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Report

Geotechnical Investigation for Coastal Erosion Vulnerability Assessment.

Emu Point, City of Albany WA.

Date: 04 February 2025
Report Ref: 3142A

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EXECUTIVE SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Emu Point in the City of Albany, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 275m corridor of coastal beach and dune formation adjacent to Firth Street which has been identified as an at-risk site as part of Hotspot# 52.

The investigation scope consisted of acquiring multi-channel analysis of surface waves data as a series of specified transects either along-shore (parallel to the coast) or cross-shore (perpendicular to the coast) and cone penetration testing at spot locations along these transects. This was supplemented with geological mapping of surface rock outcrops and topographic survey using high resolution aerial photogrammetry for the generation of a surface level model and orthomosaic image.

The acquired MASW dataset was processed for the generation of seismic velocity sections along the transects showing variations in the seismic shear wave velocity of the subsurface material to a target depth of 10-15m below ground level (BGL). The seismic velocity sections were calibrated with the CPT plots and demarcated into velocity ranges representing different material types and conditions for the generation of interpreted geological sections consisting of loose to compacted sediment and variably weathered to fresh rock.

The interpreted geological sections have been compiled to develop subsurface models of the level to rock substrate (relative to AHD) and overlying sediment thickness within the region between the foreshore and the settlement. This model will be used to assess the potential vulnerability of the site to erosion and future inundation risk, and whether there is a continuous rock barrier located below the ground surface of sufficient strength and height that may prevent the advancement of erosion to the settlement.

The following observations have been made:

- No rock substrate was observed along any of the transects within the maximum target investigation depth of 10-15m BGL.
- Sediment thickness is generally greater than 15m across the site.

CONTENTS

1 INTRODUCTION

At the request of The Government of Western Australia Department of Transport (DoT), GBG Group carried out a geotechnical investigation at Emu Point, City of Albany in January 2025. During the investigation seismic geophysical testing and intrusive geotechnical testing was conducted within a 275m corridor of coastal beach and dune formation which has been identified as an at-risk site as part of Hotspot #52.

The objective of the investigation was to provide detailed mapping of the extent, elevation and consistency/strength of the rock underlying the coastal beach and dune formation. In particular, the key outcome of the investigation was to develop a subsurface model of the level to competent rock substrate (relative to AHD) within the region between the foreshore and the settlement. This model will be used to assess the potential vulnerability of the site to erosion and future inundation risk, and whether there is a continuous rock barrier located below the ground surface of sufficient strength and height that may prevent the advancement of erosion to the settlement.

To achieve the project objectives, data from the following investigation methods was acquired, processed and analysed to obtain the required subsurface information within the anticipated geological conditions:

1. **Geological mapping** of surface rock outcrops within the study area using high resolution photogrammetry.
2. **Geophysical testing** by way of Multi-channel Analysis of Surface Waves (MASW) to obtain seismic shear wave velocity models related to variations in subsurface material stiffness.
3. **Topographic survey** using Differential GNSS receiver and photogrammetry.

2 INVESTIGATION SITE

The investigation was carried out within approximate 275m corridor of coastal beach and dune formation between Firth St and Medcalf Parade. The extents of the site are shown as a yellow dashed polygon in Figure 1.

Data was acquired as a series of transects for the seismic geophysical testing. These were positioned so as to best utilise existing roads, tracks, and beach whilst not impacting on native vegetation and in order to ensure the most optimal, efficient and economic acquisition methodology. Data was not acquired where surface obstructions were present such as thick vegetation, steep topography or where the beach was inundated with seawater. Photographs showing the typical site conditions are provided in Figure 2. Topography at the site was generally flat to undulating and surface level ranged from 0mAHD to 4mAHD. Topographic maps showing surface level are provided in Appendix C drawing 3142A-05.

Figure 1: The extent of the geophysical investigation (yellow polygon) at the Emu Point site. Aerial imagery from drone photogrammetry (main image) and Google Maps (inset image).

Figure 2: Site conditions at Emu Point including the southern along-shore transect on the beach (left image) and northern along-shore track on the walking track (right image).

3 INVESTIGATION METHODOLOGY

3.1 FIELD SURVEY LOGISTICS

Geophysical data acquisition was carried out on 13th January 2025 by a two-person team from GBG Group consisting of qualified geophysicists. CPT data acquisition was carried out by a technician from Probedrill on 13th and 14th January 2025.

Prior to the commencement of data acquisition, a site assessment was carried out with potential concerns and issues including the placement of and access to the MASW transects were addressed.

The site work for the investigation consisted of a total of 608m of MASW profiling acquired as 2 along-shore transects (parallel to the coast) and 3 cross-shore transects (perpendicular to the coast). Details of the acquired MASW transects are provided in Table 1. The extents of the MASW transects overlaid onto aerial imagery are shown in Appendix A drawing 3142A-01.

Table 1 – Acquired MASW Transects (Coordinates in GDA2020, MGA Zone 50).

Transect	Orientation	Start Coordinate		End Coordinate		Length
ID		East	North	East	North	(m)
MASW-01	Along-shore	585560.1	6126348.4	585804.3	6126454.6	288
MASW-02	Along-shore	585565.5	6126316.2	585793.1	6126427.5	256
MASW-03	Cross-shore	585765.6	6126420.2	585770.0	6126435.4	16
MASW-04	Cross-shore	585758.8	6126420.8	585735.4	6126439.5	32
MASW-05	Cross-shore	585580.2	6126323.8	585574.4	6126338.4	16

3.2 MULTI-CHANNEL ANALYSIS OF SURFACE WAVES

MASW is a seismic geophysical method that utilises phase and frequency information to calculate Shear wave (S-wave) velocities in vertical layer models averaged over an array of linearly spaced geophones. These 1D models can be laterally stacked to provide 2D cross-sections of S-wave velocity in layers. Under most circumstances it is an indicator of material stiffness and as such the method can be used to provide quantitative results on the compaction of the subsurface material.

MASW data was acquired using a Geode (Geometrics) seismograph connected to a receiver array of 24 geophones set at 1m intervals for a total array length of 23m. The receiver array was mobilised on a land streamer whereby the geophones are mounted on base plates attached to webbing, and either towed behind a 4WD vehicle or manually pulled by the field team. Seismic energy was generated using summed impacts from a PEG-40 (R.T. Clark) vehicle mounted accelerated weight drop (AWD) or softened steel sledgehammer with source points made at a constant offset from the receiver array. MASW acquisition parameters are provided in Table 2. Photographs of MASW data acquisition are shown in Figure 3.

Table 2 – MASW Acquisition Parameters

Parameter	Value
Number of geophones	24
Geophone spacing	1 m
Array length	23 m
Geophone frequency	4.5 Hz
Record length	1 s
Sample interval	0.125 ms
Source	40kg AWD / 5.9kg Sledgehammer
Source offset	4 m
Sounding interval	8m
Source stacks	3

Figure 3: MASW data acquisition using a seismic streamer and AWD (left image) and a sledgehammer and plate (right).

The MASW data was observed to be of high quality with the seismic records having high signal to noise ratio. The generated overtone images plotting phase velocity against frequency mostly showed a prominent dispersion curve of the surface wave component. The MASW data was processed using SurfSeis version 6++ (Kansas Geological Survey, 2017) with the following processing routine:

1. Import acquired seismic data files and apply geometry including geophone spacing, source offset and sounding interval.
2. Generate overtone images giving the percentage intensity of phase velocity versus frequency for each seismic record (Figure 4).
3. Pick the maximum intensity across the useful range of frequencies for each overtone image resulting in a dispersion curve.
4. Run the dispersion curves through a 10-layer inversion algorithm to produce 1D soundings plotting seismic S-wave velocity with depth.

The S-wave velocity soundings were compiled with reference to distance along the transects and gridded with Surfer version 25 (Golden Software, 2023). The resulting contoured cross-sections show

the variation in the modelled S-wave velocity of the subsurface material in metres per second laterally along each of the transects and with elevation.

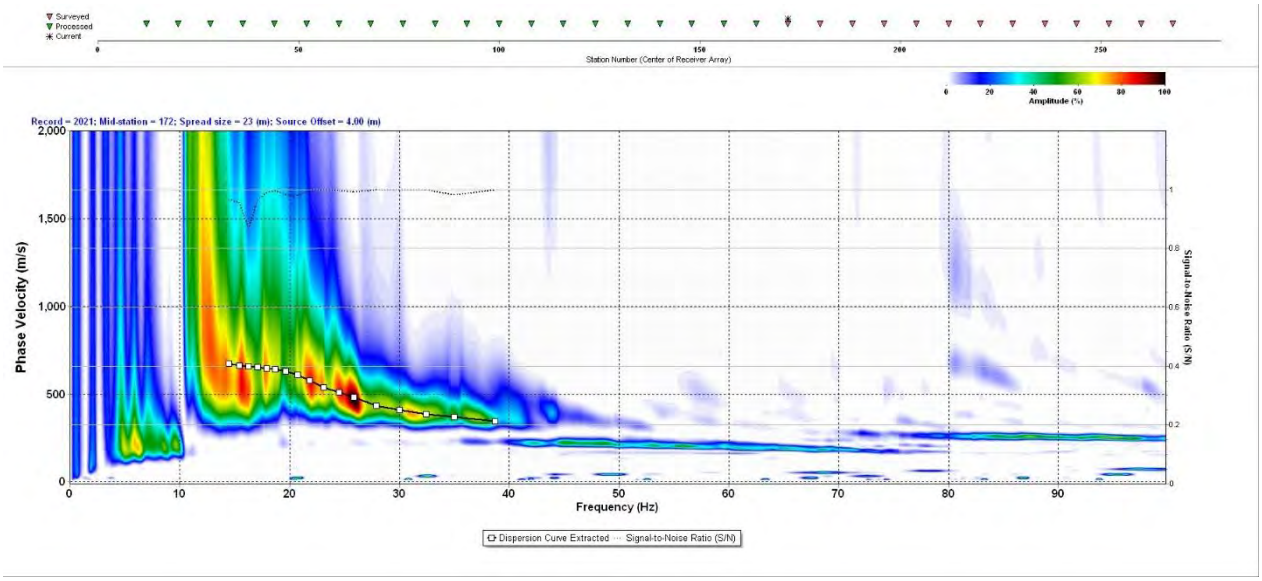


Figure 4: MASW overtone image with high signal to noise ratio and picked dispersion curve.

3.3 SPATIAL POSITIONING AND PHOTOGRAMMETRY

Spatial positioning of the acquired geophysical transects was achieved using Reach RS2+ (Emlid) GNSS receivers with a coordinate recorded for each MASW sounding location. Coordinates of the geophysical transects have been provided in GDA2020, MGA zone 50 for horizontal component and Australian Height Datum (mAHD) for vertical component. An accuracy of +/-0.2m is expected for both vertical and horizontal components.

To achieve precise reduced levels referenced to AHD, the positioning data was acquired with Real-Time Kinematics (RTK) using a Geoscience Australia AUSCORS station in Albany for the base corrections. Details of the AUSCORS station used for this investigation are provided in Table 3.

Table 3 – Details of AUSCORS station

Parameter	Value
Mount Point	ABNY00AUS0
Latitude	S 33° 1' 37.74"
Longitude	E 117° 53' 11.652"
Ellipsoidal height (m)	-13m

A reduced level of 0.0mAHD is considered to be the Mean Sea Level (MSL) for the purpose of this investigation. This relationship for Mean Sea Level was established by the Geoscience Australia Survey in 1971*.

*http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/datums-projections/australian-height-datum-ahd

Aerial photogrammetry was carried out to obtain an up-to-date high-resolution aerial image and a surface level model of the survey area. Data was acquired with a Mavic 3E (DJI) multi-rotor drone with RTK capability for the capture of multiple overlapping images.

The acquired photogrammetry images were processed using Metashape Professional (Agisoft) for the generation of a point cloud, surface level model and orthomosaic image of the survey area. Note for this investigation, vegetation has not been removed during the processing stage and as such the height of existing vegetation needs to be considered when assessing surface levels.

4 RESULTS AND INTERPRETATION

4.1 PRESENTATION OF RESULTS

The results of the geotechnical investigation at Emu Point, City of Albany are presented in Appendices B and C of this report as follows:

Appendix B – Geophysical and Interpreted Sections

- **3142A-02.** Transect 01 seismic S-wave velocity model and interpreted geological section.
- **3142A-03.** Transect 02 seismic S-wave velocity model and interpreted geological section.
- **3142A-04.** Transects 03, 04, and 05 seismic S-wave velocity model and interpreted geological section.

Appendix C – Modelled Level to Surface and Sediment Thickness

- **3142A-05** Contoured surface level models derived from aerial photogrammetry.
- **3142A-06** Class post map modelled sediment thickness over rock.

4.2 SEISIMC SHEAR WAVE VELOCITY SECTIONS

The seismic S-wave velocity (Vs) sections modelled from the MASW data acquired along the along-shore and cross-shore transects are presented at the top of each drawing in Appendix B. These sections show variations in the modelled Vs as per the colour scale with velocity ranging from 150m/s to 1000m/s representing a wide range of material types and conditions.

Seismic S-wave velocity is governed by the elastic properties of the medium that the wave propagates through as shown in the equation below. In particular, it is primarily a function of soil density, void ratio and effective stress. As such calculated values can provide a useful guide to the subsurface material condition with increasing velocity an indication of increasing material stiffness.

Seismic S-wave velocity $$V_S = \sqrt{\frac{G}{\rho}}$$

where; G = Shear modulus,
ρ = In-situ material density

4.3 INTERPRETED GEOLOGICAL SECTIONS

Below the seismic S-wave velocity sections are the interpreted geological sections based on detectable seismic velocity contrasts. Four classes have been defined representing different subsurface material conditions as follows:

1. **Very low seismic S-wave velocity** (Vs <250m/s). Representing the lowest seismic velocities modelled during the investigation, this class is interpreted as sediment of low compaction from either the beach or dune formation.

2. **Low seismic S-wave velocity** (Vs 250-650m/s). This class is interpreted as sediment of moderate to high compaction due to increased depth of cover on the beach and dune formation, or due to development adjacent to the settlement. Due to the high compaction and S-wave velocity encountered in this class, it is interpreted that this sediment is likely to be clay weathered from the underlying granitic rocks.

3. **Moderate seismic S-wave velocity** (Vs 650-750m/s). This class is interpreted as low strength variably weathered rock. Where continuous and at base of the sections it likely represents a transitional zone to stronger, more competent underlying rock. Where present as isolated anomalies within the interpreted sediment, it is likely to represent partially lithified sediment or rock lenses.

4. **Moderate to high seismic wave velocity** (Vs >750m/s). This class is interpreted as moderate strength slightly weathered to fresh rock. It is typically observed at the base of the sections as competent rock underlying the variably weathered rock.

4.4 CALIBRATION WITH GEOTECHNICAL TESTING AND ROCK MAPPING

The results of the CPTs are presented in Appendix D showing the plots of cone tip resistance in mega-pascals against depth in metres. The CPT plots are also shown in Appendix B and overlayed onto the interpreted geological sections with the following observations being made:

- **CPT-01 on Transect 02 / 05** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-02 on Transect 01** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-03 on Transect 01** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-04 on Transect 02** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-05 on Transect 01 / 04** – refusal due to rod friction at a depth of 3.6 m Below Ground Level (BGL) which corresponds to compacted/ lithified sediment.

- **CPT-06 on Transect 02 / 03** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-07 on Transect 01** – no refusal to 11.2 m Below Ground Level (BGL)

The differences in the modelled level to low compaction and moderate compaction sediment as interpreted from the MASW transects and from the CPT data can be attributed to the fact that the geophysical methods used are broad scale whilst the CPT is a point method. Geophysical methods sample a volume of subsurface material with the calculated depths at any particular point representing an average value over this volume. The CPT method samples the subsurface directly below the probe and is influenced by local variations in the subsurface such as rock floaters, highly weathered zones or lenses of partially lithified sediment. The differences in the type of subsurface sampling of the methods will not adversely affect the results as the CPT results have been used to constrain the geophysics interpretation and as such the results represent the best modelled fit between the datasets.

4.5 MODELLED LEVEL TO TOP OF ROCK AND SEDIMENT THICKNESS

Subsurface model for the level to top of rock substrate has not been presented in this report since no significant competent rock was observed along any of the transects. Consequently, sediment thickness can be considered to be greater than the maximum investigation depth of 10m since no substantial rock interface was observed from the surface to maximum depth on any of the geophysical transects. This finding is further supported by the CPT results. The following subsurface models have been provided:

- **Contoured Surface Level Model** (drawing 3142A-05) – generated from the aerial photogrammetry, this presents the level to ground surface ranging from 0mAHD to 10mAHD. Note: vegetation and built-up features have not been removed from these models.
- **Classed Post Map Sediment Thickness** (drawing 3142A-06) – this presents the thickness of sediment overlying the rock substrate along the acquired transects at 2m depth increments from <6mBGL to >16mBGL.

5 PROJECT SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Emu Point in the City of Albany, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 275m corridor of coastal beach and dune formation adjacent to Firth Street which has been identified as an at-risk site as part Hotspot # 52.

The investigation scope consisted of acquiring multi-channel analysis of surface waves data as a series of specified transects either along-shore (parallel to the coast) or cross-shore (perpendicular to the coast). This was supplemented with geological mapping of surface rock outcrops and topographic survey using high resolution photogrammetry for the generation of a surface level model and orthomosaic image.

The acquired MASW dataset was processed for the generation of seismic velocity sections along the transects showing variations in the seismic shear wave velocity of the subsurface material to a target depth of 10-15m below ground level. The seismic velocity sections were calibrated with the CPT plots and demarcated into velocity ranges representing different material types and conditions for the generation of interpreted geological sections consisting of loose to compacted sediment and variably weathered to fresh rock.

The interpreted geological sections have been compiled to develop subsurface models of the sediment thickness within the region between the foreshore and the settlement. This model will be used to assess the potential vulnerability of the site to erosion and future inundation risk, and whether there is a continuous rock barrier located below the ground surface of sufficient strength and height that may prevent the advancement of erosion to the settlement.

The methods used during the investigation are geophysical and as such the results are based on indirect measurements and the processing and interpretation of seismic wave signals calibrated with intrusive geotechnical testing. The findings in this report represent the professional opinions of the authors, based on experience gained during previous similar investigations.

We trust that this report and the attached drawings provide you with the information required. If you require clarification on any points arising from this investigation, please do not hesitate to contact the undersigned on 08 9354 6300.

For and on behalf of
GBG GEOTECHNICS (AUSTRALIA)

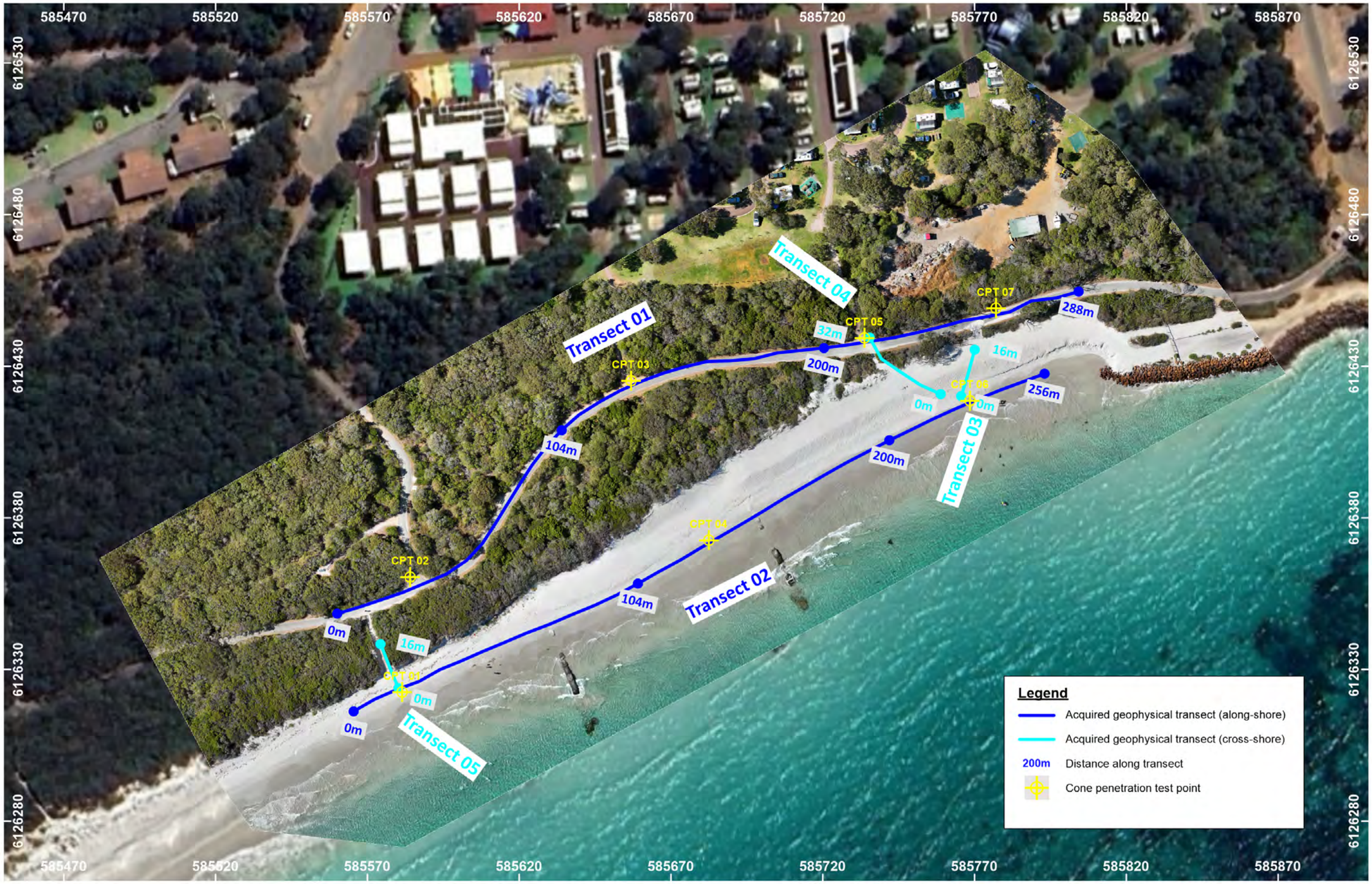
QASIM ASAD
Senior Geophysicist

APPENDIX A – INVESTIGATION SITE MAP

GBGGROUP

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
EMU POINT, CITY OF ALBANY WESTERN AUSTRALIA

INVESTIGATION SITE MAP

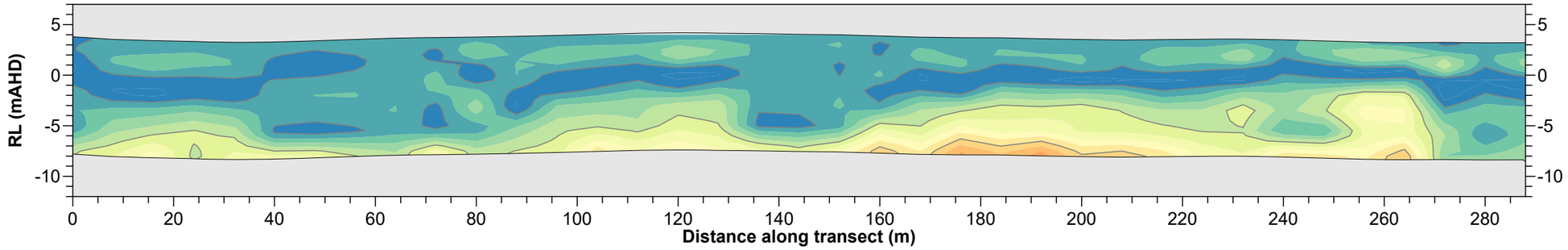


NOTES Drawing to be used in conjunction with Report 3142A. Map Projection GDA94 MGA Zone 50. Aerial image from Google Earth Pro and GBG photogrammetry.	N	CLIENT DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date 15 January 2025	Paper Size A3	GBGGROUP G B Geotechnics (Australia) Pty Ltd 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 9890 2122 Email: info@gbgoz.com.au
		GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT EMU POINT, CITY OF ALBANY WA	Scale 1:1300	Drawn SMK	
			Drawing 3142A-01	Revision 0	

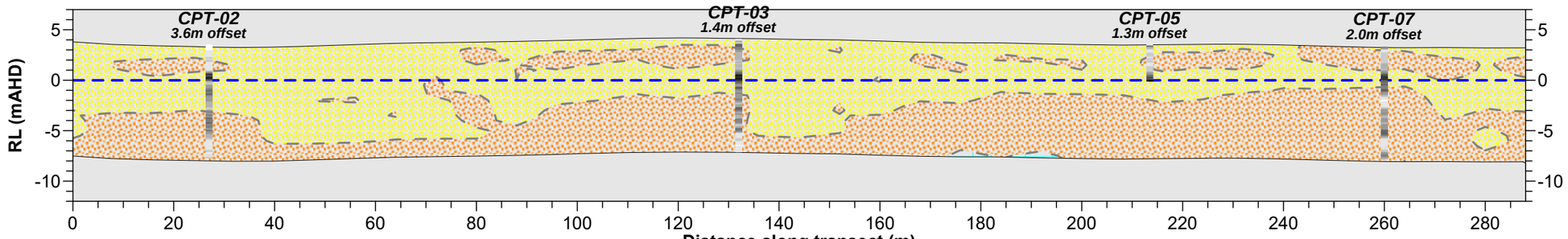
APPENDIX B – GEOPHYSICAL AND INTERPRETED SECTIONS

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
EMU POINT, CITY OF ALBANY WESTERN AUSTRALIA

TRANSECT 1 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 1 - INTERPRETED GEOLOGICAL SECTION



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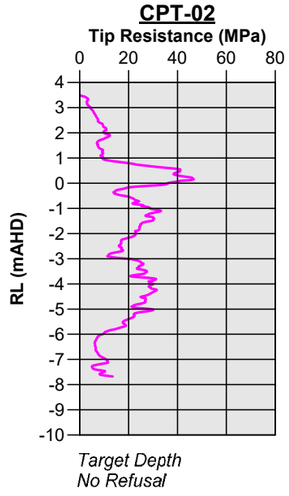

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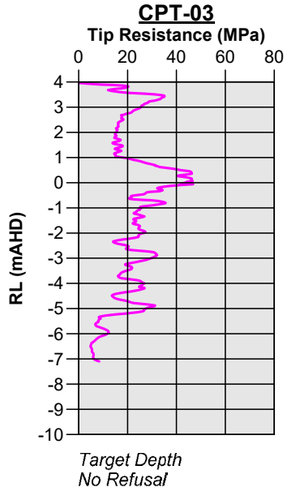

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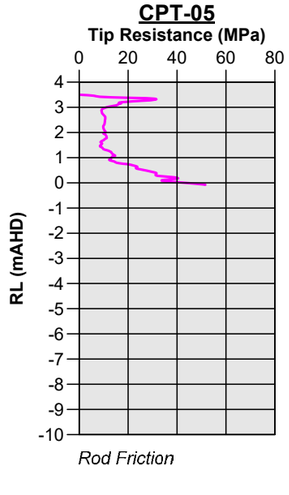

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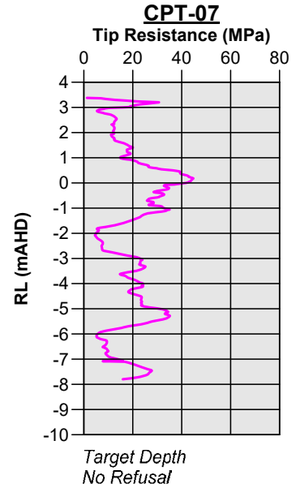
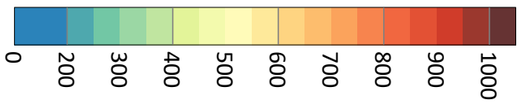


SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE

- SEDIMENT - LOW COMPACTION
  S-WAVE VELOCITY < 250 m/s
- SEDIMENT - MODERATE TO HIGH COMPACTION
  S-WAVE VELOCITY 250-650 m/s
- LOW STRENGTH WEATHERED ROCK
  S-WAVE VELOCITY 650-750 m/s
- MODERATE STRENGTH COMPETENT ROCK
  S-WAVE VELOCITY > 750 m/s.
- 0m AUSTRALIAN HEIGHT DATUM

CONE PENETRATION TEST

Tip Resistance (MPa)

- 0 to <5
- 5 to <10
- 10 to <15
- 15 to <20
- 20 to <25
- 25 to <30
- 30 to <35
- 35 to <40
- 40 to <45
- 45 to <50
- Equal to or >50

NOTES

Drawing to be used in conjunction with Report 3142A.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	14 January 2025	Paper Size	A3
	GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. EMU POINT, CITY OF ALBANY WA	Scale	1:1000H, 1:500V	Drawn	SMK
		Drawing	3142A-02	Revision	0

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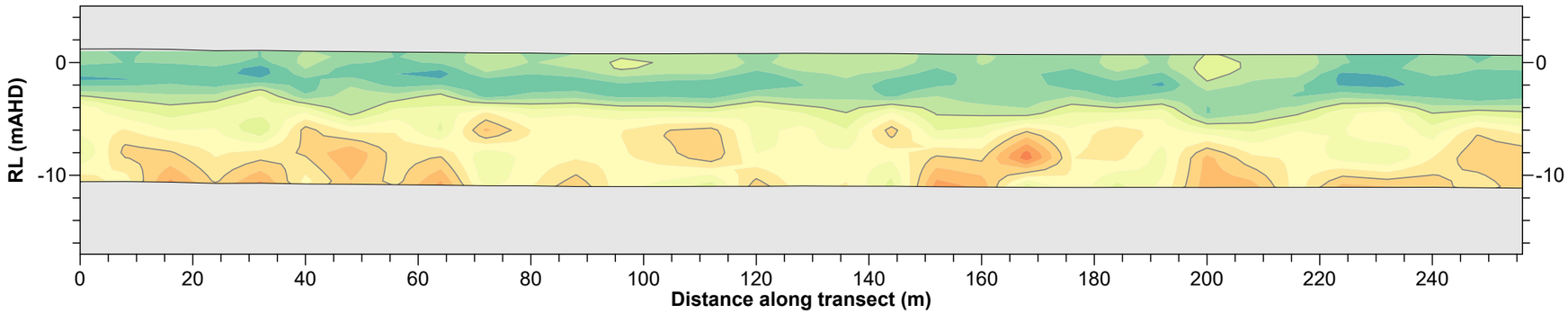
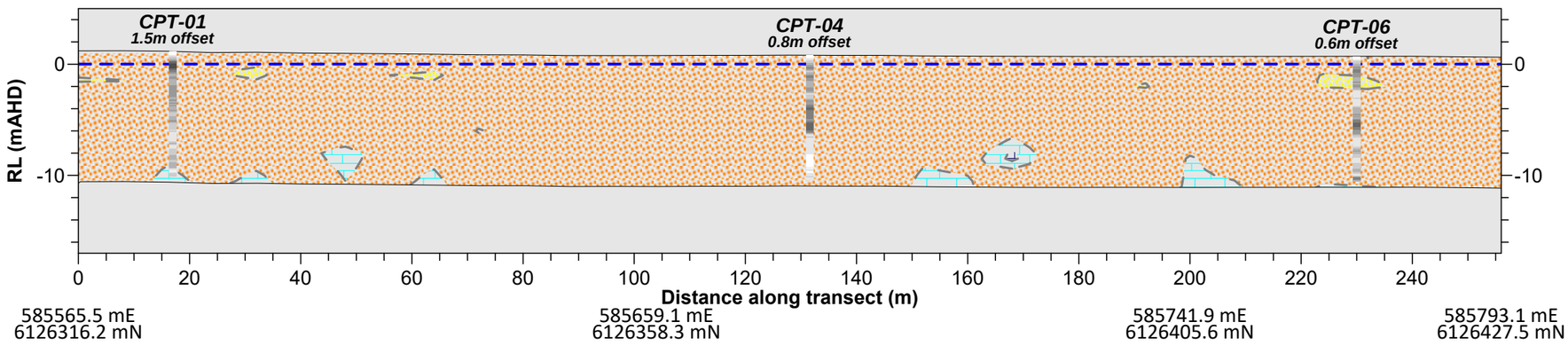
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
EMU POINT, CITY OF ALBANY WESTERN AUSTRALIA

TRANSECT 02 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 02 - INTERPRETED GEOLOGICAL SECTION



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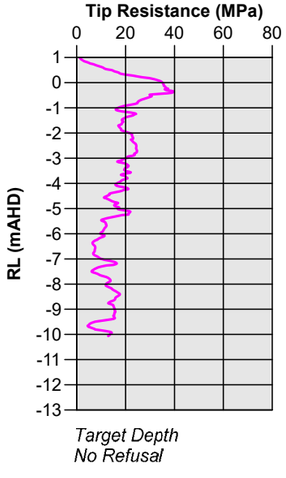
CPT-01



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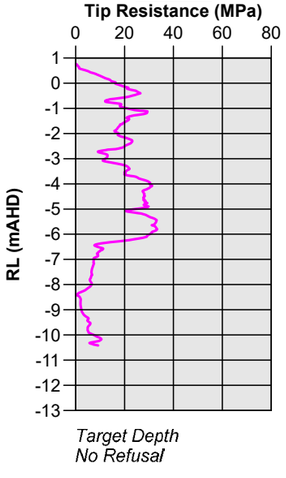

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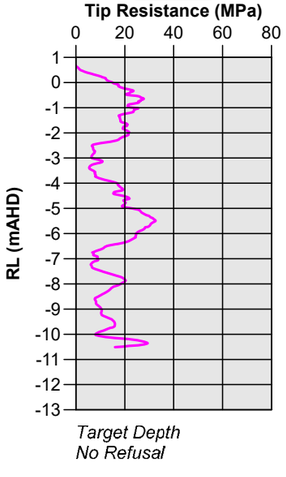

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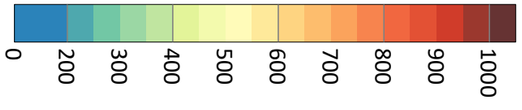
SEISMIC S-WAVE VELOCITY (m/s)



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- 10 to <15
- 15 to <20
- 20 to <25
- 25 to <30
- 30 to <35
- 35 to <40
- 40 to <45
- 45 to <50
- Equal to or >50

NOTES

Drawing to be used in conjunction with Report 3142A.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	14 January 2025	Paper Size	A3
	GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. EMU POINT, CITY OF ALBANY WA	Scale	1:1000H, 1:500V	Drawn	SMK
		Drawing	3142A-03	Revision	0

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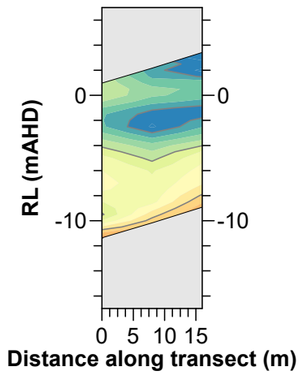
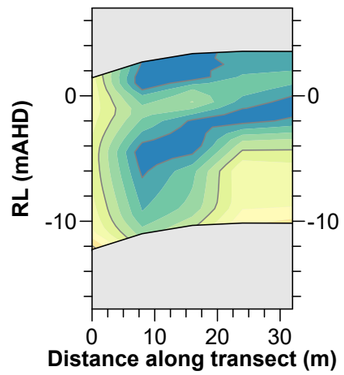
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
EMU POINT, CITY OF ALBANY WESTERN AUSTRALIA

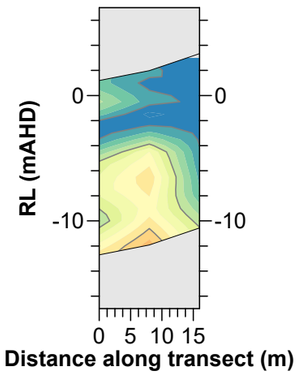
TRANSECT 03 - SEISMIC SHEAR WAVE VELOCITY MODEL



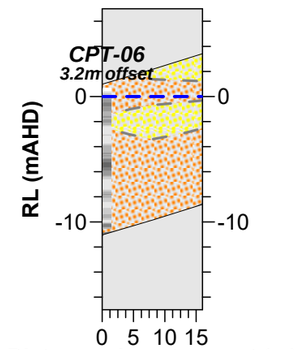
TRANSECT 04 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 05 - SEISMIC SHEAR WAVE VELOCITY MODEL

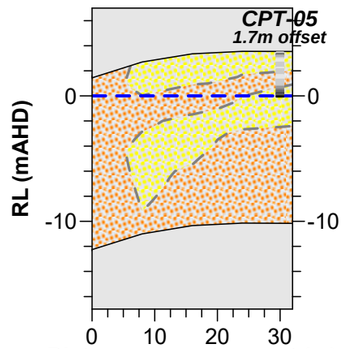


TRANSECT 03 - INTERPRETED GEOLOGICAL SECTION



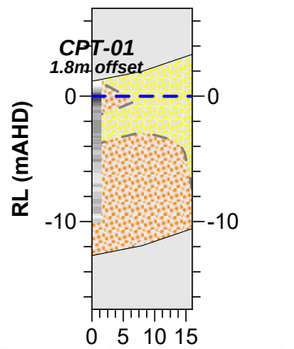
585765.6 mE 585770 mE
6126420.2 mN 6126435.4 mN

TRANSECT 04 - INTERPRETED GEOLOGICAL SECTION



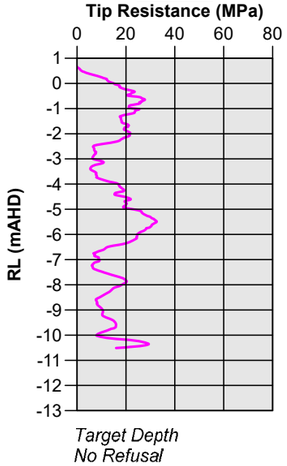
585758.8 mE 585735.4 mE
6126420.8 mN 6126439.5 mN

TRANSECT 05 - INTERPRETED GEOLOGICAL SECTION



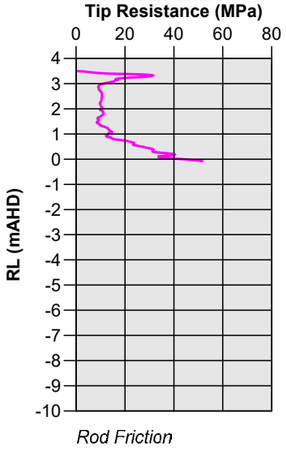
585580.2 mE 585574.4 mE
6126323.8 mN 6126338.4 mN

CPT-06



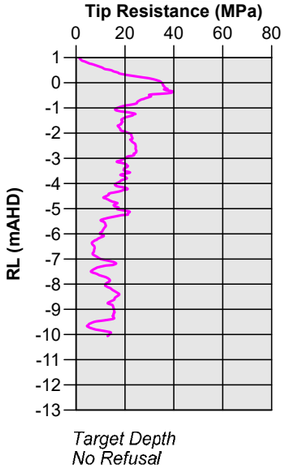
Target Depth
No Refusal

CPT-05



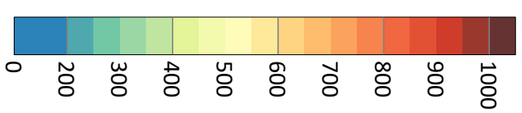
Rod Friction

CPT-01



Target Depth
No Refusal

SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE

- SEDIMENT - LOW COMPACTION
  S-WAVE VELOCITY < 250 m/s
- SEDIMENT - MODERATE TO HIGH COMPACTION
  S-WAVE VELOCITY 250-650 m/s
- LOW STRENGTH WEATHERED ROCK
  S-WAVE VELOCITY 650-750 m/s
- MODERATE STRENGTH COMPETENT ROCK
  S-WAVE VELOCITY > 750 m/s.
- 0m AUSTRALIAN HEIGHT DATUM

CONE PENETRATION TEST

Tip Resistance (MPa)

- 0 to <5
- 5 to <10
- 10 to <15
- 15 to <20
- 20 to <25
- 25 to <30
- 30 to <35
- 35 to <40
- 40 to <45
- 45 to <50
- Equal to or >50

NOTES

Drawing to be used in conjunction with Report 3142A.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	14 January 2025	Paper Size	A3
	GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. EMU POINT, CITY OF ALBANY, WA	Scale	1:1000H, 1:500V	Drawn	SMK
		Drawing	3142A-04	Revision	0

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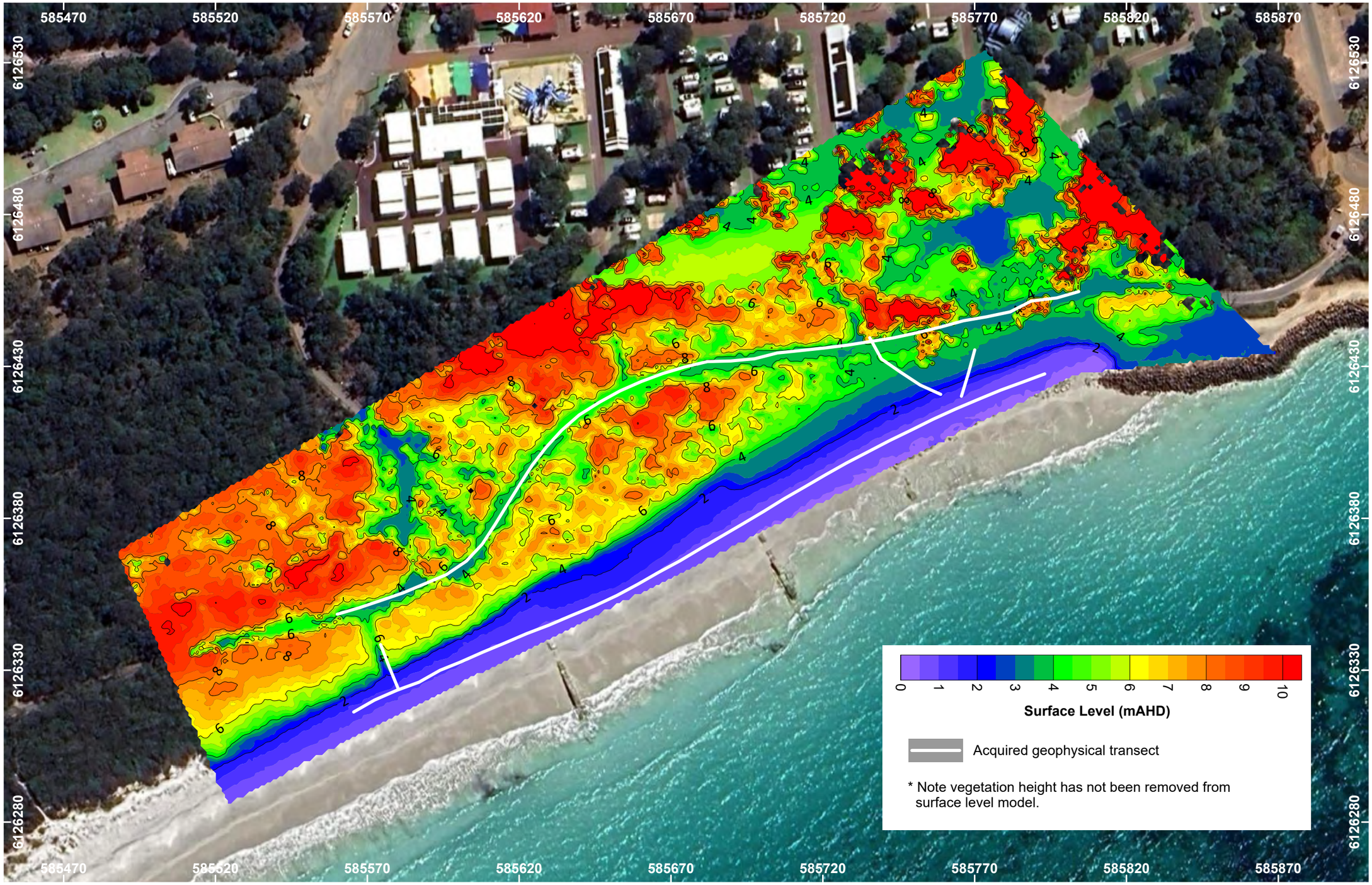
APPENDIX C – MODELLED SURFACE LEVEL AND SEDIMENT THICKNESS

GBGGROUP

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
EMU POINT, CITY OF ALBANY WESTERN AUSTRALIA

SURFACE LEVEL MODEL



NOTES

Drawing to be used in conjunction with Report 3142A.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.

N

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	15 January 2025	Paper Size	A3
	GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT EMU POINT, CITY OF ALBANY WA	Scale	1:1300	Drawn	SMK
		Drawing	3142A-05	Revision	0

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GBGGROUP

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
EMU POINT, CITY OF ALBANY WESTERN AUSTRALIA

CLASSED POST MAP SEDIMENT THICKNESS OVER ROCK

NOTES

Drawing to be used in conjunction with Report 3142A.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.

N

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	15 January 2025	Paper Size	A3
	GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT EMU POINT, CITY OF ALBANY WA	Scale	1:1300	Drawn	SMK
		Drawing	3142A-06	Revision	0

GBGGROUP

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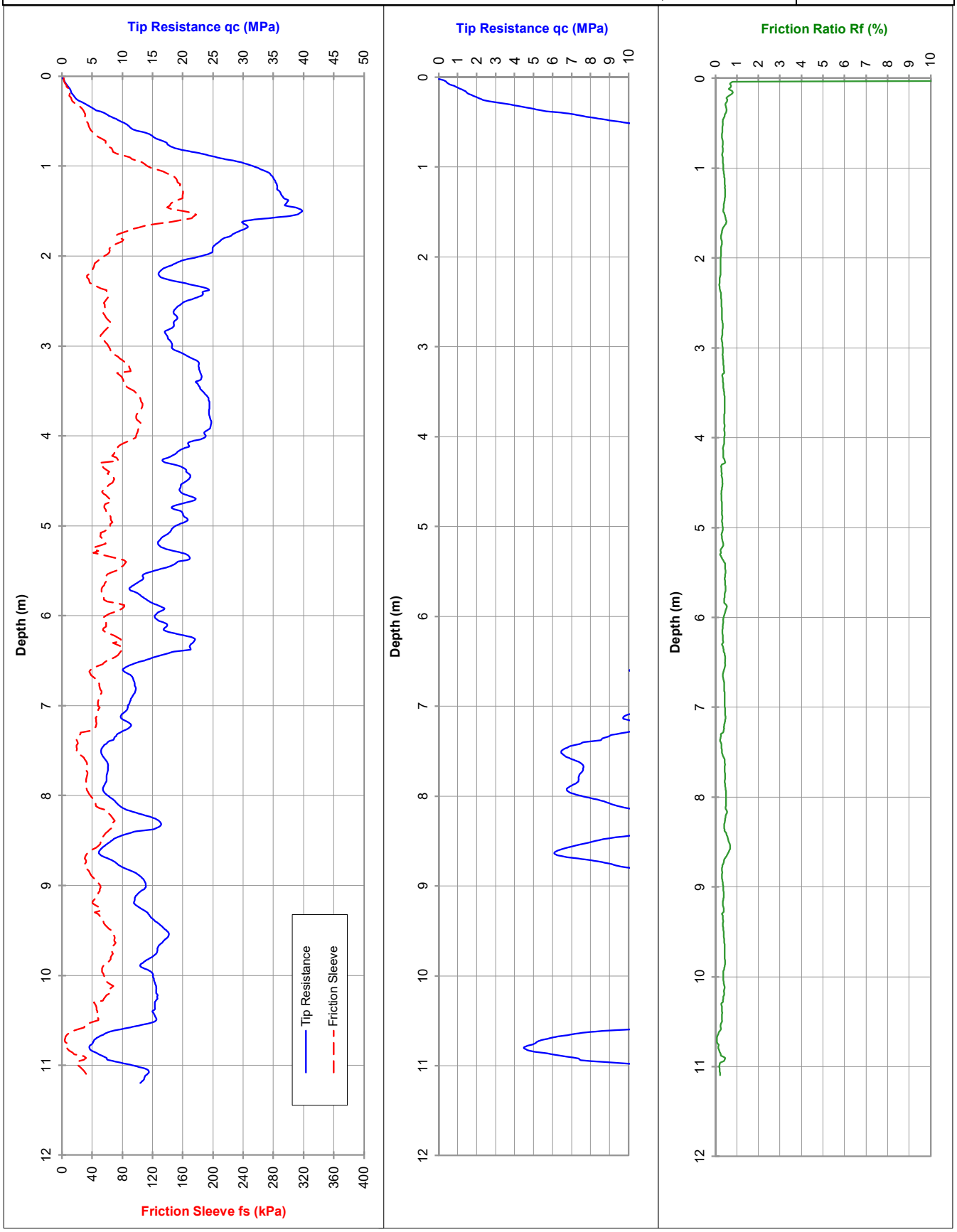
APPENDIX D – CONE PENETRATION TEST PLOTS

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: GBG Group	Job No.: 3142	Probe I.D
PROJECT: Southern and Southwest Coastal	RL (m): 1.73	**CPT 01**
LOCATION: Emu Point	Co-ords: 585581.5mE, 6126322.48mN	14-Jan-25



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 0.8

Dummy probe to (m):

Refusal:

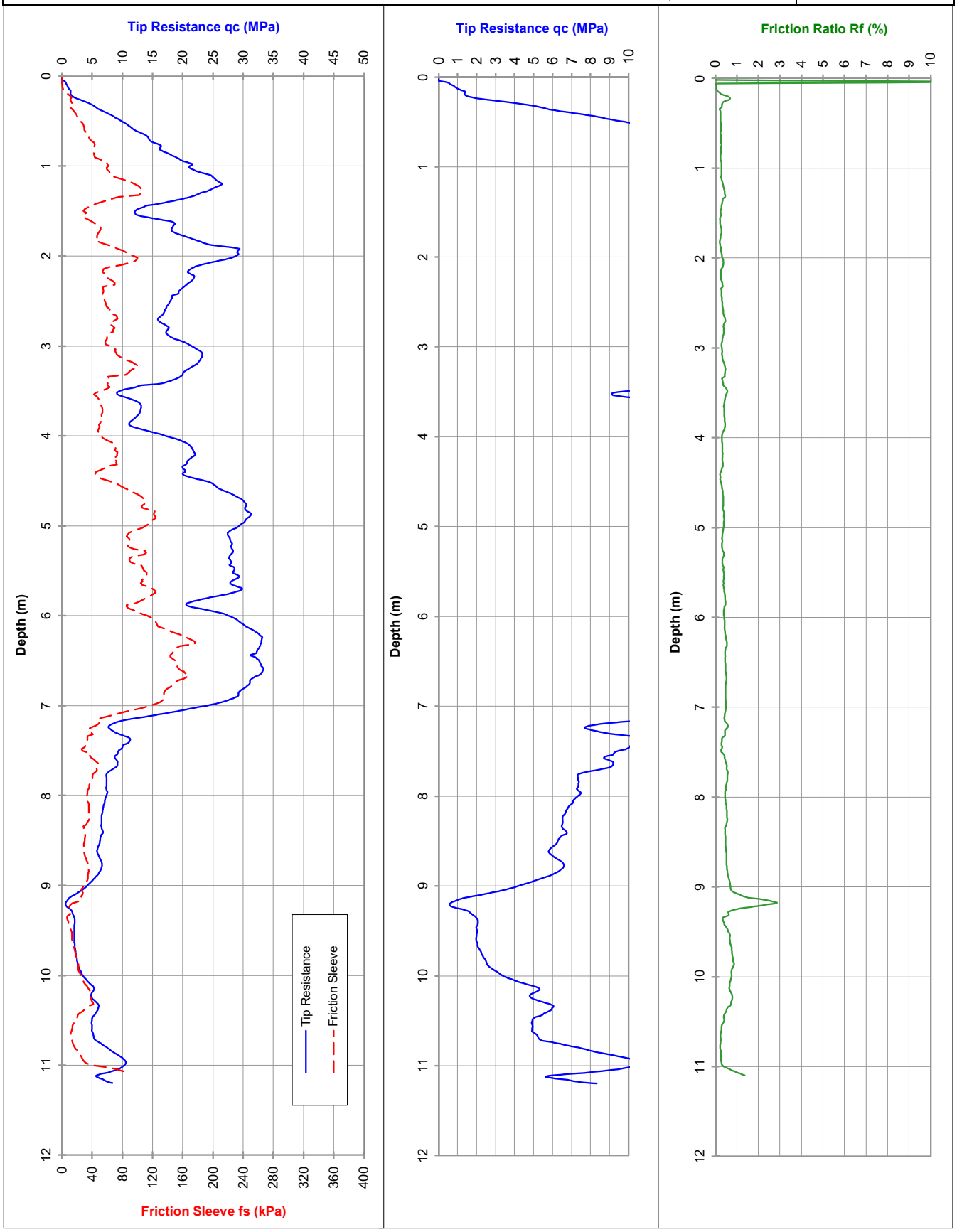
Cone I.D.: EC47

File: GB0065T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: GBG Group	Job No.: 3142	Probe I.D
PROJECT: Southern and Southwest Coastal	RL (m): 1.56	**CPT 04**
LOCATION: Emu Point	Co-ords: 585682.46mE, 6126372.56mN	14-Jan-25



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 0.6

Dummy probe to (m):

Refusal:

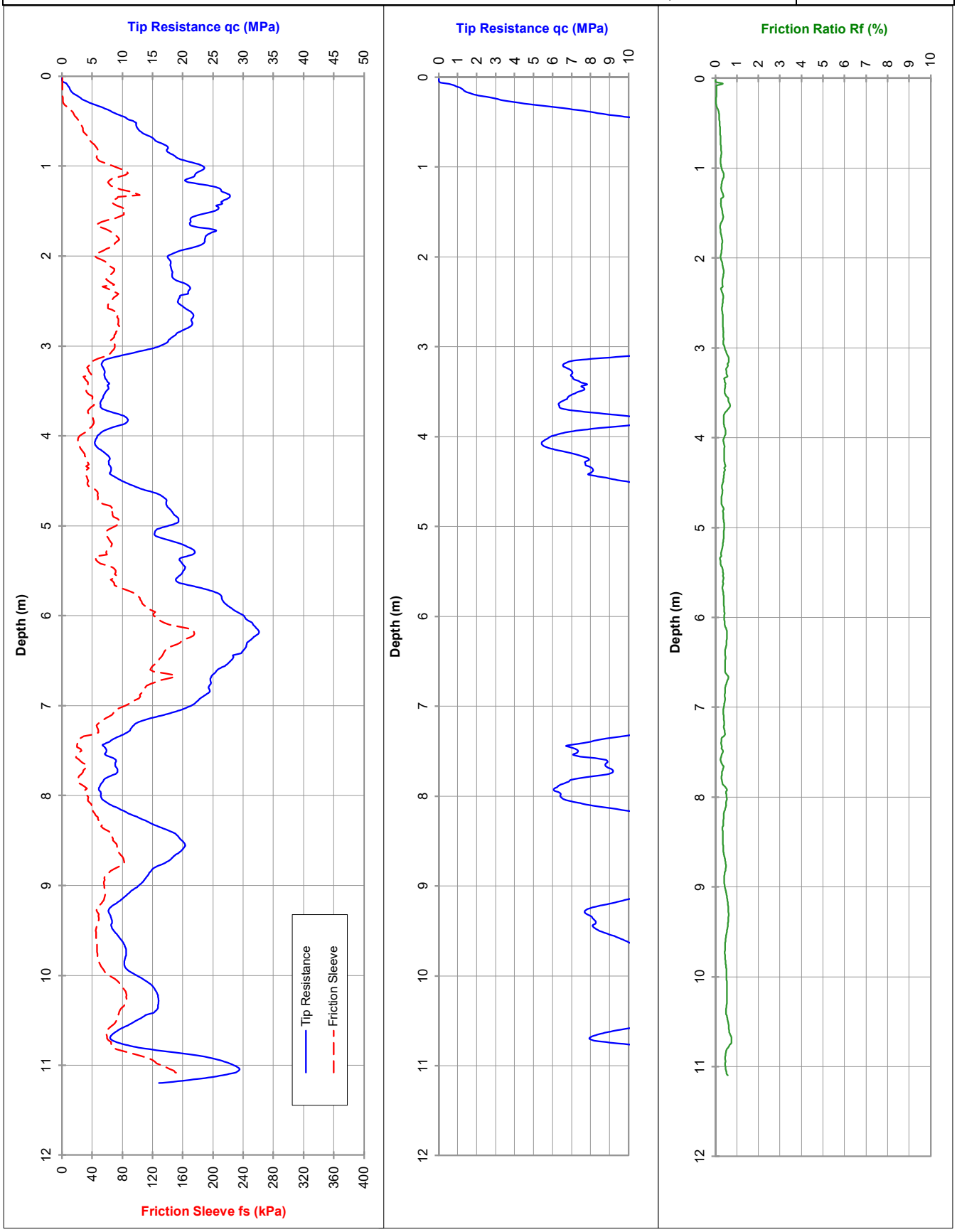
Cone I.D.: EC47

File: GB0066T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: GBG Group	Job No.: 3142	Probe I.D
PROJECT: Southern and Southwest Coastal	RL (m): 1.69	**CPT 06**
LOCATION: Emu Point	Co-ords: 585768.51mE, 6126418.62mN	14-Jan-25



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 0.8

Dummy probe to (m):

Refusal:

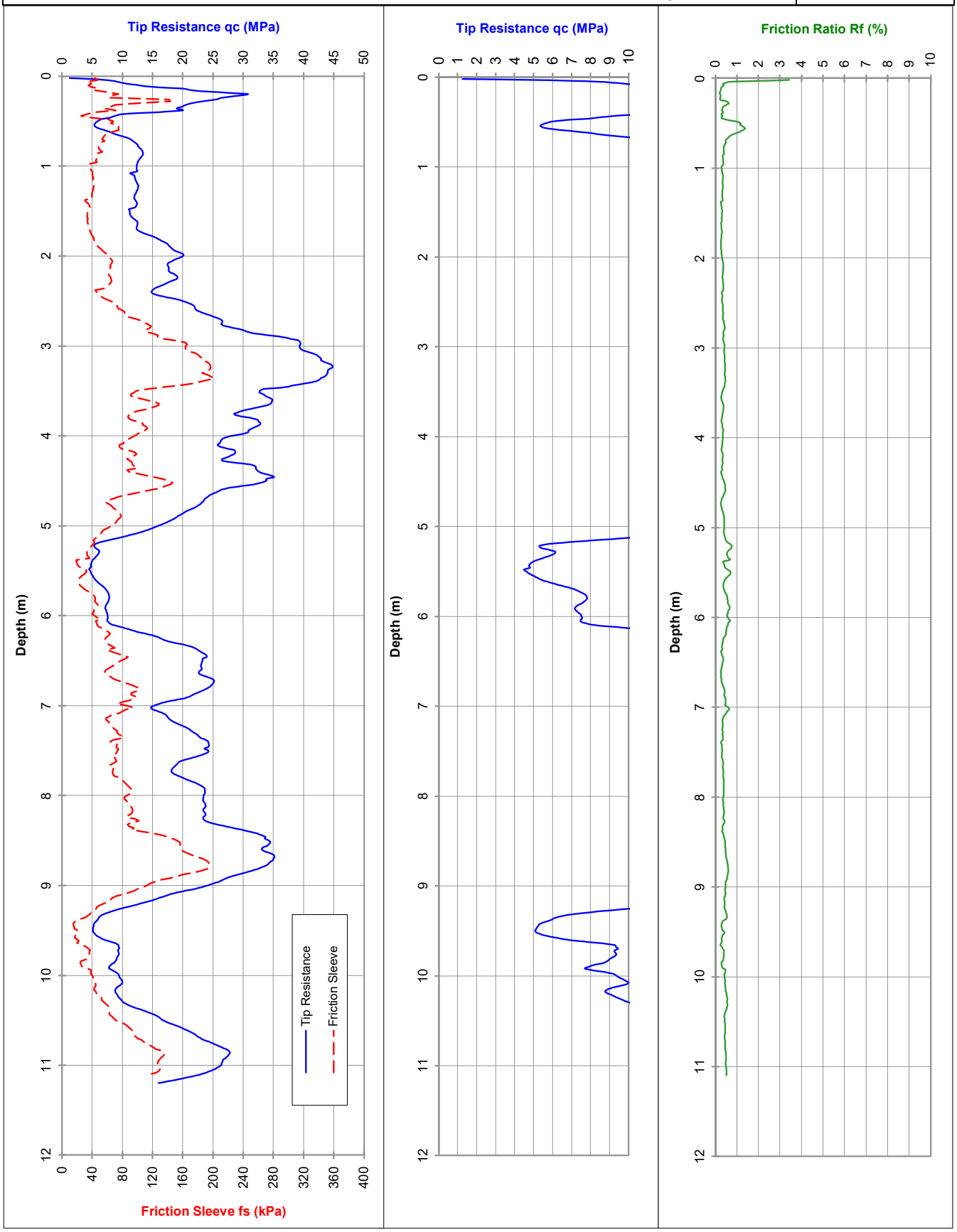
Cone I.D.: EC47

File: GB0067T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: GBG Group	Job No.: 3142	Probe I.D
PROJECT: Southern and Southwest Coastal	RL (m): 3.45	**CPT 07**
LOCATION: Emu Point	Co-ords: 585777.04mE, 6126449.02mN	15-Jan-25



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.6

Dummy probe to (m):

Refusal:

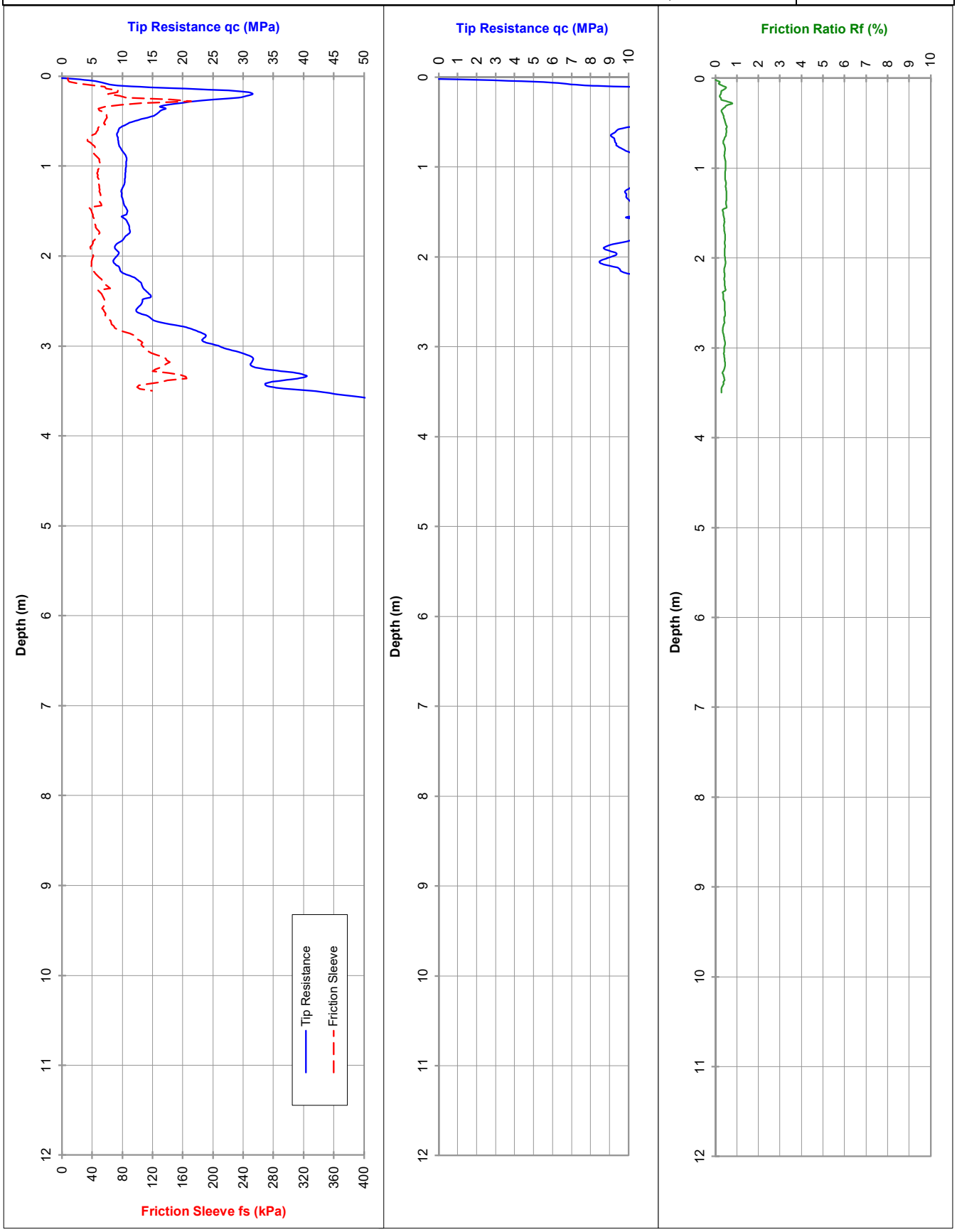
Cone I.D.: EC47

File: GB0068T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: GBG Group	Job No.: 3142	Probe I.D
PROJECT: Southern and Southwest Coastal	RL (m): 4.43	**CPT 05**
LOCATION: Emu Point	Co-ords: 585733.76mE, 6126439.25mN	15-Jan-25



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.8

Dummy probe to (m):

Refusal: Rod Friction

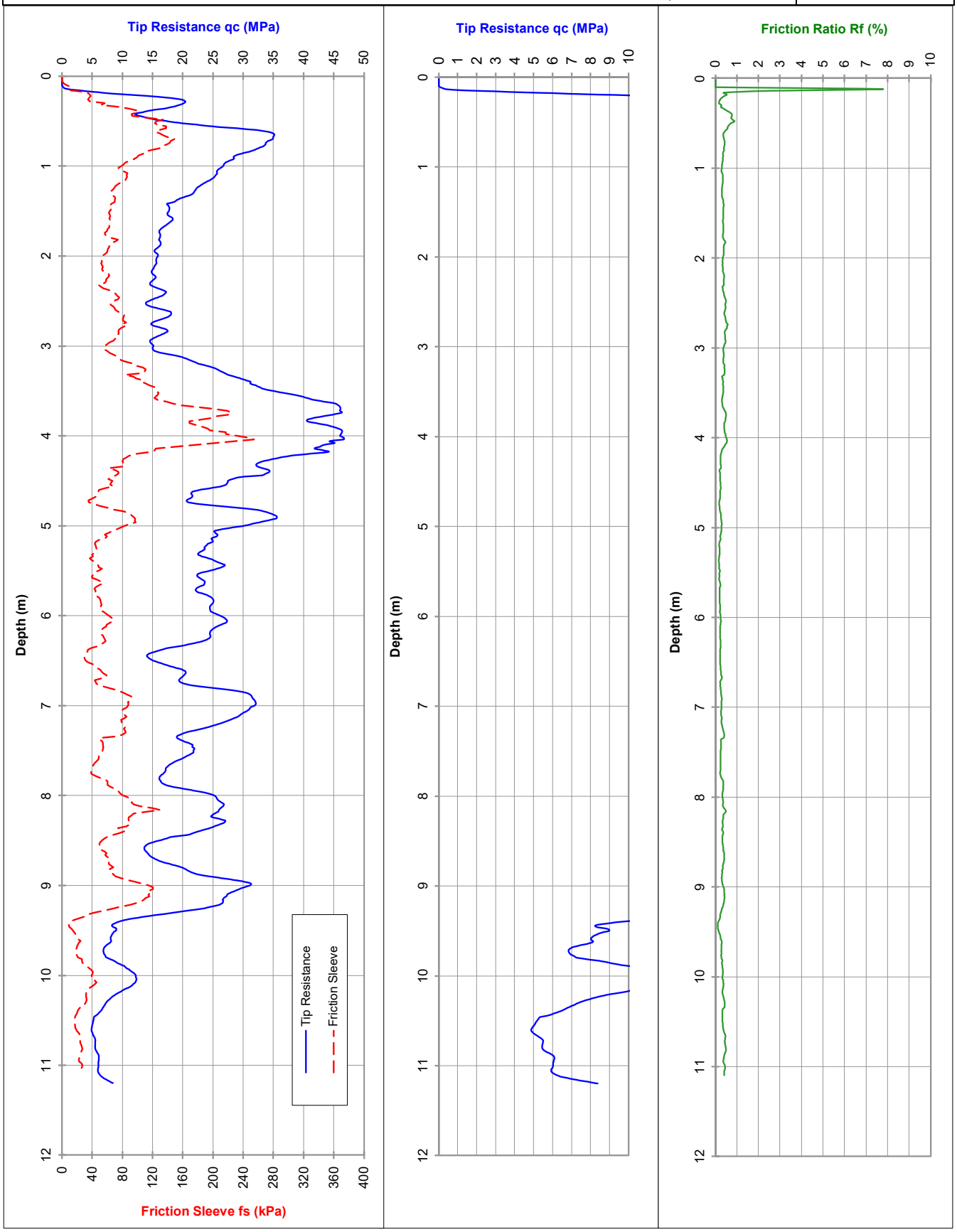
Cone I.D.: EC47

File: GB0069T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: GBG Group	Job No.: 3142	Probe I.D
PROJECT: Southern and Southwest Coastal	RL (m): 5.28	**CPT 03**
LOCATION: Emu Point	Co-ords: 585656.83mE, 6126425.16mN	15-Jan-25



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 2.1

Dummy probe to (m): 0.3

Refusal:

Cone I.D.: EC47

File: GB0070T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CPT 02

CLIENT: GBG Group

Job No.: 3142

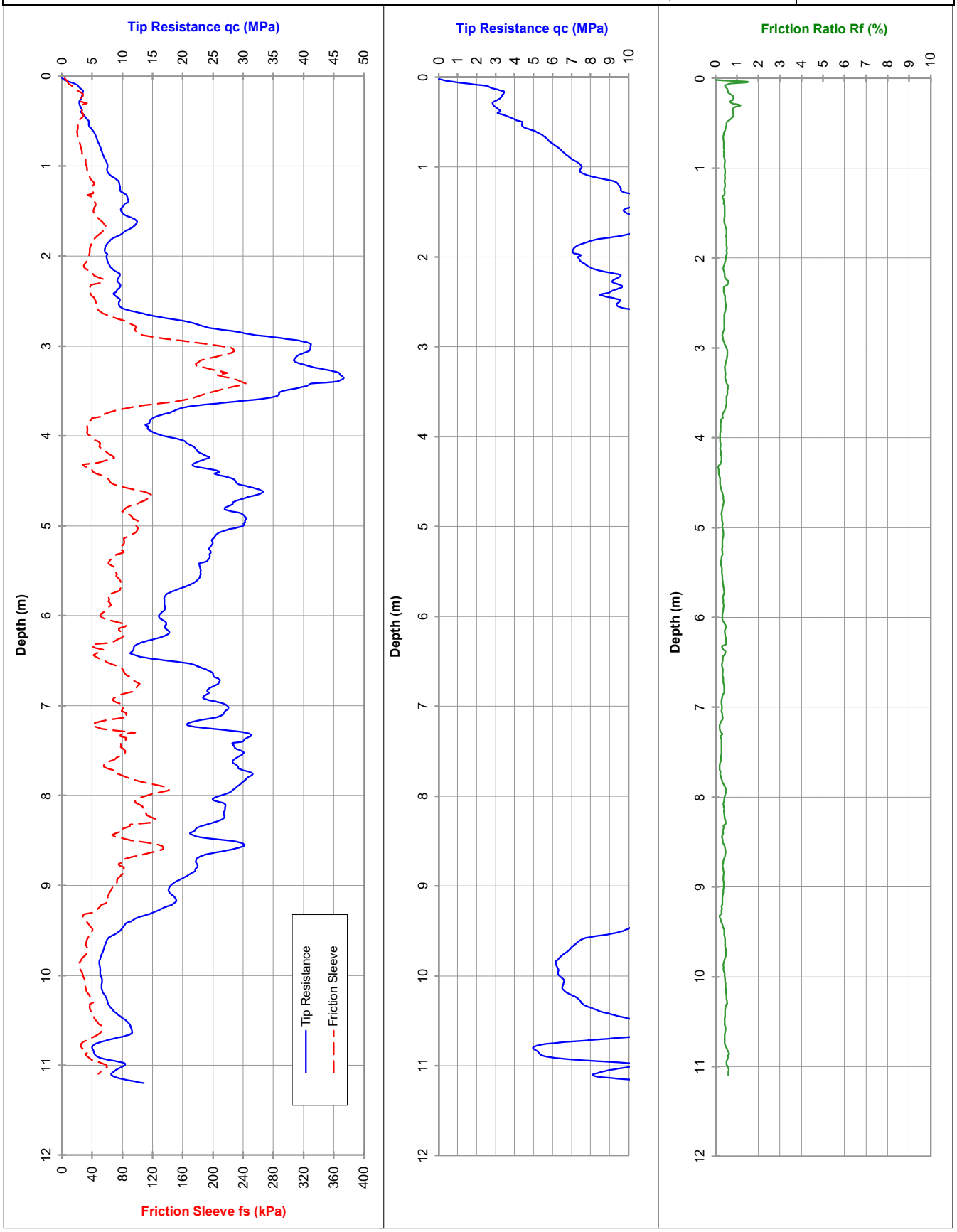
PROJECT: Southern and Southwest Coastal

RL (m): 3.52

LOCATION: Emu Point

Co-ords: 585584.13mE, 6126360.46mN

15-Jan-25



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 2.0

Dummy probe to (m):

Refusal:

Cone I.D.: EC47

File: GB0071T

Rig Type: 7t track

PROBEDRILL
GEOTECHNICAL SURVEY

CALIBRATION CERTIFICATE

CONE ID: EC47

Cone Type:	Compression
Calibration Date (qc/fs):	20 November 2024
Calibration Date (u):	25 November 2024
Preliminary Inspection:	Pass
Calibrated By:	Henky Lawer
Calibration Procedure:	ISO 22476-1:2012, IRTP 2001
Force Application:	Compression
Reference Equipment:	PT - S type 100kN Serial # 5126009 (Calibrated 10/03/23 - NATA approved Cert. No. 230664) Bongshin - S type 50kN Serial #I44427 (Calibrated 05/06/24 - NATA approved Cert. No. 241683) Digitron Panel Meter Serial #: 060213/01 (Calibrated 09/03/23 - NATA endorsed Report No. 230658, 230659, 230660)

Note: In accordance with AS1289 F5.1 the force calibration derived by NATA Calibration Certificates are converted to a qc reading in MPa and fs reading in kPa by dividing by 1000 mm² and 15000mm² respectively.

Results of Calibration:

qc (tip resistance):

Capacity: 100 (MPa)
Area 1000 (mm²)

Applied Load kN	Eqv. Pressure MPa	Mean Observed Reading Volts
0	0	0.000
10	10	0.757
20	20	1.514
30	30	2.273
40	40	3.033
50	50	3.797
60	60	4.562
70	70	5.330
80	80	6.100
90	90	6.865
100	100	7.634
90	90	6.889
80	80	6.131
70	70	5.372
60	60	4.610
50	50	3.850
40	40	3.084
30	30	2.318
20	20	1.549
10	10	0.780
0	0	0.004
R^2 Value =	1.000	

Zero Load Error: 0.06%
Max. Linearity 0.38%
Max. Hysteris 0.70%

MPa/Volt: 13.094

fs (sleeve friction):

Capacity: 2000 (kPa)
Area 15000 (mm²)

Applied Force kN	Eqv. Load kPa	Mean Observed Reading Volts
0	0	0.000
3	200	0.746
6	400	1.502
9	600	2.259
12	800	3.014
15	1000	3.766
18	1200	4.517
21	1400	5.270
24	1600	6.022
27	1800	6.780
30	2000	7.540
27	1800	6.814
24	1600	6.067
21	1400	5.315
18	1200	4.563
15	1000	3.809
12	800	3.055
9	600	2.296
6	400	1.528
3	200	0.765
0	0	0.002
R^2 Value =	1.000	

Zero Load Error: 0.03%
Max. Linearity 0.47%
Max. Hysteris 0.61%

kPa/Volt: 264.97

u (pore pressure):

Capacity: 3500 (kPa)
Position u2

Applied Pressure bar	Eqv. Pressure kPa	Mean Observed Reading Volts
0	0	0.000
3	300	0.351
6	600	0.700
9	900	1.050
12	1200	1.399
15	1500	1.749
18	1800	2.098
21	2100	2.443
25	2500	2.909
30	3000	3.488
35	3500	4.066
30	3000	3.495
25	2500	2.916
21	2100	2.452
18	1800	2.103
15	1500	1.754
12	1200	1.405
9	900	1.053
6	600	0.702
3	300	0.352
0	0	0.001
R^2 Value =	1.000	

Zero Load Error: 0.01%
Max. Linearity 0.25%
Max. Hysteris 0.22%

kPa/Volt: 859.97
Net Area (calibrated): 0.81

"Class 1" Application Accuracy achieved (in accordance with ISO 22476:2012 classification)

Calibration Checked & Authorised: Kylie Walker

Job Details

Client:	GBG Maps	**Date of Job:**	14/01/2025
Rep:	Peter Eccleston	**Tip Diameter:**	35.85
Location:	Albany/ Harbourside	**Sleeve Diameter:**	35.97