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Report

Geotechnical Investigation for Coastal Erosion Vulnerability Assessment.

Point Peron, City of Rockingham WA.

Date: 22 October 2025
Report Ref: 3177C

DOCUMENT HISTORY

DETAILS

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COMPANY DETAILS

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EXECUTIVE SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Point Peron in the City of Rockingham, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 900m corridor of coastal beach and dune formation along the Peron Foreshore which which has been identified as an at-risk site at the request of the WA State Government.

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:

- Interpreted rock substrate was observed in the north-west of the site and at the center of the site in isolated zones, however rock strata was not observed along the majority of transects. within the maximum target investigation depth of 10-15m BGL.

- Interpreted top of rock substrata across the site was generally not observed across the site, however a minor rock feature was modelled within the center of the site with rock levels at approximately -3 to -5m, and at the north-west with rock levels rising from -4m to 4mAHD approaching the headland.

- Sand thickness across the site ranged from 1m to greater than 8m with the majority of the site exhibiting sand thickness of >6m.

CONTENTS

1 INTRODUCTION

At the request of The Government of Western Australia Department of Transport (DoT), GBG Group carried out a geotechnical investigation at Point Peron, City of Rockingham in September and October 2025. During the investigation seismic geophysical testing and intrusive geotechnical testing was conducted within a 900m corridor of coastal beach and dune formation which has been identified as an at-risk site at the request of the WA State Government.

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 900m corridor of coastal beach and dune formation parallel to Point Peron Road. 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 0.5mAHD to 5mAHD. Topographic maps showing surface level are provided in Appendix C drawing 3177C-05.

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

Figure 2: Site conditions at Point Peron including the eastern end of along-shore transect on the beach (left image) and central along-shore track near beach access along cross-shore transect (right image).

3 INVESTIGATION METHODOLOGY

3.1 FIELD SURVEY LOGISTICS

Geophysical data acquisition was carried out on 30 September and 1 October 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 30 September 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 1792m 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 3177C-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	376669.27	6428863.58	377236.15	6428470.66	728
MASW-02	Along-shore	376582.44	6428715.65	377169.37	6428340.68	760
MASW-03	Cross-shore	376574.57	6428735.33	376580.57	6428817.11	88
MASW-04	Cross-shore	376833.62	6428694.50	376895.29	6428699.67	64
MASW-05	Cross-shore	377177.62	6428351.23	377298.44	6428403.19	152

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 softened steel sledgehammer with source points made at a constant offset from the receiver array. MASW acquisition parameters are provided in Table 2.

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

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 3).
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.

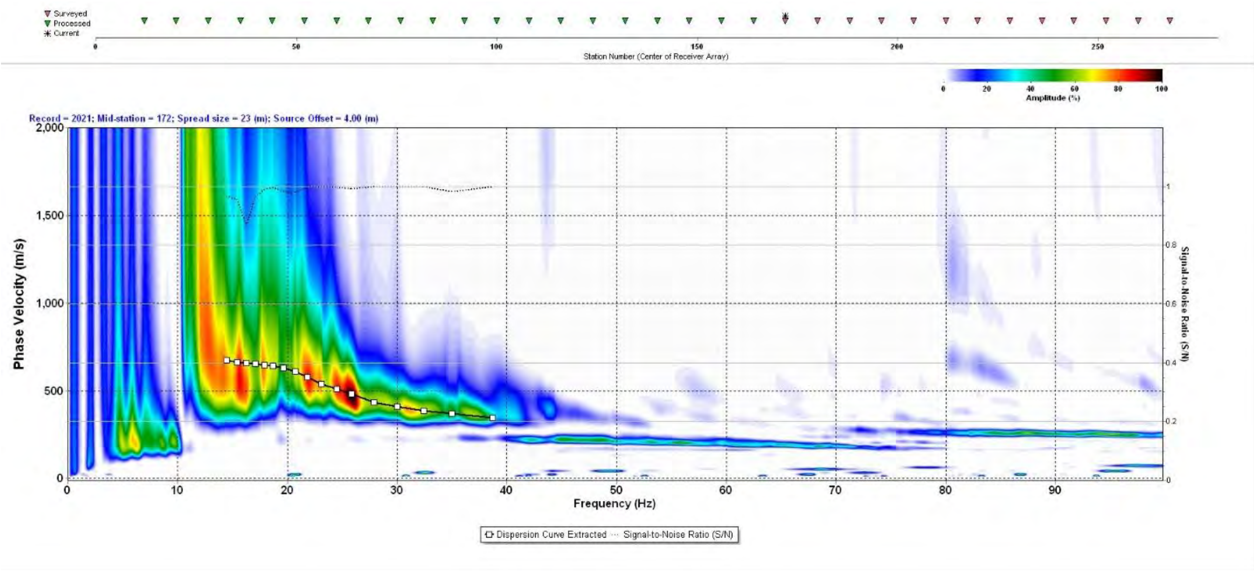

Figure 3: MASW overtone image with high signal to noise ratio and picked dispersion curve.

3.3 CONE PENETRATION TESTING

CPT is a geotechnical test method for evaluating the properties of soils and assessing subsurface stratigraphy including the sediment/rock interface at spot locations. The method involves pushing a calibrated cone and rod into the ground with a measured force with the resulting friction resistance plotted against depth to provide sediment compaction rates as well as the refusal depth indicating the depth to competent rock.

Testing was carried out using a M2 (Morooka) 11 tonne track mounted CPT Rig, specifications of which are provided in Appendix D. The test points were initially marked out at suitable locations within 2m of the intersecting geophysical transects. Dial Before You Dig enquiries and if necessary, utility locating was carried out prior to testing commencing.

CPT readings was made with sufficient ground bearing pressure to obtain a target depth of 10m or prior refusal. Where shallow refusal depths of less than 2m was encountered, when deemed necessary, an additional offset test was made to ascertain whether shallow refusal was due to a rock floater or other shallow obstruction. A photograph of CPT data acquisition is shown in Figure 4.

Figure 4: CPT data acquisition during a previous coastal investigation.

3.4 SPATIAL POSITIONING AND PHOTOGRAMMETRY

Spatial positioning of the acquired geophysical transects was achieved using an Atlas Hemisphere (S631) with Satellite-Based Differential Correction Service (L-Band) 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 Survey marker SMM NT 23 within the survey area as base station to broadcast coordinate corrections in real time via NTRIP. Details of the survey marker used for this investigation are provided in Table 3.

Table 3 – Details of Survey Marker Station

Parameter	Value
Survey Marker (Spike)	SMM NT 23
Latitude	S 32 16 10.91193
Longitude	E 115 41 20.11983
Derived GDA2020 Ellipsoidal height (m)	-6.093

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 Point Peron, City of Rockingham are presented in Appendices B and C of this report as follows:

Appendix B – Geophysical and Interpreted Sections

- **3177C-02.** Transect 1 seismic S-wave velocity model and interpreted geological section.
- **3177C-03.** Transect 2 seismic S-wave velocity model and interpreted geological section.
- **3177C-04.** Transect 2, 3 and 4 seismic S-wave velocity model and interpreted geological section.

Appendix C – Modelled Level to Surface and Sediment Thickness

- **3177B -05.** Contoured surface level models derived from aerial photogrammetry.
- **3177B -06.** Contoured level to modelled top of rock.
- **3177B -07.** Class post map level to modelled top of rock.
- **3177B -08.** Contoured modelled sand thickness over rock / Depth to top of rock.
- **3177B -09.** Class post map modelled sand thickness over rock / Depth to top of 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 250-550m/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.

3. **Moderate seismic S-wave velocity** (Vs 550-750m/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-11 on Transect 01** – no refusal to 10.2m.
- **CPT-37 on Transect 01** – rod friction at 1.08m depth. This is unlikely to be due to rock.
- **CPT-28 on Transect 01 and 04** – refusal (73MPa) at 5.76m.
- **CPT-55 on Transect 01** – refusal (57MPa) at 5.24m.
- **CPT-05 on Transect 01** – no refusal to 10.2m.

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 models for the level to top of rock substrate and overlying sand thickness within the region between the coastal foreshore and settlement are presented in Appendix C. These has been generated by digitising the interface between the interpreted sediment and underling rock profile from the interpreted geological sections along the acquired along-shore and cross-shore transects. The modelled sand thickness was then generated by subtracting this from the surface elevation. The sand thickness can also be considered to be the depth to top of rock where rock exists within the depth of investigation. Interpreted rock depths and levels should be analysed in conjunction with interpreted seismic sections in Appendix B. The following subsurface models have been provided:

- **Contoured Surface Level Model** (drawings 3177C-05) – generated from the aerial photogrammetry, this presents the level to ground surface ranging from 0mAHD to 15mAHD. Note: vegetation height has not been removed from these models.

- **Contoured Level to Top of Rock Substrate** (drawings 3177C-06) – this presents the level to the top of rock substrate ranging from <-8mAHD to 6mAHD.

- **Classed Post Map Level to Top of Rock Substrate** (3177C-07) – this presents the level to the top of rock substrate along the acquired transects at 2m level increments from <-10mAHD to >2mAHD.

- **Contoured Sand Thickness / Depth to Top of Rock** (3177C-08) – this presents the thickness of sand overlying the rock substrate ranging from 1mBGL to >8mBGL.

- **Classed Post Map Sand Thickness / Depth to Top of Rock** (3177B-09) – this presents the thickness of sand overlying the rock substrate along the acquired transects at 2m depth increments from <1mBGL to >6mBGL.

The following limitations should be considered when assessing the subsurface models for the level to top of rock substrate and overlying sand thickness:

The expected accuracy of the top of rock substrate modelled from this investigation is +/-0.5mAHD. Similarly, an accuracy of +/-0.5m is expected for the modelled sand thickness over rock. The quoted accuracies have been based on consideration to the accuracy of the GNSS receivers using during the site work, 1D inversion of the MASW dataset using a 10-layer model and expected undulations in the sand/rock interface. Note the quoted accuracies are only valid along the geophysical transects. Values given between transects have been interpolated in the contour maps and as such the accuracy in this case is indeterminable.

The generated contours will give the general trend of the top of rock profile however will not image local variations when the extent of these is less than transect spacing. Spatially small features such as karst sinkholes or pinnacle features may not be imaged. The significance of this limitation is considered minor for this investigation since although local geological features such as pinnacles may not be represented in the data, the generated surface of the top of rock will show the broad trends in the geology over the site which is suitable for a coastal erosion assessment.

Transition zones including between fresh and weathered rock and between sediment and lithified/partially lithified sediment may be gradational and as such the interface between these layers are not well defined.

The calculated levels to the top of rock will only be valid along the geophysical transects. Values shown on the contour maps not on the transects have been interpolated using the krigging algorithm and as such the accuracy of these levels is indeterminable. The contour surface will give the general trend of the interface however may not image local variations, it is recommended that the interpreted geological sections presented in Appendix B be used to obtain more accurate top of rock levels and overlying sand thickness.

5 PROJECT SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Point Peron in the City of Rockingham, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 900m corridor of coastal beach and dune formation along the Peron Foreshore which which has been identified as an at-risk site at the request of the WA State Government.

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
GB Geotechnics (Australia) Pty Ltd

Peter Eccleston
Principal Geophysicist

APPENDIX A – INVESTIGATION SITE MAP

GBGGROUP

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

INVESTIGATION SITE MAP

NOTES
Drawing to be used in conjunction with Report 3177C.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.

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CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	1 October 2025	Paper Size	A3
	GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale	1:3000	Drawn	PJE
		Drawing	3177C-01	Revision	1

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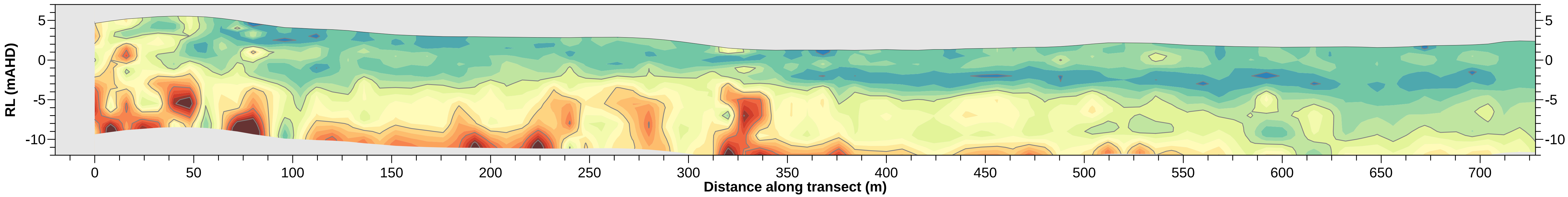
APPENDIX B – GEOPHYSICAL AND INTERPRETED SECTIONS

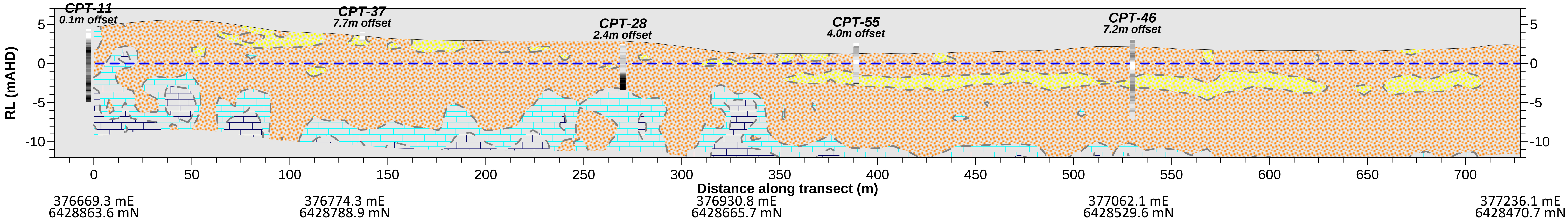
GBGGROUP

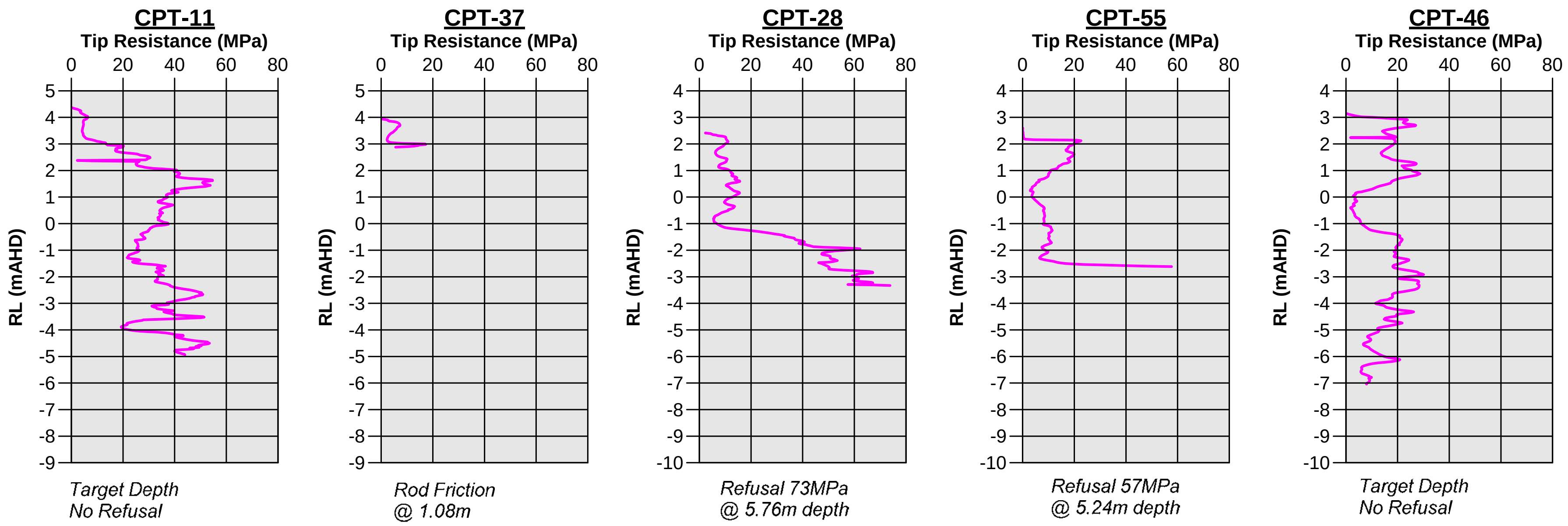
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

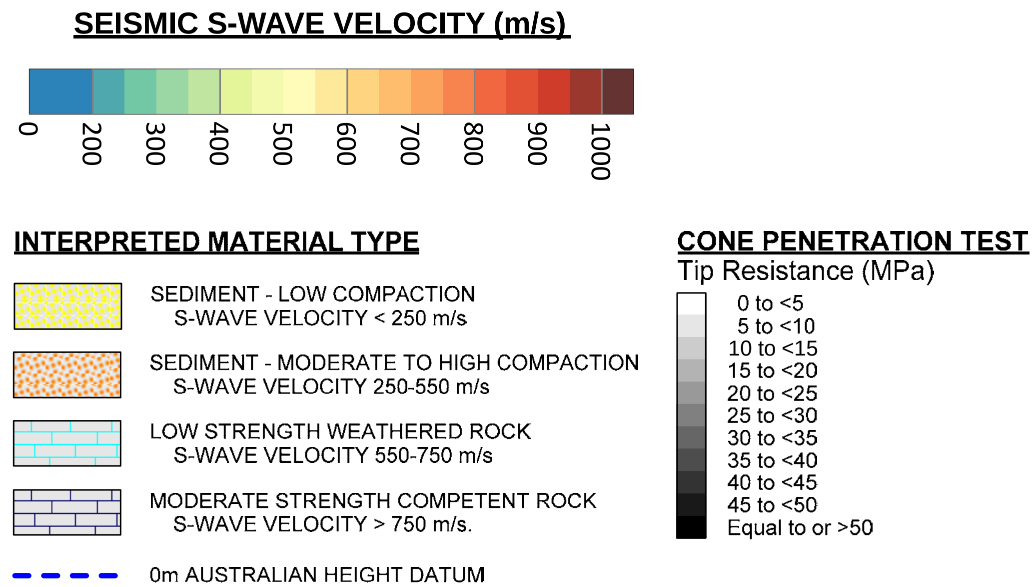
TRANSECT 1 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 1 - INTERPRETED GEOLOGICAL SECTION







NOTES
Drawing to be used in conjunction with Report 3177C.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	3 October 2025	Paper Size	A3
	GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale	1:2000H, 1:500V	Drawn	PJE
		Drawing	3177C-02	Revision	0

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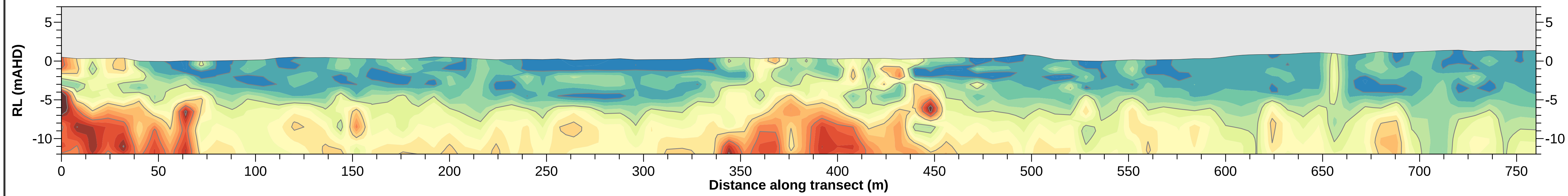
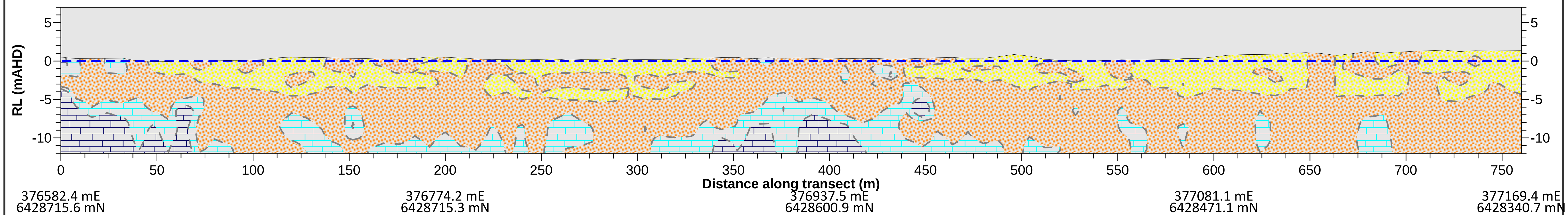
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

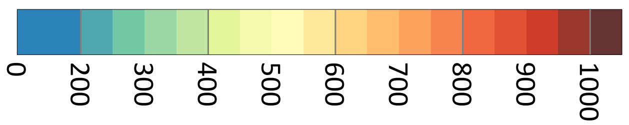
TRANSECT 2 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 2 - INTERPRETED GEOLOGICAL SECTION



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 250-550 m/s
- LOW STRENGTH WEATHERED ROCK
  S-WAVE VELOCITY 550-750 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 3177C.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date 3 October 2025	Paper Size A3	
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale 1:2000H, 1:500V	Drawn PJE	
	Drawing 3177C-03	Revision 0	

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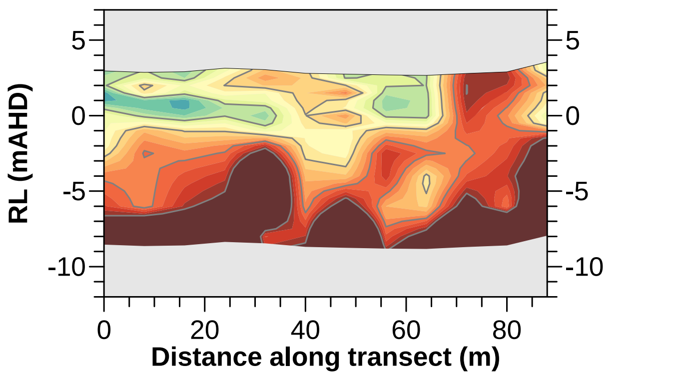
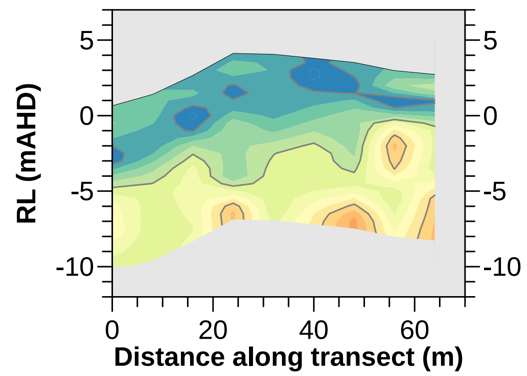
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

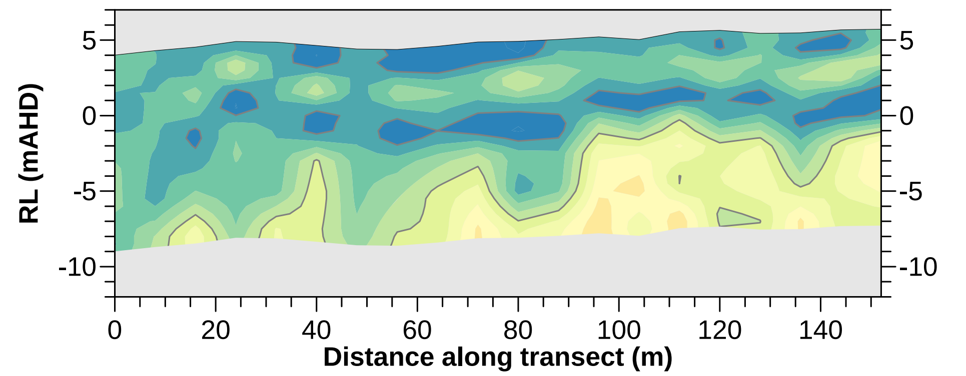
TRANSECT 3 - SEISMIC SHEAR WAVE VELOCITY MODEL



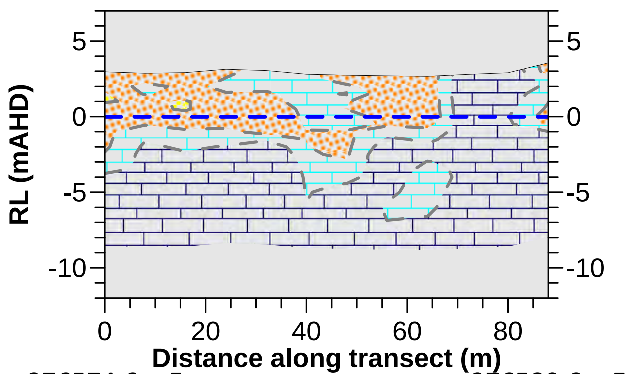
TRANSECT 4 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 5 - SEISMIC SHEAR WAVE VELOCITY MODEL

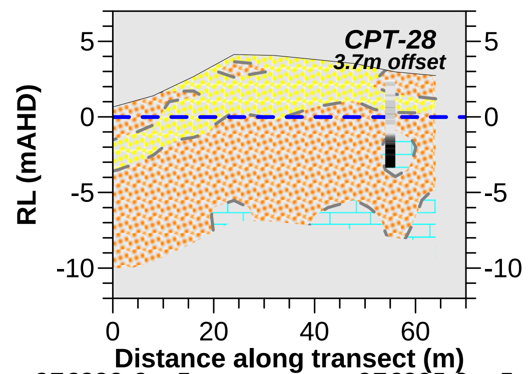


TRANSECT 3 - INTERPRETED GEOLOGICAL SECTION



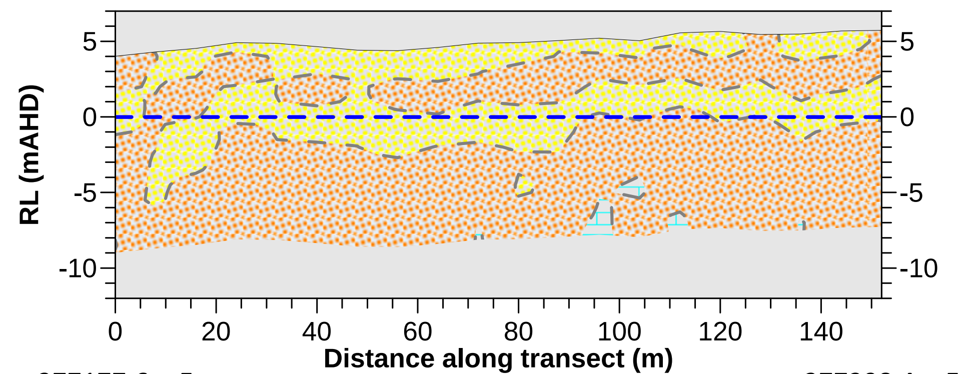
376574.6 mE 6428735.3 mN — 376580.6 mE 6428817.1 mN

TRANSECT 4 - INTERPRETED GEOLOGICAL SECTION



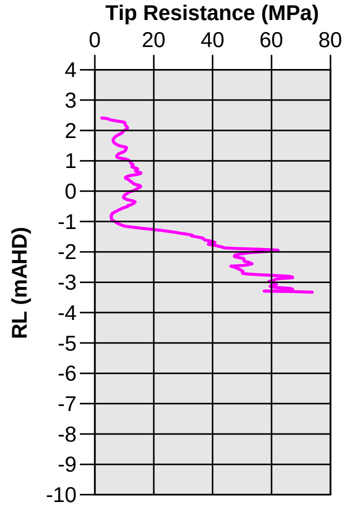
376833.6 mE 6428694.5 mN — 376895.3 mE 6428699.7 mN

TRANSECT 5 - INTERPRETED GEOLOGICAL SECTION



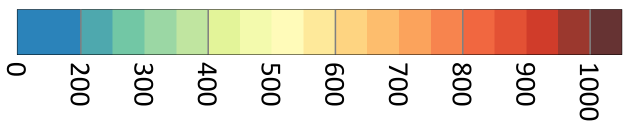
377177.6 mE 6428351.2 mN — 377298.4 mE 6428403.2 mN

CPT-28



Refusal 73MPa @ 5.76m depth

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 250-550 m/s
- LOW STRENGTH WEATHERED ROCK S-WAVE VELOCITY 550-750 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 3177C.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT: DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date: 3 October 2025	Paper Size: A3	
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale: 1:2000H, 1:500V	Drawn: PJE	
	Drawing: 3177C-04	Revision: 0	

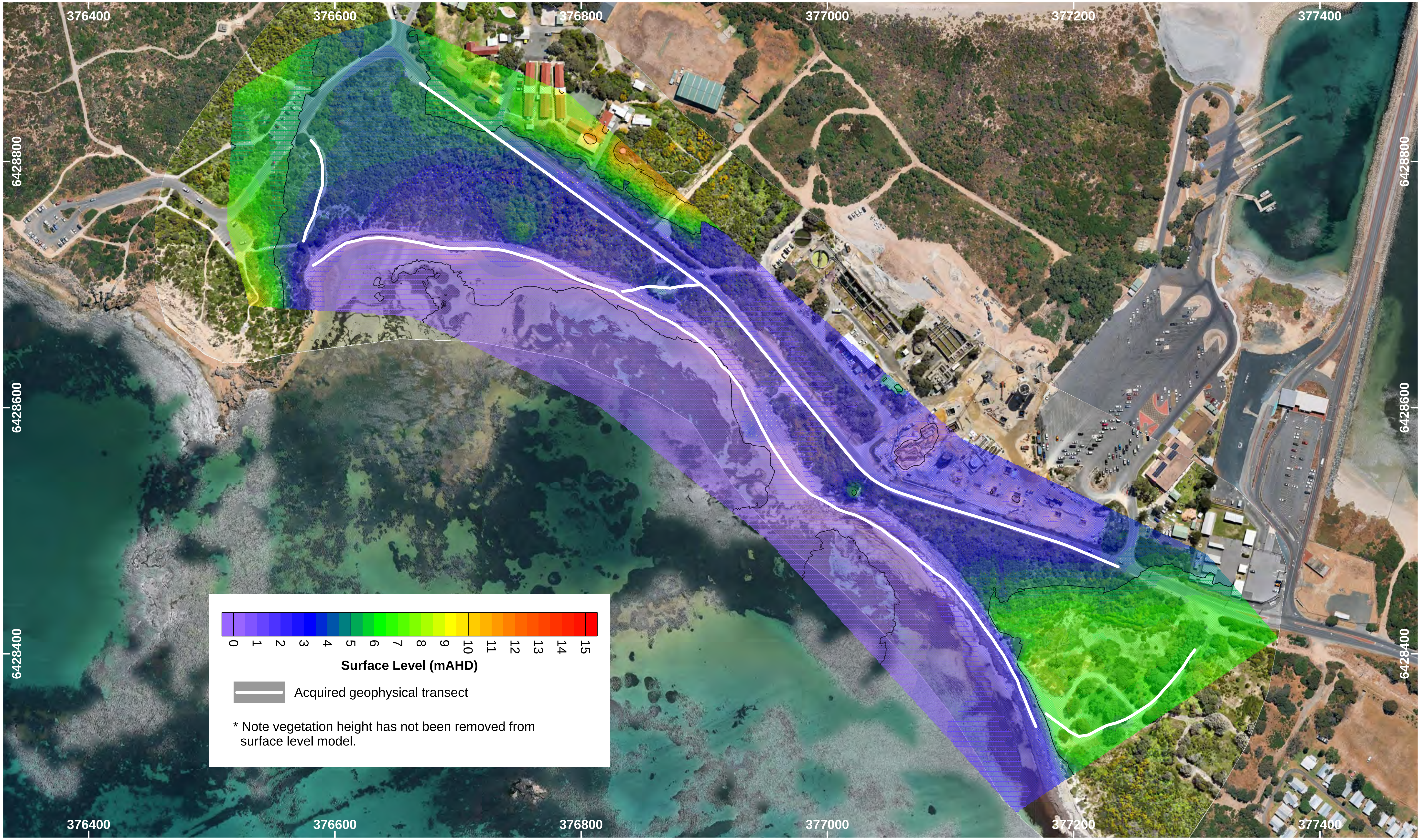
G B Geotechnics (Australia) Pty Ltd
1/11 Gympie Way Willetton WA 6155
ABN: 77 009 550 869
Telephone: 02 9890 2122
Email: info@gbgoz.com.au

APPENDIX C – MODELLED SURFACE LEVEL AND SEDIMENT THICKNESS

GBGGROUP

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

SURFACE LEVEL MODEL



NOTES
Drawing to be used in conjunction with Report 3177C.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.

N

CLIENT: DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date: 13 October 2025	Paper Size: A3	
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale: 1:3000	Drawn: PJE	
	Drawing: 3177C-05	Revision: 1	

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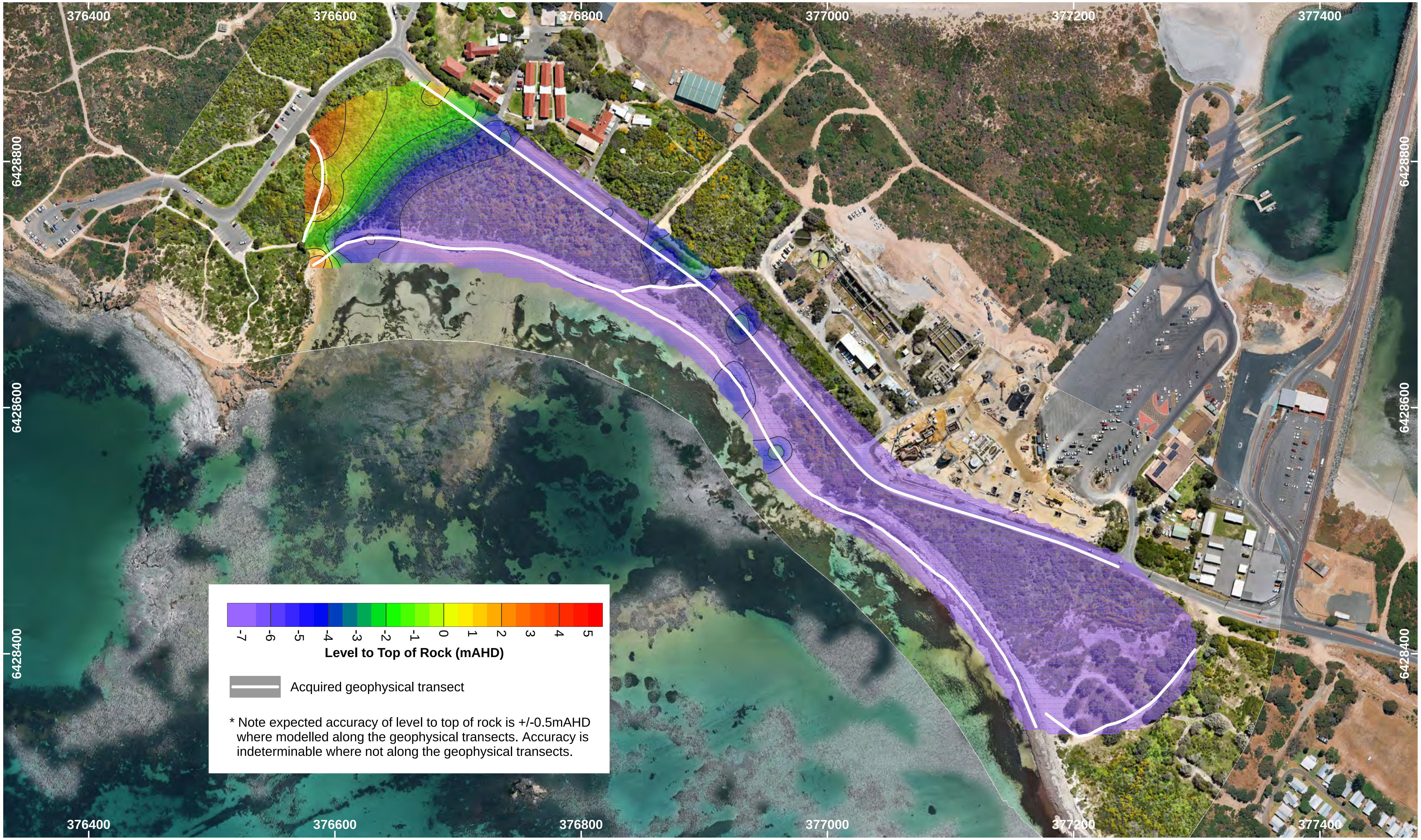
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

CONTOURED LEVEL TO TOP OF ROCK



NOTES

Drawing to be used in conjunction with Report 3177C.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.

N

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	13 October 2025	Paper Size	A3
	GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale	1:3000	Drawn	PJE
		Drawing	3177C-06	Revision	1

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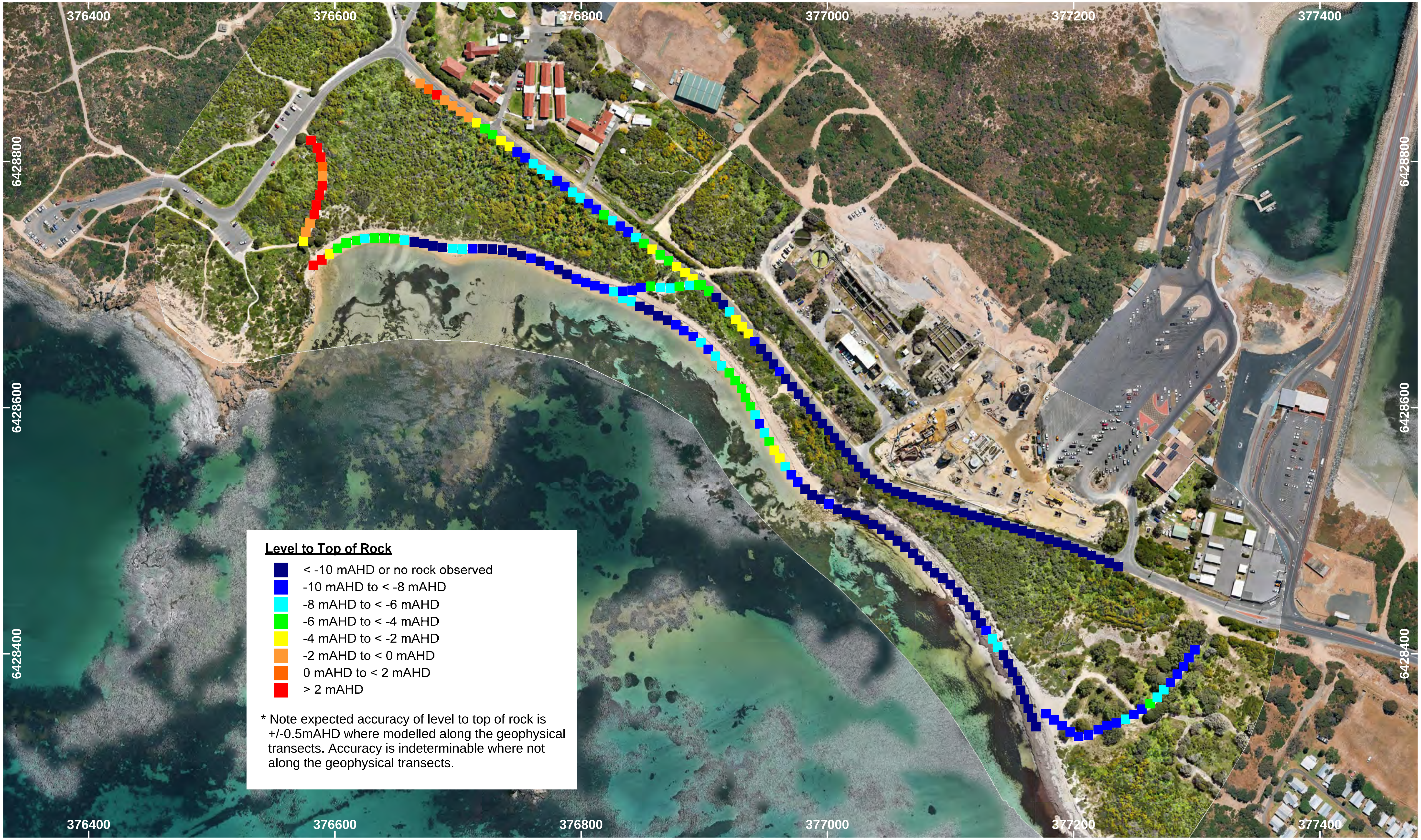
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

CLASSED POST MAP LEVEL TO TOP OF ROCK



Level to Top of Rock

- < -10 mAHD or no rock observed
- -10 mAHD to < -8 mAHD
- -8 mAHD to < -6 mAHD
- -6 mAHD to < -4 mAHD
- -4 mAHD to < -2 mAHD
- -2 mAHD to < 0 mAHD
- 0 mAHD to < 2 mAHD
- > 2 mAHD

* Note expected accuracy of level to top of rock is +/-0.5mAHD where modelled along the geophysical transects. Accuracy is indeterminable where not along the geophysical transects.

NOTES

Drawing to be used in conjunction with Report 3177C.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.

N

CLIENT: DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date: 13 October 2025	Paper Size: A3	
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale: 1:3000	Drawn: PJE	
	Drawing: 3177C-07	Revision: 1	

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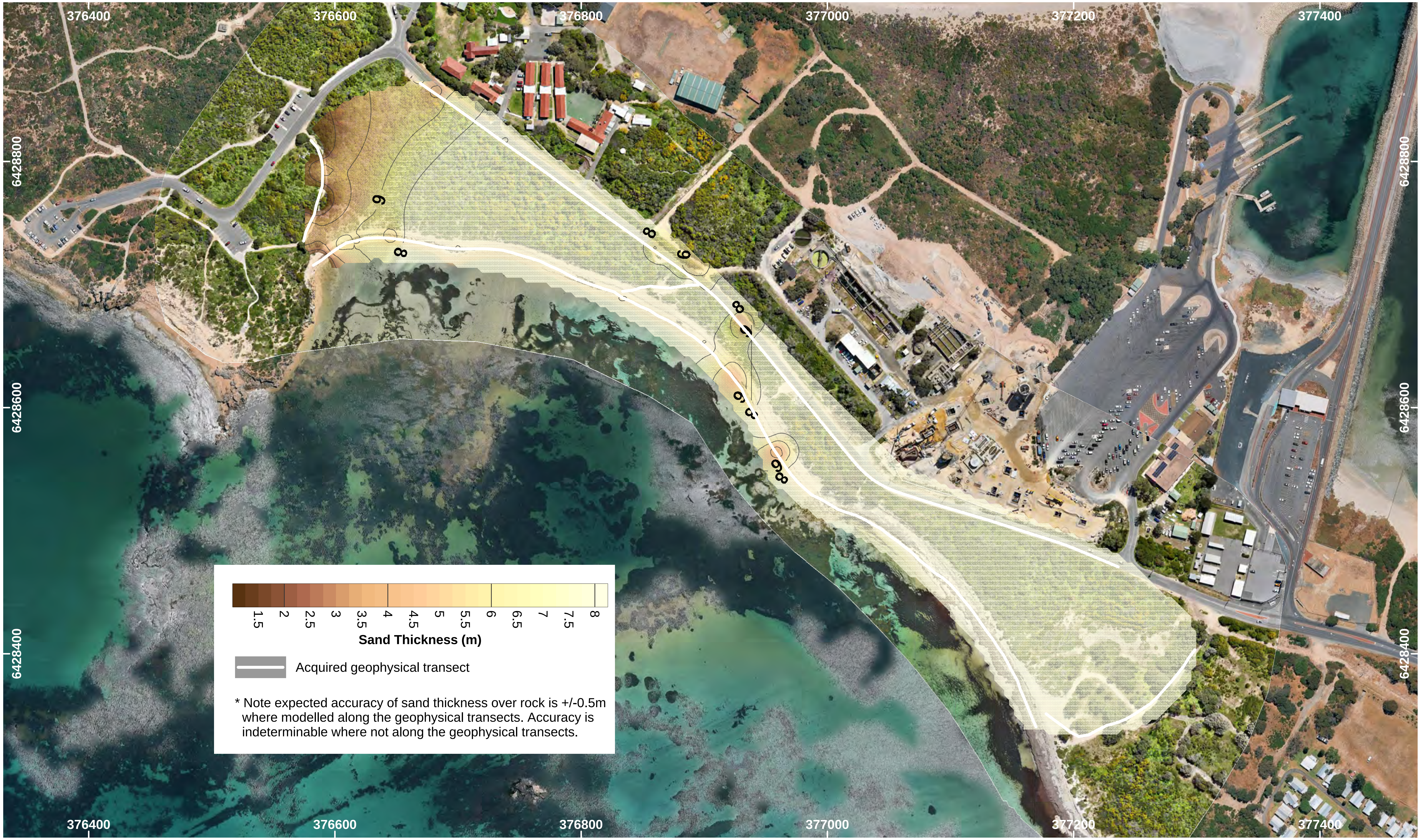
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

CONTOURED SAND THICKNESS OVER ROCK



NOTES

Drawing to be used in conjunction with Report 3177C.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.

N

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date	13 October 2025	Paper Size	A3
	GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale	1:3000	Drawn	PJE
		Drawing	3177C-08	Revision	1

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GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
POINT PERON, CITY OF ROCKINGHAM WESTERN AUSTRALIA

CLASSED POST MAP SAND THICKNESS OVER ROCK

NOTES

Drawing to be used in conjunction with Report 3177C.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.

N

CLIENT DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA	Date 13 October 2025	Paper Size A3	
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. POINT PERON, CITY OF ROCKINGHAM WA	Scale 1:3000	Drawn PJE	
	Drawing 3177C-09	Revision 1	

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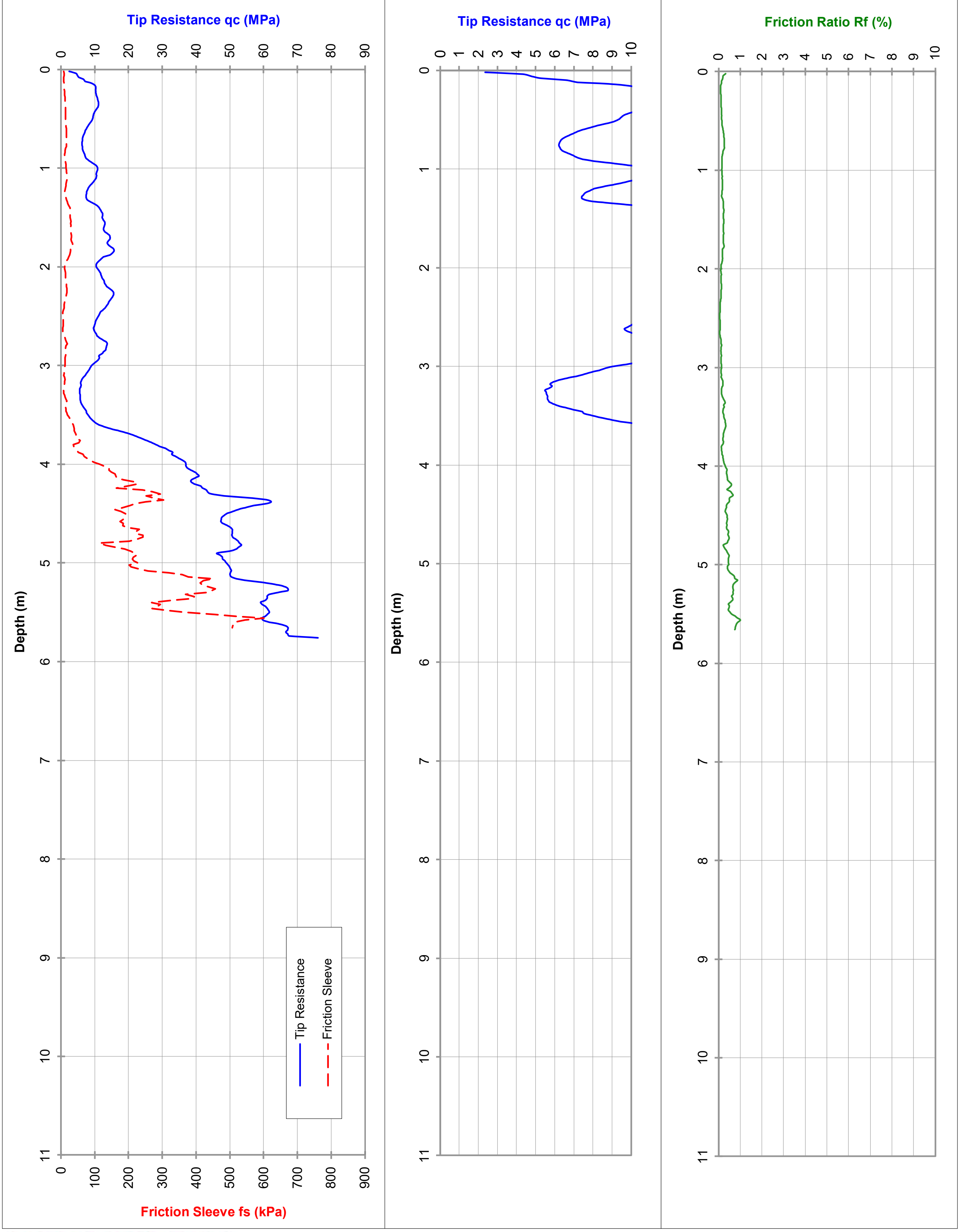
APPENDIX D – CONE PENETRATION TEST PLOTS

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: GBG Group	Job No.: 3177	Probe I.D
PROJECT: Coastal Survey Stage 4	RL (m): 2.43	CPT 28
LOCATION: Point Peron (Rockingham)	Co-ords: 376888.21mE, 6428703.36mN	30-Sep-25



PROBEDRILL GEOTECHNICAL SURVEY

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

Approx. water (m): 2.5

Dummy probe to (m):

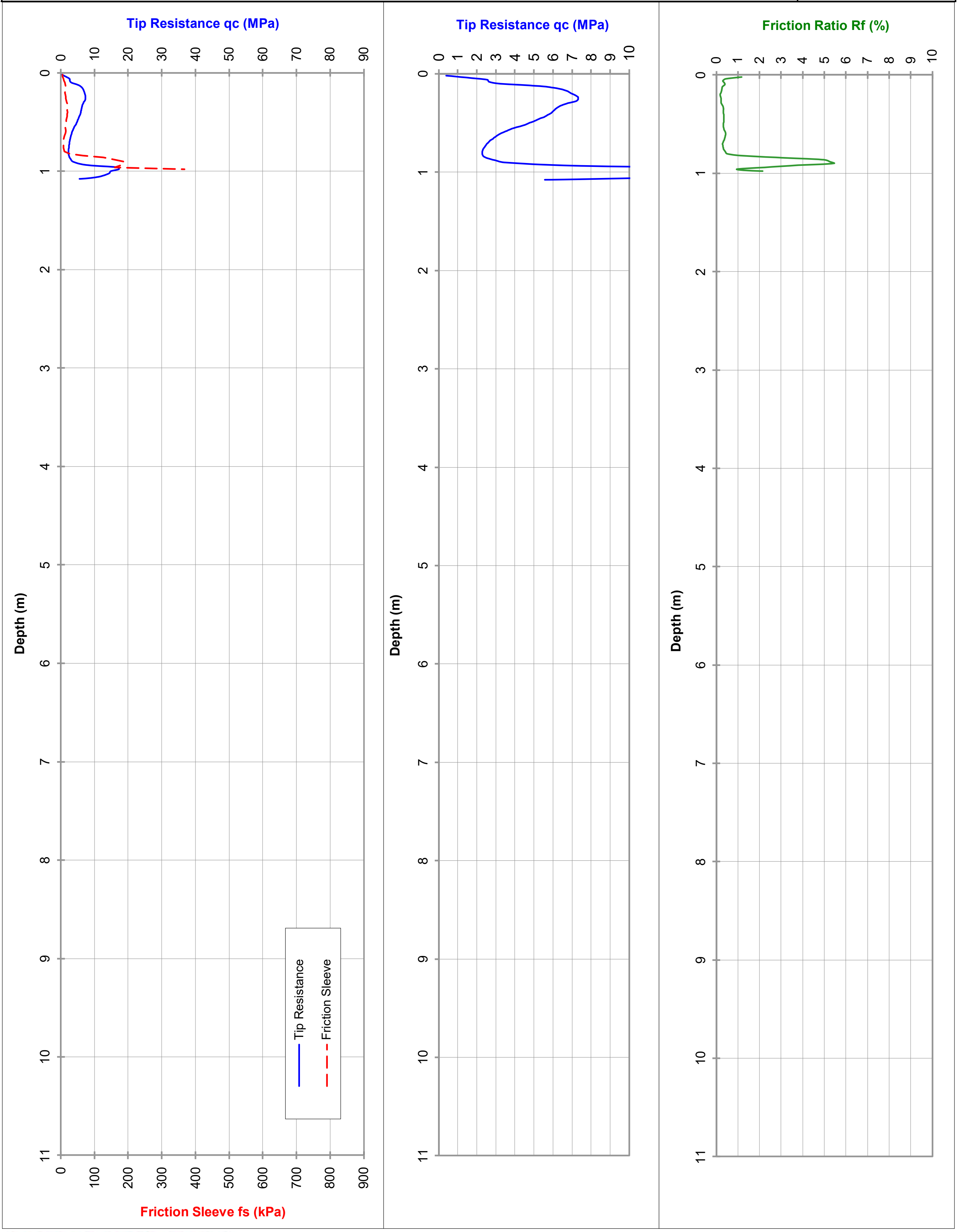
Refusal: 76 MPa + Rod Friction

Cone I.D.: EC10

File: GB0094TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER		Probe I.D
CLIENT: GBG Group	Job No.: 3177	CPT 37
PROJECT: Coastal Survey Stage 4	RL (m): 3.96	
LOCATION: Point Peron (Rockingham)	Co-ords: 376781.58mE, 6428792.76mN	30-Sep-25



PROBEDRILL GEOTECHNICAL SURVEY

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

Approx. water (m): Dry to 1.0

Dummy probe to (m):

Refusal: Inclination

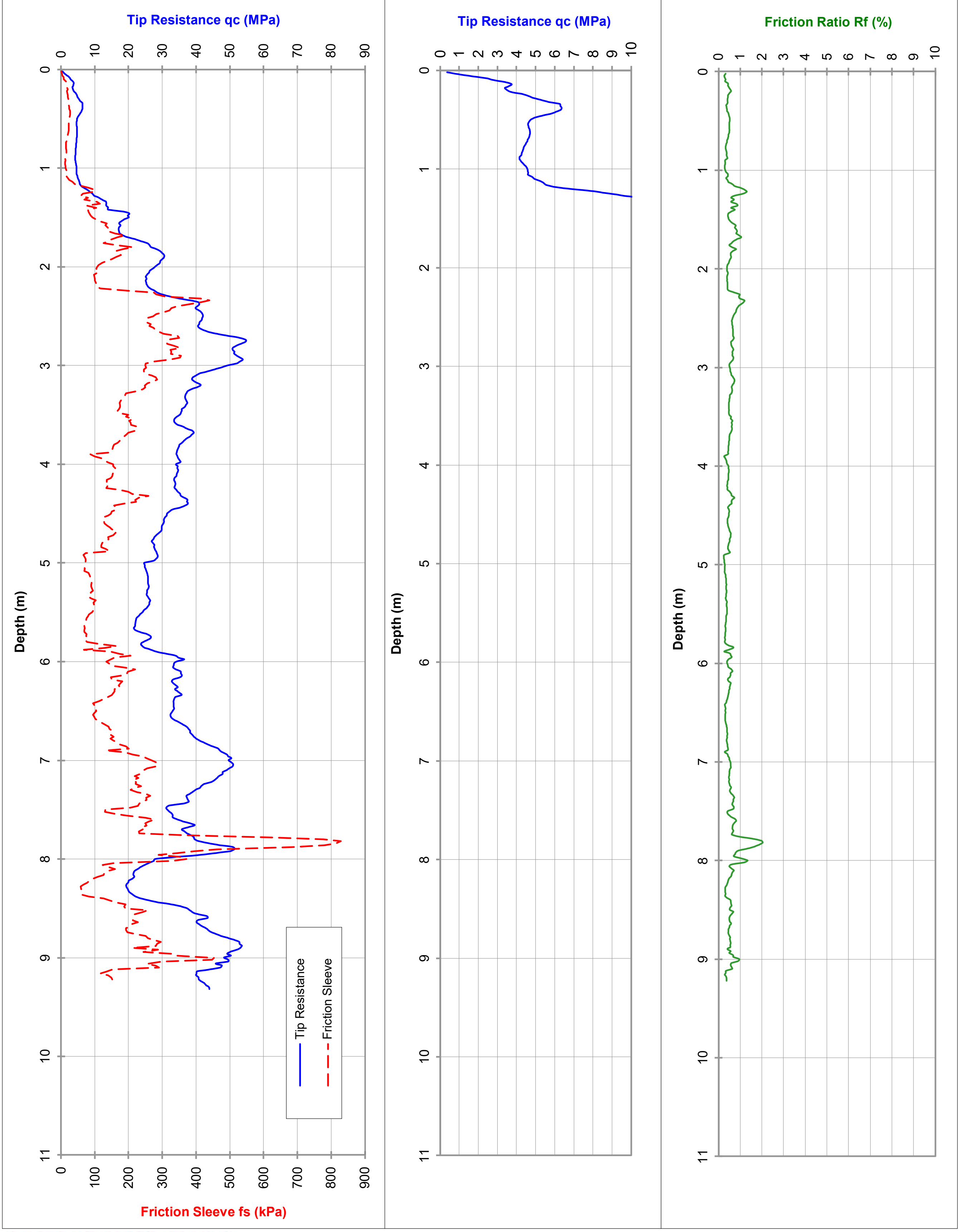
Cone I.D.: EC10

File: GB0095TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	GBG Group	Job No.:	3177	Probe I.D
PROJECT:	Coastal Survey Stage 4	RL (m):	4.38	CPT 11
LOCATION:	Point Peron (Rockingham)	Co-ords:	376666.85mE, 6428864.76mN	30-Sep-25



PROBEDRILL GEOTECHNICAL SURVEY

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

Approx. water (m): 4.7

Dummy probe to (m):

Refusal: Inclination

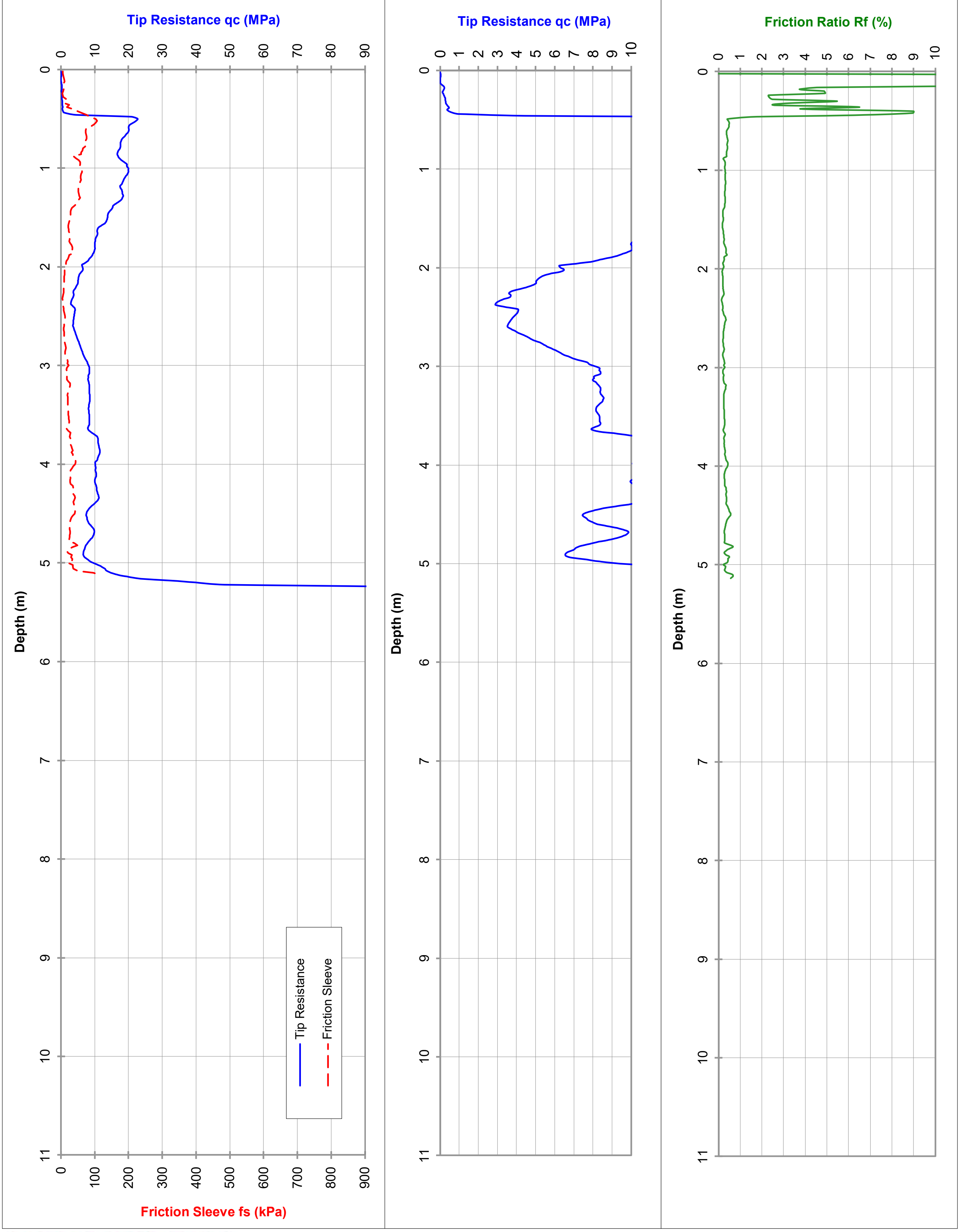
Cone I.D.: EC10

File: GB0096TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: GBG Group	Job No.: 3177	Probe I.D
PROJECT: Coastal Survey Stage 4	RL (m): 2.62	CPT 55
LOCATION: Point Peron (Rockingham)	Co-ords: 376967.01mE, 6428616.06mN	30-Sep-25



PROBEDRILL GEOTECHNICAL SURVEY

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

Approx. water (m): 2.3

Dummy probe to (m): 0.38

Refusal: 95MPa

Cone I.D.: EC10

File: GB0097TT

Rig Type: 22t truck (Track-Truck)

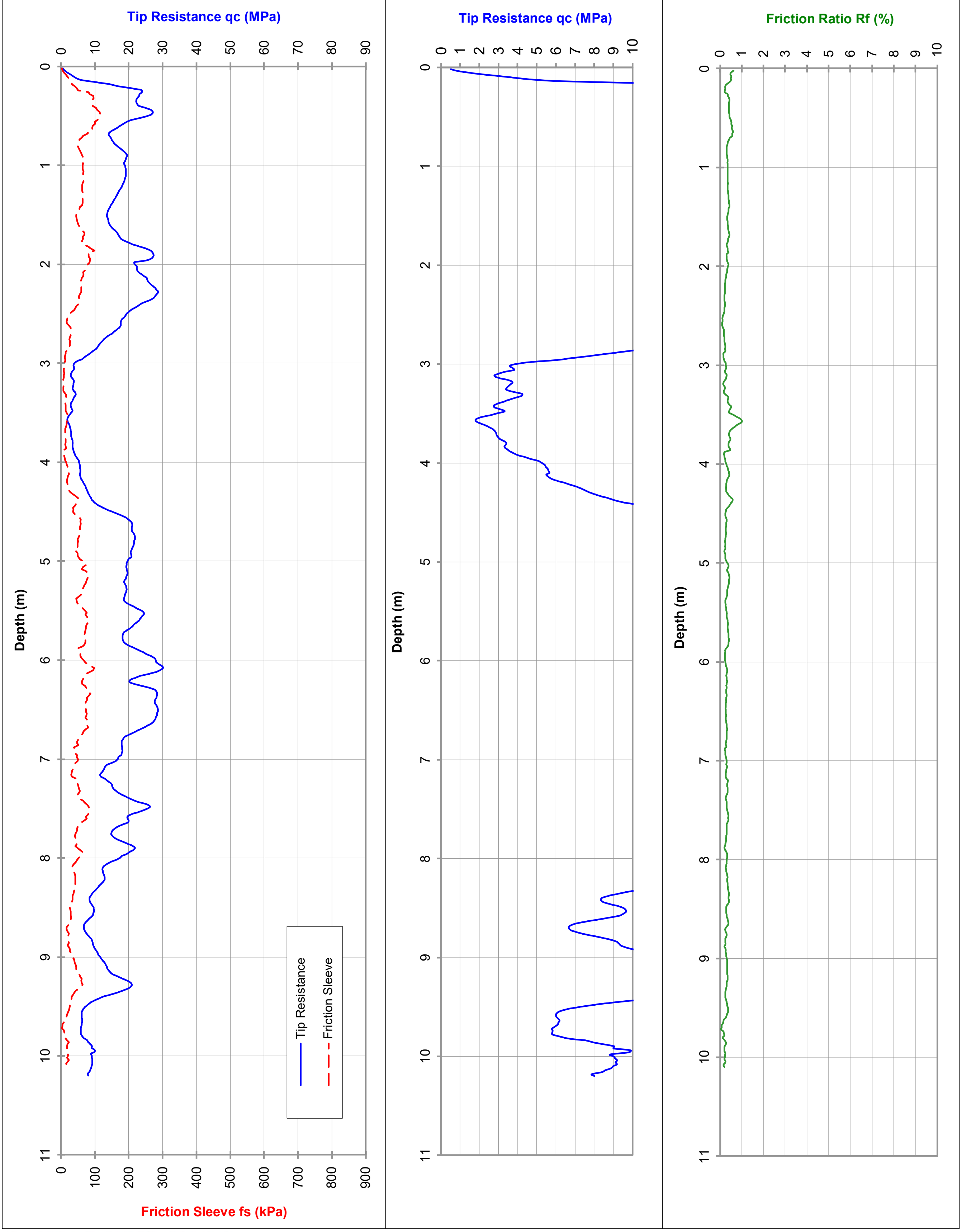
ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	GBG Group	Job No.:	3177
PROJECT:	Coastal Survey Stage 4	RL (m):	3.16
LOCATION:	Point Peron (Rockingham)	Co-ords:	377065.77mE, 6428536.26mN

Probe I.D

CPT 46

30-Sep-25



PROBEDRILL GEOTECHNICAL SURVEY

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

Approx. water (m): Dry to 2.1

Dummy probe to (m):

Refusal:

Cone I.D.: EC10

File: GB0098TT

Rig Type: 22t truck (Track-Truck)