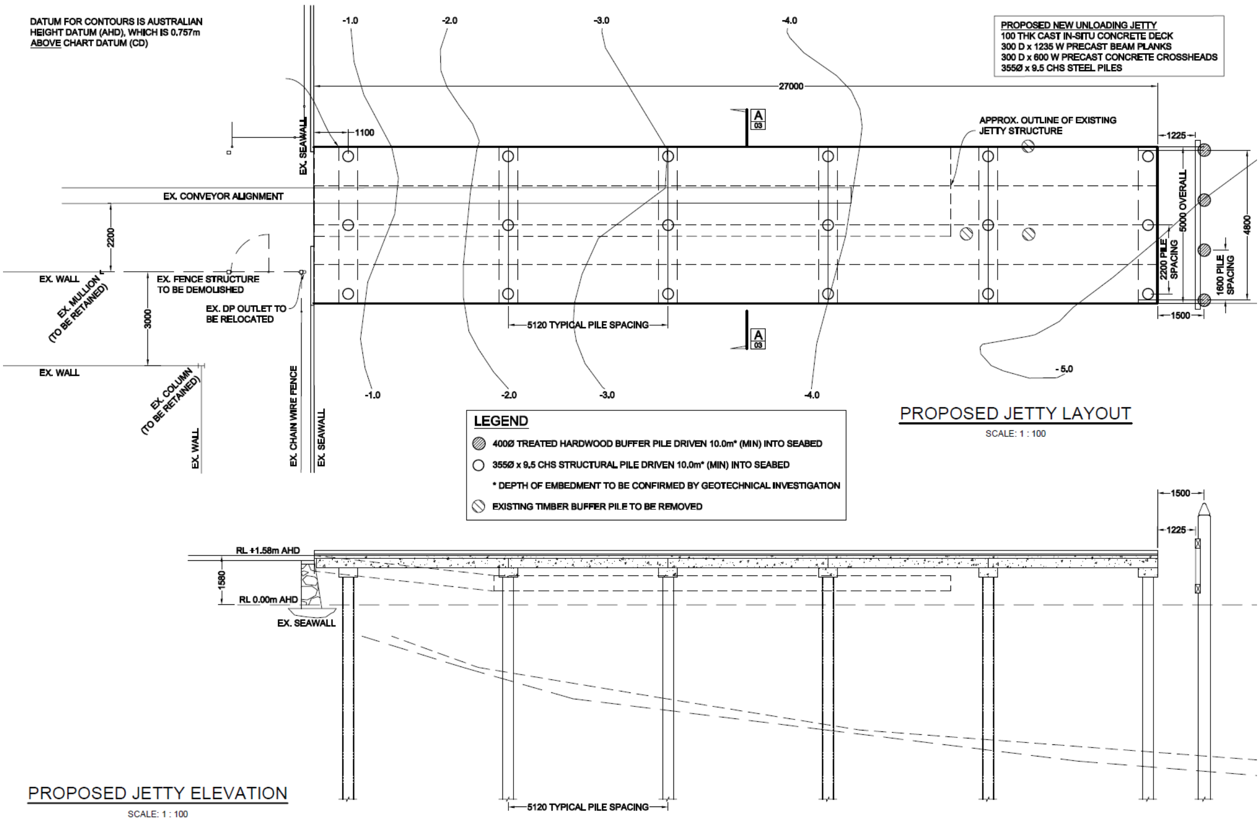

Image 2 - Proposed jetty layout and elevation. Gippsland Ports Drawing No. 23-417_LEFL-ULJS-02

1.3 Existing conditions

The existing jetty is about 20.5 m long and 3 m wide. The jetty deck is supported by timber posts spaced about 1.65 m apart. The jetty is primarily used to transport fish from boats into the LEFL building.

Photos of the site are shown below in Images 3 to 7.

Image 3 - View of the drill rig setting up on the barge.

Image 4 - Aerial view of the drill rig, looking west back towards the Fisherman's Co-Op.

Image 5 - View of the existing jetty, looking northwest.

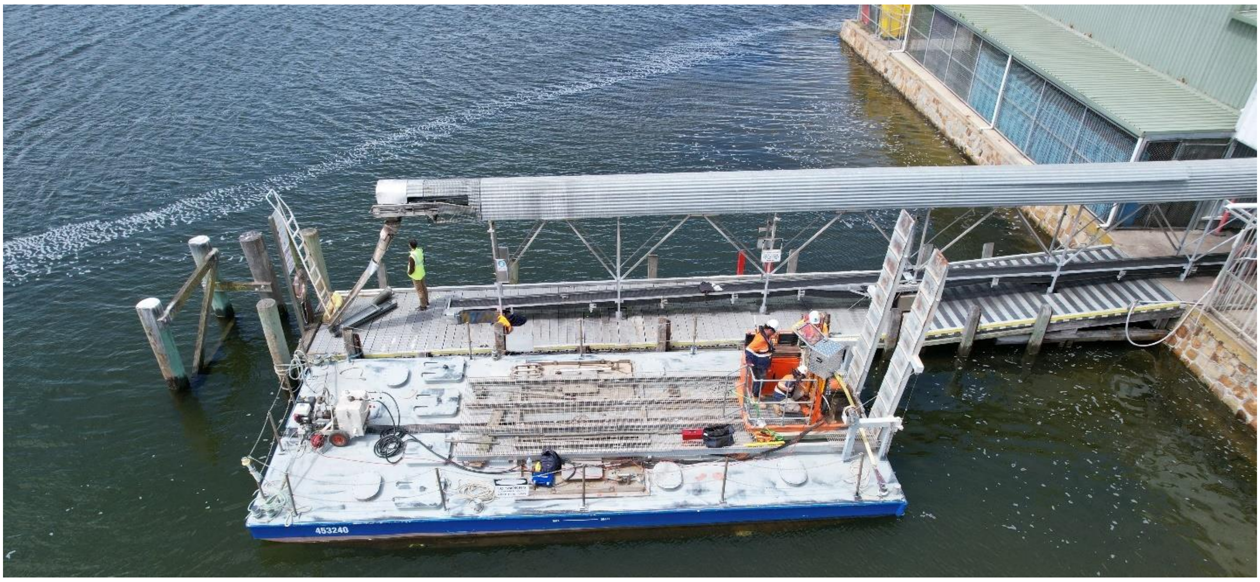

Image 6 - Aerial view of the CPT rig setting up for CPT01, looking south.

Image 7 - View of Bullock Island, looking west.

continued...

2.0 SUBSURFACE CONDITIONS

2.1 Reported geology

The GeoVic3 online, 1:250,000 series, 2007-2014 seamless geological database, indicates the site surface geology is Quaternary period coastal dune deposits of sand, silt and clay (Qdl1). Older Neogene period Haunted Hills Formation (Nlh) consisting of sand, silt and clay is shown about 625 m northwest of the site.

An extract from the GeoVic3 database is shown in Image 8.

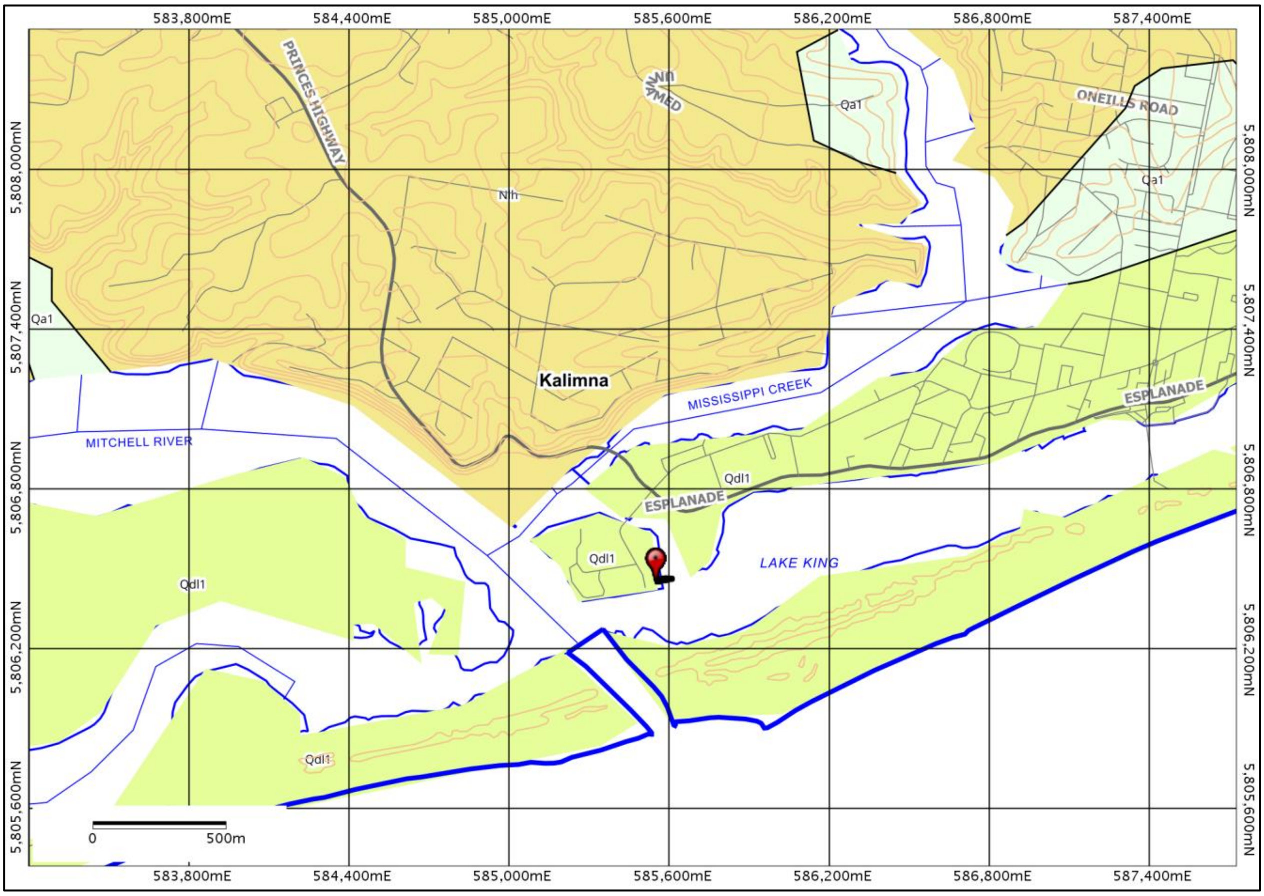

Image 8 - Extract from the GeoVic3 database. Site location denoted by red teardrop.

2.2 Fieldwork

To assess the site sub-surface conditions two Cone Penetration Tests (CPTs) were pushed to depths of 4.87 m & 2.34 m, respectively, and one rotary drilled borehole was drilled to a depth of 16.35 m. All depths are from below the lakebed level at the test location.

The CPTs were performed using a portable CPT platform, owned and operated by Black Insitu Testing.

The rotary drill borehole was performed by a small, track mounted, Comacchio 205 drill rig, owned and operated by Star Drilling.

The approximate test locations are shown in Figure 1 included in Appendix A, and in an extract from the test location plan, Image 9.

CPT plots showing corrected cone resistance, sleeve friction, pore pressure and friction ratio together with a description of the cone penetration test are included in Appendix A.

Engineering logs of the boreholes and a summary of descriptive terms used in logging are included in Appendix A.

Standard penetration tests were conducted at regular intervals in the boreholes. The results are shown on the logs.

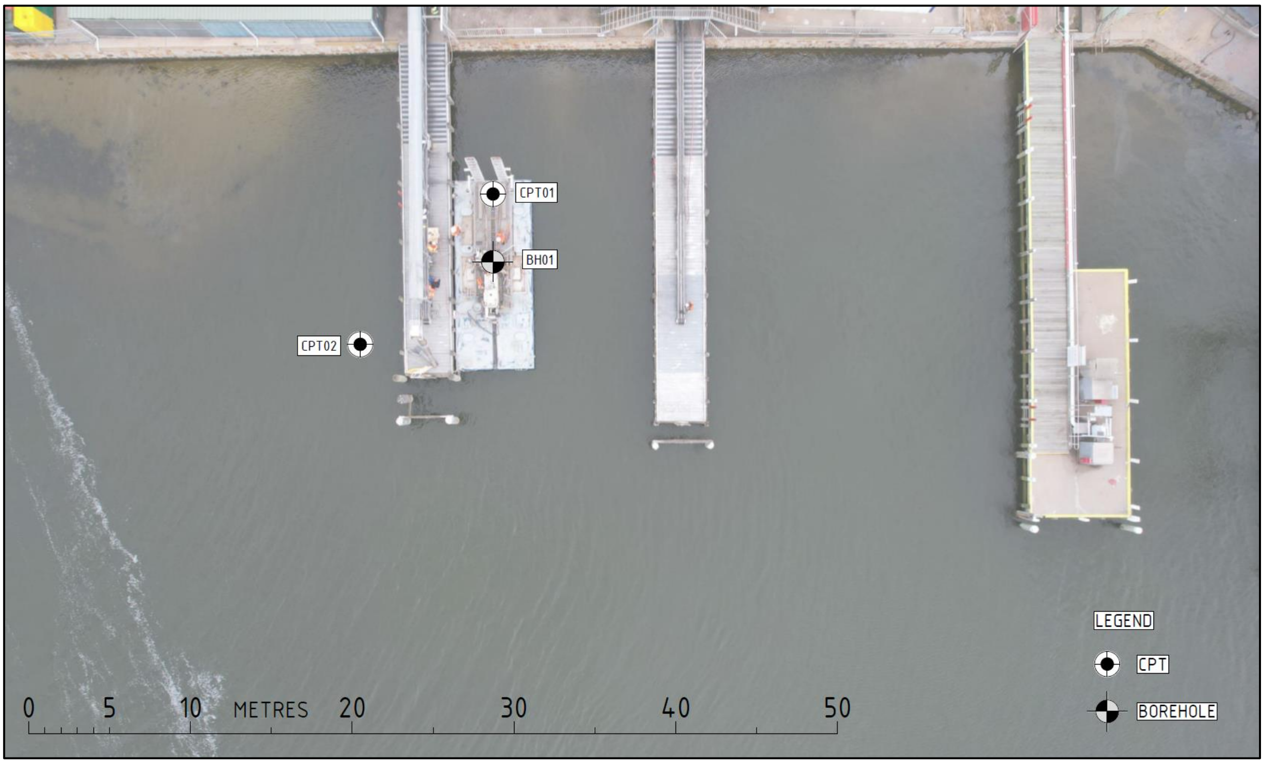

Image 9 – CPT and borehole location plan. North is to the right on the image.

2.3 Subsurface profile

The borehole and CPTs encountered relatively uniform sub-surface conditions consistent with the reported geology of the site.

The subsurface profile encountered in the CPTs and borehole is summarised in Table 2.3.1.

Note the depths are all measured from lakebed level. Depending on tides and distance from the shore, the lake water level was about 4.1±0.5 m above the lakebed level at the centre of the jetty during the investigation.

The jetty deck is about 5.7 m above lakebed level at the end of the jetty.

Table 2.3.1. Summary of subsurface profile

stratum			depth & thickness (m)		
unit	type	description	top	base	thickness
1	COASTAL DUNE DEPOSITS	SAND, loose, fine to coarse grained, brown-pale brown with pale-grey & dark brown granules, wet Becoming medium dense, with seashells, from 1.2-1.5 m.	0.0	4.8	4.8
2	HAUNTED HILLS FORMATION	Clayey SAND, medium dense, fine to medium grained, orange-brown, wet	4.8	6.05	1.25
		Sandy CLAY, stiff, medium to high plasticity, pale brown mottled grey-orange, W>Wp Becoming firm from 7.8 m.	6.05	12.3	6.25
		Sandy SILT, very stiff to hard, low plasticity, pale grey, W>Wp, very fine grained sand.	12.3	>16.25	>3.95

The CPT01 refused on medium dense sand layer at the top of the Haunted Hills Formation, and CPT02 refused on a medium dense sand layer encountered in the Coastal Dune Deposits.

2.4 Groundwater

As the investigation was conducted under the lake water level, it is assumed that the subsurface soil is saturated.

2.5 Laboratory testing

A suite of environmental laboratory tests, including pH, chloride, sulphate, and conductivity, were conducted on samples of soil recovered from the site for the purpose of durability design.

The test results are summarised in Table 2.5.1. The test certificates and chain of custody are included in Appendix A.

Table 2.5.1. Summary of environmental laboratory testing results

Log ID	depth, m	soil condition [A]	pH	conductivity (µS/cm)	resistivity (ohm.cm)	chloride [B] (ppm)	sulphate [B] (ppm)
BH01	70-7.45	A	5.2	1,400	710	2,500	380
BH01	13.0-13.45	A	5.0	1,800	560	3,400	480

[A] Refer to AS2159 – 2009, Table 6.4.2(C) and Table 6.5.2(C). Relevant to recovered sample.
[B] Units in parts per million (ppm), or mg/kg for soil samples and mg/L for water sample.

AS2159 – 2009, Table 6.4.2(C) and Table 6.5.2(C) provide the following classification for soil type:

- Soil condition A – high permeability soils (e.g., sands and gravels) which are in groundwater.
- Soil condition B – low permeability soils (e.g., silts and clays) or all soils above groundwater.

Based on AS2159 – 2009, Table 6.4.2(C) and Table 6.5.2(C), and the above laboratory test results, the following exposure classifications are applicable:

- Concrete piles in soil – ‘moderate’ for soil condition A, and ‘mild’ for soil condition B.
- Steel piles in soil – ‘severe’ for soil condition A, and ‘moderate’ for soil condition B as the resistivity is <1000.

The soil at the site is ‘Soil condition A’ as there is granular soil beneath the regional groundwater table. Based on the foregoing, the exposure classification for concrete piles is ‘moderate’ and for steel piles is ‘severe’.

It should be noted that in accordance with AS 2159-2009, Table 6.5.2(A), the exposure classification for steel piles in water is ‘severe’.

3.0 DISCUSSION & RECOMMENDATIONS

3.1 Earthquake classification

The Earthquake Site Sub-Soil Class in accordance with AS 1170.4 – 2007, Structural design actions, Part 4: Earthquake actions in Australia, Section 4, is judged to be **Class D_e.** This is due to the depth of the Haunted Hills Formation and the underlying unconsolidated Sale Group soil

The Hazard Factor (Z) in accordance with AS 1170.4 – 2007 is **0.09**.

3.2 Relevant levels and depths

Relevant levels and depths are shown in Table 3.2.1.

Table 3.2.1. Relevant levels and depths

location	depth below proposed jetty (m)[1]	reduced level, AHD (m)
Top of seawall	-0.55	1.65
Pier end	0	1.1
CPT01	-0.3	1.4
CPT01 ground surface level	4.2	-3.1
CPT02 test height	-0.3	1.4
CPT02 ground surface level	-5.7	-4.6
BH01 test height	1.05	0.05
BH01 ground surface level	5.75	-4.65

[1]proposed jetty level is assumed to be the same as the existing jetty level, RL 1.1 m AHD

3.3 Footing Recommendations

3.3.1 Footing Type

Driven steel CHS piles are suitable for the jetty.

Due to the relatively significant depth of water and presence of loose soil at the site, the steel CHS piles will need to have a relatively large diameter to achieve the required lateral capacity. 508x12.7 mm steel CHS piles are discussed in Section 3.3.2.

Axial capacities for 508 mm steel CHS piles are discussed in Section 3.3.3. For a CHS pile, the design geotechnical strength end bearing is applied to the gross sectional area on the assumption that a plug will form in the lower part of the pile.

3.3.2 Laterally loaded pile performance

The performance of the steel CHS piles under lateral loaded has been estimated using L-Pile (produced by Ensoft). The pile was modelled as an elastic section. An elastic modulus of 210 GPa and a yield stress of 240 MPa have been adopted for the modelling.

The exact applied lateral load is not known at this stage, so a range of lateral loads understood to be reasonable have been evaluated. Due to the relatively rigid superstructure, a fixed-head condition (pile top is prevented from rotating) is adopted for the analysis, this condition should be confirmed by the jetty designers.

It has been assumed that the lateral load will be applied 6 m above the above the ground surface, this is based on the impact occurring at the end of the jetty during high tide. In the analysis, the top 1 m of soil below the surface level has been ignored to account for potential erosion. A pile embedment depth of 13 m below the ground surface level has been adopted for the model, this is based on the pile depth required penetrate the very stiff to hard sandy silt.

Table 3.3.2.1 outlines the results from the analysis for a 508x12.7 mm steel CHS pile. The lateral loads range from 25-100 kN per pile to evaluate the understood lateral load range of 75-300 kN on a single pile group.

 continued...

Table 3.3.2.1. Pile performance for a 508x12.7 mm steel CHS pile with a fixed-head condition

Lateral load (kN) per pile	Deflection (mm)	Maximum moment (kNm)	Maximum shear force (kN)
25	17.6	128	32.1
50	39.6	267	67.0
75	63.3	409	101
100	88.0	553	133

Results from the L-Pile analysis are shown in Image 10 for the 100 kN lateral load with a fixed-head condition.

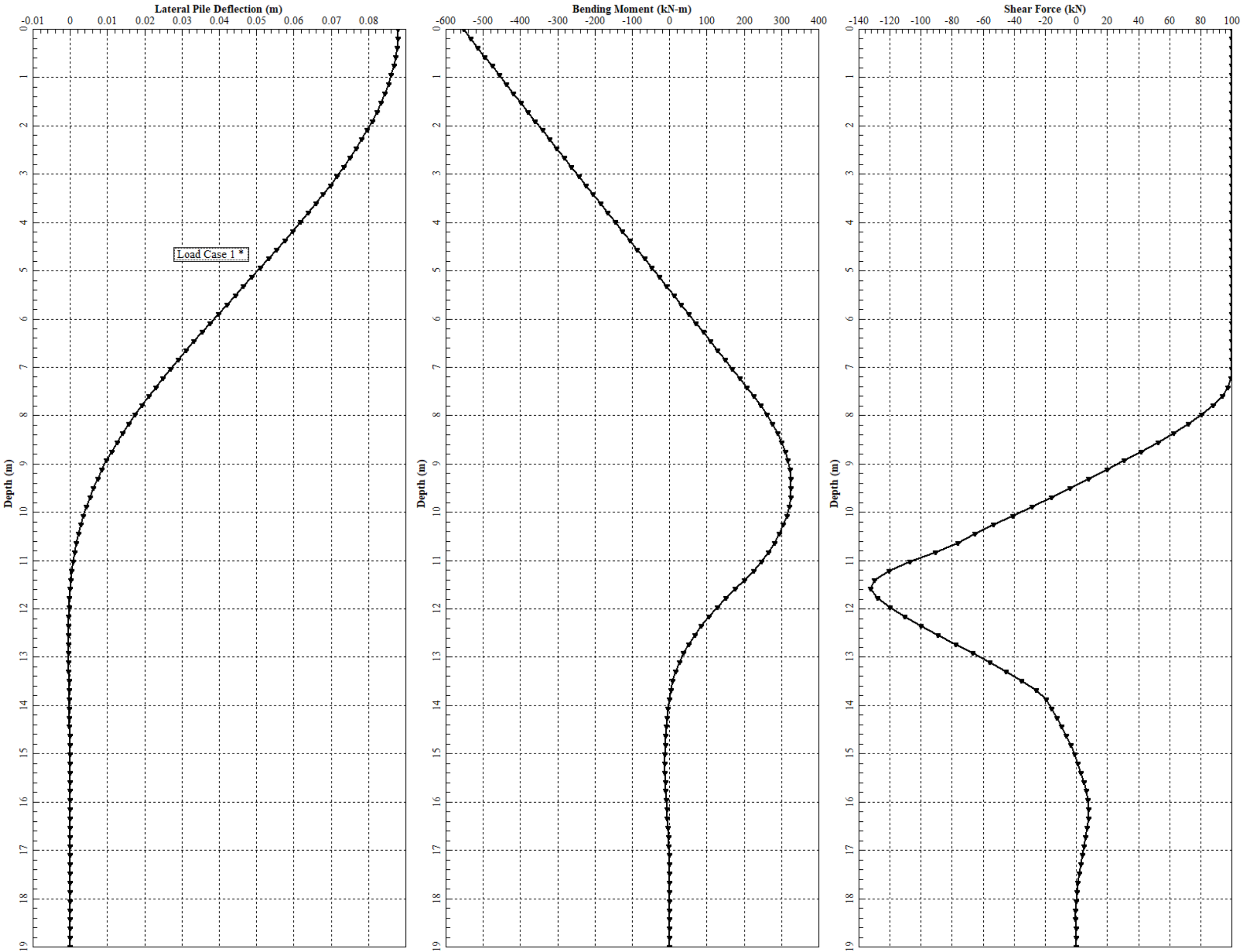

Image 10 – L-pile results for a 508x12.7 mm steel CHS pile with 100 kN applied 6 m above surface level. Fixed head condition.

The lateral analysis above is based on a relatively wide range of lateral loads. If the final lateral loads are at the lower end of the range provided to Black Geotechnical, the feasibility of smaller diameter steel CHS piles could be evaluated.

If the pile is deemed to not have a fixed-head condition, the deflections of the piles will likely exceed the tolerable deflection limit. If this is the case, the model may have to be re-evaluated with the CHS piles backfilled with concrete to strengthen their lateral capacity.

3.3.3 Axial pile capacity

The 508 mm steel CHS piles will achieve the design geotechnical capacity with a combination of end bearing and shaft adhesion.

It is recommended that a driven pile capacity is determined from a combination of:

- A design geotechnical strength shaft adhesion of 15 kPa below a depth of 2 m (RL -6.65 m) below lakebed level.

- A design geotechnical strength end bearing pressure of 750 kPa in the very stiff to hard sandy silt stratum below a depth of 12.3 m, below lakebed level.

Based on the above pile design parameters, a 508 steel CHS pile will achieve a capacity of 414 kN with an embedment depth of 13 m (RL -17.65 m). The ground surface level varies across the jetty alignment, so both an embedment depth of 13 m and a pile toe RL of no higher than -17.65 m should be maintained, whichever results in longer piles. The pile capacity for the 508 mm steel CHS pile is calculated as follows:

Shaft adhesion 11 m (13 – 2 m) x 1.6 m x 15 kPa + end bearing 0.20 m^2 x 750 kPa = 414 kN > 300 kN

3.3.4 Footing settlement

The theoretical maximum post construction vertical settlement of the proposed driven piles under SLS loads due to ground compression is less than 5 mm. The settlement computation assumes the SLS is 75% of the assumed ULS load.

Driven pile settlement estimates are based on the elastic solutions of Poulos, 1972.

3.3.5 Footing testing

It is recommended that high strain dynamic testing with wave matching analysis (PDA testing) is conducted on a minimum of 5% of the total number of driven piles. Dynamic testing should be conducted using a Pile Driving Analyzer® with CAPWAP modelling (or similar).

The pile test load is calculated by dividing the design action effect on the pile (i.e. the pile ULS load), E_d, by the geotechnical strength reduction factor, Φ_g, where $\Phi_g = \Phi_{gb} + (\Phi_{tf} - \Phi_{gb})$ *K ≥ Φ_g.

Φ_g = geotechnical strength reduction factor
Φ_{gb} = basic geotechnical strength reduction factor (determined as in Appendix A)
Φ_{tf} = intrinsic geotechnical strength reduction factor = 0.8 for dynamic load testing of preformed piles
K = testing benefit factor = 1.13p/(p+3.3) ≤ 1
p = percentage of the total piles that are tested and meet the specified acceptance criteria

For this site, it is estimated that Φ_{gb} = 0.48. For 5% of piles tested, a Φ_g of 0.70 is appropriate. For a ULS load of 300 kN, this results in a pile test load of 430 kN.

If no piles are tested, $\Phi_g = \Phi_{gb}$ = 0.48.

The capacities of untested piles can be confirmed by driving to a minimum set and energy determined by CAPWAP modelling.

PDA testing of piles requires sensors to be attached to the sides of the test piles at least 1.5 pile diameters below the top of the pile. For high strain dynamic testing to be conducted on the piles, contractors should ensure there is sufficient and safe access to the sides of the test piles for sensor attachment.

Black Geotechnical can provide a fee to perform PDA testing at the site.

3.4 Construction

No construction difficulties are expected with the jetty footings provided the new piles are away from existing piles.

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APPENDIX A

Figure 1	**Test location plan**
Figure 1A	**Soil classification sheet**
Log	**BH01**
Figure 1C	**Description of the Cone Penetration Test**
Plots	**CPT01 & CPT02 (2 sheets)**
Results	**Environmental laboratory tests (2 sheets)**

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REVISION	DETAILS OF AMENDMENT	DATE
A	First Issue	22/12/2022

NORTH

ELEVATION DATUM: -

COORDINATE DATUM / PROJECTION: -

PROJECT TITLE / ADDRESS: PROPOSED REPLACEMENT OF THE LEFL UNLOADING JETTY
BULLOCK ISLAND, LAKES ENTRANCE

DRAWING TITLE: BOREHOLE & CPT LOCATION PLAN

SCALE	SIZE	DRAWN	CHECKED	PROJECT NO.	DRAWING NO.	REV.
1:200	A3	AJB	NDS	V2206	FIGURE 1	A

Version 2.6, * * 2022
File: W:\2022 Job Files\V2206 - Bullock Is Jetty\Drawings\V2206 Location Plan.dwg
Plot Date: 2022-11-30

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CLASSIFICATION BASED ON UNIFIED SOIL CLASSIFICATION. AS1726 – 1993

WATER

▽	Water level at time of drilling.	GROUNDWATER NOT OBSERVED Groundwater observation was not possible due to water used in drilling process. Groundwater may be present.
▼	Static water level.	
▶—	Water inflow to borehole or test pit.	GROUNDWATER NOT ENCOUNTERED No groundwater was encountered at time of drilling or excavation in the borehole or test pit.
—◀	Water loss in borehole.	

SAMPLES AND TESTS

SPT	Standard Penetration Test (AS1289.6.3.1 – 2004). Blows per 150 mm. N = Blows for 300 mm after 150 mm seating.	SV	Shear Vane. Measures Shear Strength (s_u). Peak Strength/Residual Strength.
DCP	Dynamic Penetrometer Test (AS1289.6.3.2 – 1997). Blows per 100 mm.	N	SPT with sample collected from spoon.
U63	Undisturbed sample (Push Tube) – 63 mm diameter. 50 mm tube may be used (U50).	N*	SPT with no sample collected in spoon.
PP	Pocket Penetrometer. Measures Unconfined Compressive Strength (UCS).	Nc	SPT with solid cone. No sample.
D	Disturbed sample.	N'(60)	Corrected normalised N-value. Also known as $N_{1,60}$.
B	Bulk disturbed sample.	R	DCP / SPT refusal.

SOIL GRAPHICS (Sample)

CLAY (CL, CI, CH) — FILL — SILT (ML, MH)

GRAVEL (GW, GP) — SAND (SW, SP) — COBBLES AND BOULDERS

Graphic representation of mixed materials, such as silty clay, would be a combination of these symbols.

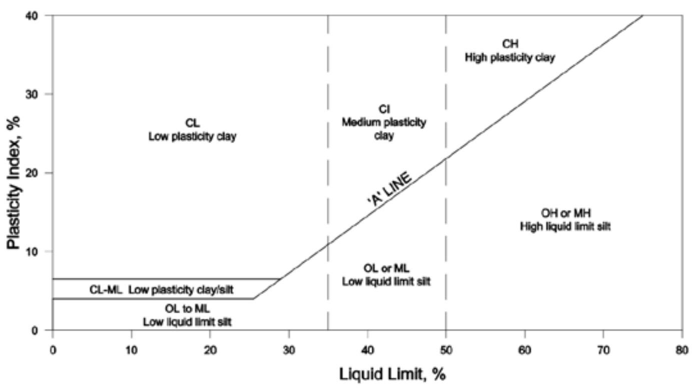
DRILLING METHOD

SSA	Solid Stem Auger	WB	Washbore
HSA	Hollow Stem Auger	ODEX	ODEX Retractable Bit System
HA	Hand Auger	AIRH	Down-the-hole Air Hammer
EX	Excavator	HE	Hand Excavation
BH	Backhoe	CC	Concrete Coring
NMLC	52mm Diamond Core	RCB	Rock Core Barrel
NDD	Non-Destructive Drilling	MC	Macro Core

PARTICLE SIZE

Boulders		> 200mm
Cobbles		63 to 200mm
Gravel	Coarse	20 to 63mm
	Medium	6.0 to 20mm
	Fine	2.0 to 6.0mm
Sand	Coarse	0.6 to 2.0mm
	Medium	0.2 to 0.6mm
	Fine	0.075 to 0.2mm
Silt		0.002 to 0.075mm
Clay		< 0.002mm

PLASTICITY PROPERTIES



PLASTICITY

Description	*Liquid Limit*
Low	< 35%
Medium	30 to 50%
High	> 50%

MOISTURE CONDITION

Dry	Looks and feels dry
Moist	Feels cool, darkened in colour, no free water or remoulding
Wet	Feels cool, darkened in colour, free water or remoulding
W	Natural moisture content
Wp	Plastic limit

SECONDARY COMPONENT

Trace	0 to 5%
Presence just detectable by feel or eye	
With	5 to 12%
Presence easily detectable by feel or eye	

CONSISTENCY

s_u kPa, AS1726 Table A4

TERM	very soft	soft	firm	stiff	very stiff	hard
s_u kPa	12	25	50	100	200	

If a soil crumbles on test it is described as friable.

DENSITY INDEX

I_d %, AS1726 Table A5

TERM	very loose	loose	medium dense	dense	very dense
I_d %	15	35	65	85	

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LOG ID: BH01

SHEET : 1 OF 2

Client: Gippsland Ports
Project: Replacement jetty at the LEFL unloading jetty
Location: Bullock Island, Lakes Entrance
Job No.: V2206
Date: 23/11/2022

Contractor: Star Drilling
Drilling Rig: Comacchio 205
Position: Refer Figure 1
Logged By: NDS
Checked By: GB

Easting: 585583.96
Northing: 5806460.01
Co-ord. Datum: GDA2020
Surface RL: 0.05 m AHD

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	ADDITIONAL OBSERVATIONS
0.0	WB-SPT	▽					WATER	
				-4.65	4.70	SP	SAND, loose, fine to coarse grained, brown-pale brown with pale grey and dark brown granules, wet	Coastal Dune Deposits
			SPT (5.5-5.95m) 1,1,1 N=2					
6.0							Becoming medium dense from 6.0 m	
			SPT (7-7.45m) 3,5,6 N=11					Environmental sample collected from SPT recovery
							Bentonite powder mixed with drilling water from 7.5 m to stablise the borehole	
8.0							With clay from 8.25 m	
			SPT (8.5-8.95m) 2,1,2 N=3					
				-9.45	9.50	SC	Clayey SAND, medium dense, fine to medium grained, brown, wet	Haunted Hills Formation
10.0			SPT (10-10.45m) 5,10,10 N=20				400 mm gravel band from 10.3 m	
				-10.70	10.75			

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

NOTES: Borehole depth measured from the top of the water surface at the time drilling commenced

BLACK GEOTECHNICAL

LOG ID: BH01

Client:	Gippsland Ports	**Contractor:**	Star Drilling	**Easting:**	585583.96
Project:	Replacement jetty at the LEFL unloading jetty	**Drilling Rig:**	Comacchio 205	**Northing:**	5806460.01
Location:	Bullock Island, Lakes Entrance	**Position:**	Refer Figure 1	**Co-ord. Datum:**	GDA2020
Job No.:	V2206	**Logged By:**	NDS	**Surface RL:**	0.05 m AHD
Date:	23/11/2022	**Checked By:**	GB		

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	GRAPHIC LOG	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	ADDITIONAL OBSERVATIONS
	WB-SPT						CI	Sandy CLAY, stiff, medium plasticity, pale brown mottled grey-orange, W>Wp, fine to medium grained sand, trace gravel & cobbles	
12.0			SPT (11.5-11.95m) 4,7,6 N=13						
								Becoming firm from 12.5 m	
			SPT (13-13.45m) 2,2,2 N=4						Environmental sample collected from SPT recovery
14.0									
			SPT (14.5-14.95m) 3,2,4 N=6						
16.0			SPT (16-16.45m) 3,1,3 N=4						
				-16.95	17.00		ML	Sandy SILT, very stiff to hard, low plasticity, pale grey, W>Wp, very fine grained sand	
18.0			SPT (17.5-17.95m) 8,12,17 N=29						
			SPT (19-19.45m) 9,12,16 N=28						
20.0									
			SPT (20.5-20.95m) 7,14,18 N=32	-20.90	20.95				
								End BH01 at 20.95 m. Groundwater encountered at 0.00 m.	

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

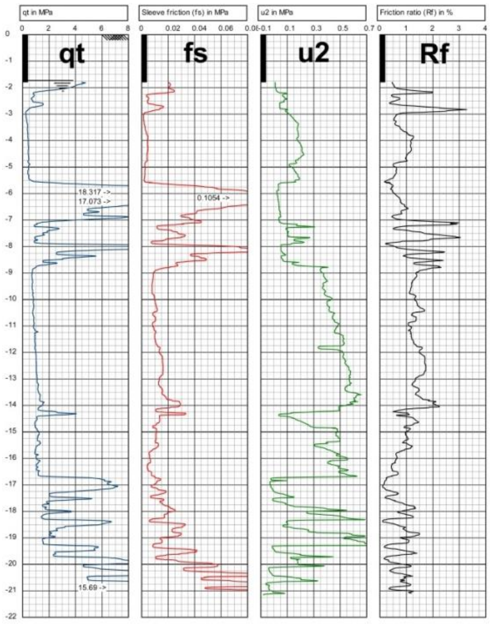
NOTES: Borehole depth measured from the top of the water surface at the time drilling commenced

A DESCRIPTION OF CONE PENETRATION TESTING

Cone Penetration Test (CPT) involves using hydraulic rams to push 36 mm diameter rods into the soil from a ballasted truck anchored drill rig or anchored portable rams. ttached to the end of the rods is a cone containing sensors that measure qc (cone resistance) fs (sleeve friction) u2 (pore water pressure) and inclination. The cone is connected to a data acquisition system during the test with the data logged every 10 mm and viewed live by the operator and engineer.

The collected data allows reliable interpretation of soil strength and stiffness parameters and the soil type.

The live inclination measurement allows the operator to determine if the cone is being bent in the soil and therefore reduces risk of damage. Clients are not responsible for any costs associated with damage to cones.



The results are presented in plots and provided in a raw format (.txt). The following procedures are applied to the data:

- The qc is corrected for pore water pressure effects to provide qt.
- The friction ratio Rf (fs/qt x 100%) helps identify soil type.

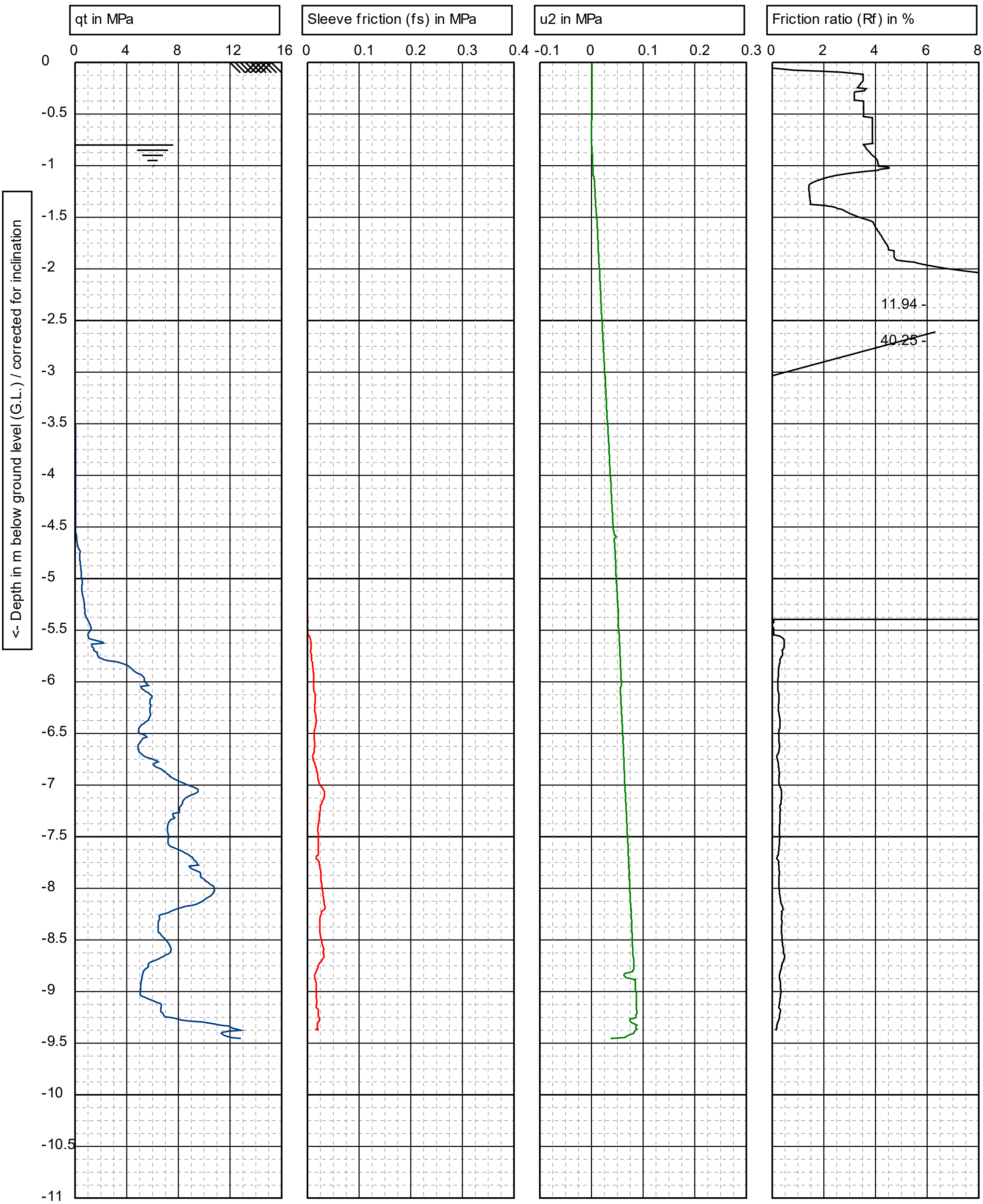
15 cm cone (larger and stronger) can be used where adverse soil conditions(gravels cobbles) are expected.

Soil samples can be rapidly collected with the use of ertek or M ST P soil piston samplers.

Testing depths of 40 m or more are achievable depending on soil conditions.

CPT conducted to a depth of 25 m will take about 2 hours. This is much quicker and therefore cheaper than drilling which may take a day or more and would not provide the same level of detailed useful subsurface information.

Black Insitu Testing Pty Ltd
258 yde Street arraville ictoria ustralia 3013
Ph: 03 9689 0200 – Fax: 03 9689 0155
office blackinsitutesting.com.au – www.blackinsitutesting.com.au



Refusal 4.87 m into soil

Maximum safe push on barge reached

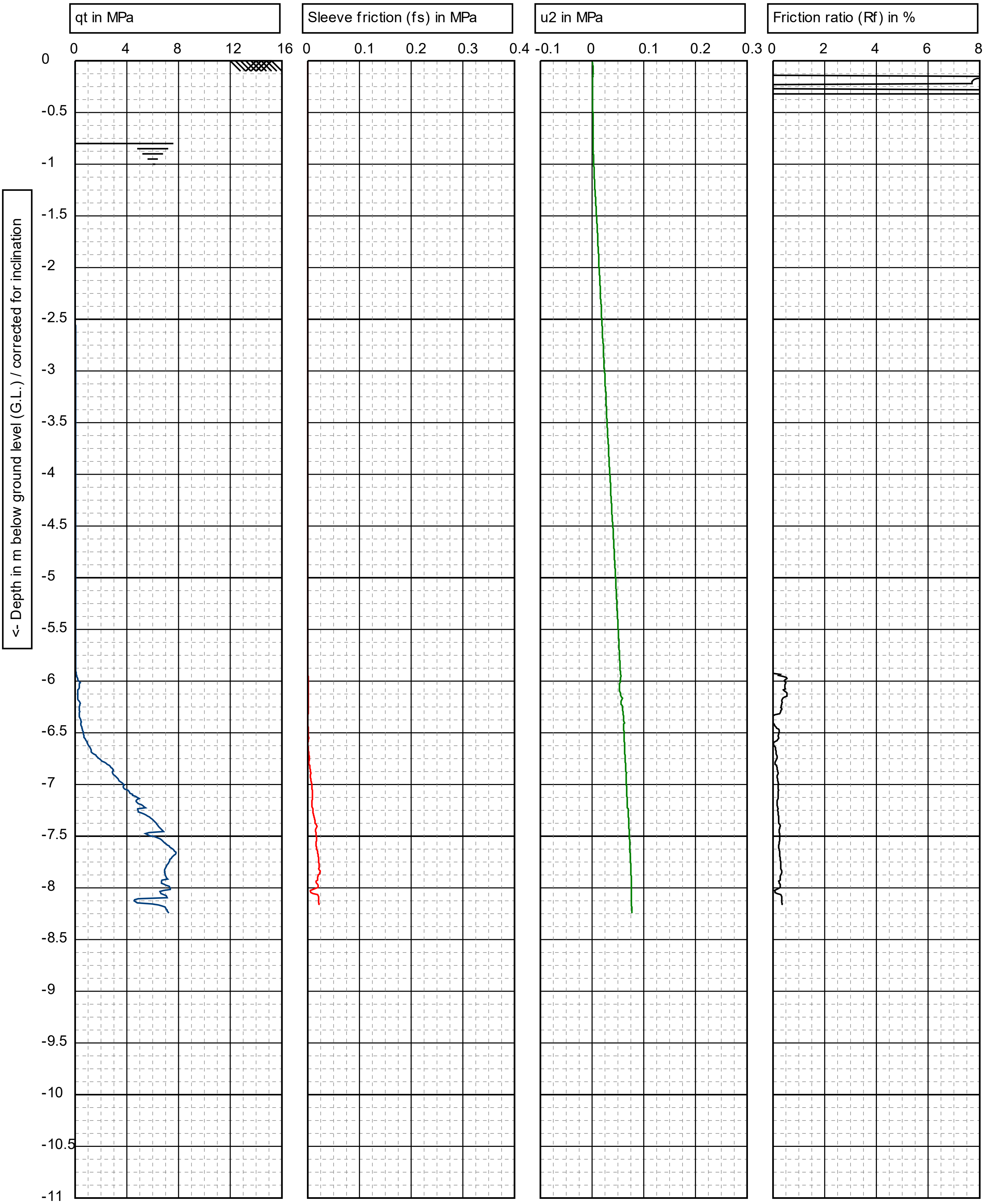
BLACK INSITU TESTING

u2 150 cm² 10 cm²

Client: Black Geotechnical		Predrill:	**0.00 m Predrilled**
G.L.: **1.4 m**	W.L.: **-0.80 m**	Date:	**24/11/2022**
Project: **LEFL South Unloading Jetty**		Cone no.:	**C10CFIIPT.C17285**
Location: **Bullock Island**		Project no.:	**F011**
		CPT no.:	**CPT 01** 1/1

1.47

Processed by: NS Checked by: BB



Refusal 2.34 m into soil

Maximum safe push on barge reached

BLACK INSITU TESTING

u2 150 cm² 10 cm²

Client: Black Geotechnical		Predrill:	0.00 m Predrilled
G.L.: **1.4 m**	W.L.: **-0.80 m**	Date:	**25/11/2022**
Project: **LEFL South Unloading Jetty**		Cone no.:	**C10CFIIPT.C17285**
Location: **Bullock Island**		Project no.:	**F011**
		CPT no.:	**CPT 02** 1/1

1.47

Processed by: NS Checked by: BB

amal ANALYTICAL PTY LTD Laboratory Services for the Environment and Occupational Health

Certificate of Analysis 40944

Client Name:	Black Geotechnical Pty Ltd	*Date Samples Received:*	01-Dec-22
Address:	258 Hyde Street, Yarraville, VIC 3013	*Issue Date:*	07-Dec-22
Contact:	Ned Smith	*Page:*	1 of 1
Client Reference:	Bullock Island Jetty	*Order Number:*	
Job Number:	V2206	*COC Number:*	

Results

		Laboratory ID:	W6365	W6366
		Sample Type:	Soil	Soil
		Date Sampled:	23-Nov-22	23-Nov-22
		Client Reference:	BH01 7.0-7.45	BH01 13.0-13.45
Analyte	**LOR**	**Units**		
Sulphate	100	mg/kg	380	480
Chloride	50	mg/kg	2500	3400
Conductivity	NA	uS/cm	1400	1800
Resistivity	NA	ohm.cm	710	560
pH (1:5 in H_2O)	NA	pH Units	5.2	5.0

Report Details

Method ID	Details	Holding Time (Days)	Date Analysed	Holding
In-house	Anions (1:5 aqueous) by IC	28	06-Dec-22	OK
In-house	pH and conductivity (1:5 in aqueous extract)	7	05-Dec-22	Exceeded

Definitions
mg/kg - milligram per kilogram
LOR - Level of reporting

Results Authorised By

Sample(s) are analysed as received on site by AMAL Analytical Pty Ltd unless otherwise noted. Results pertain only to the sample(s) analysed and are reported on a dry weight basis for soils, and an 'as received' basis for other matrices. Where a sample holding time is unknown or exceeded, the validity of results may be compromised. This report supersedes any released prior and shall not be reproduced, except in full, without express written permission from the laboratory.

J. Martens (B.Sc)
General Manager

BLACK GEOTECHNICAL

AMAL ANALYTICAL PTY LTD
27 SHAFTON STREET
HUNTINGDALE VIC 3166
AUSTRALIA

40944

Chain of Custody Documentation

Black Geotechnical
258 Hyde Street
Yarraville VIC 3013
Ph: 03 9689 0200 Fax: 03 9689 0155
E-mail Report to: ned@blackgeotechnical.com.au

Laboratory:	AMAL Analytical
Address:	27 Shafton Street, Huntingdale
Contact:	Jeremy Martens
Phone:	03 9544 4111

Job Number:	V2206	Purchase Order:	
Project Name:	BULLOCK ISLAND JETTY	Quote No:	
Sampled By:	Ned Smith	Turn Around Time:	
Project Manager:	Ned Smith	CoC Page #:	1
Contact Ph: / Mobile:	0403 113 820		

Lab ID	Sample ID	Matrix*	Date	Time	Type/Code	Total Containers	C/S pH (soil & groundwater)	C Sulfates (SO_4, soil & grundwate,)	C/S Chlorides (Cl, soil & groundwater)	S Resistivity (soil)	VIC EPA IWRG Screen	Pesticides, PCB, Heavy Metals, PAH, TPH, pH	Heavy Metals, PAH, TPH, pH	Heavy Metals, pH				Comments:
	BH01-7.0-7.45	S	23/11/22	13:00	GC	1	✓	✓	✓	✓								C = concrete, S = steel. Sulfates & Chlorides in ppm. Resistivity in ohm.cm.
	BH01-13.0-13.45	S	23/11/22	14.00	GC	1	✓	✓	✓	✓								

Relinquished By:		Received By:		Method of Shipment:
Name: ~~Ned Smith~~ AWR	Date:	Name: JWells	Date: 1/12/22	Courier:
Of: Black Geotechnical	Time:	Of: Amal Analytical	Time:	TBA
Name:	Date:	Name:	Date:	
Of:	Time:	Of:	Time:	
Name:	Date:	Name:	Date:	
Of:	Time:	Of:	Time:	

(*) Matrix Type: Soil = S; Water = W; Gas = G; Sediment = Sed; Other = O (F) = Fill soil; (N) = Natural soil

Container Codes: GC = Glass (Clear); GA = Glass (Amber); UP = Unpreserved Plastic; NPP = Nitric Acid (HN03) Preserved Plastic; SPP = Sodium Hydroxide (NaOH) Preserved Plastic; VGHP = VOA Vial Hydrochloric (HCl) Acid Preserved; HPP = HCl Preserved Plastic; SPP = Suphuric Acid (H2SO4) Preserved Plastic; SPG =H2SO4 Preserved Glass; SP = Sterile Plastic; SG = Sterile Glass; PB = Plastic Bag; GC = Gas Canister; GT = Gas Tube; ZNPP= Zinc Acetate + NaOH Preserved Plastic; EZPP = EDTA + Zinc Acetate Preserved Plastic; OPPN= Opaque Plastic Preserved with NaOH, PVC-L = PVC liner with plastic end caps