

Report

Geotechnical Investigation for Coastal Erosion Vulnerability Assessment.

Floreat Beach, Town of Cambridge WA.

Date: 23 October 2025

Report Ref: 3177E

DOCUMENT HISTORY

DETAILS

Project number	3177E
Document Title	Geotechnical Investigation for Coastal Erosion Vulnerability Assessment
Site Address	Floreat Beach, Town of Cambridge WA
Report prepared for	The Government of Western Australia, Department of Transport

STATUS AND REVIEW

Revision	Prepared by	Reviewed by	Date issued
0	Peter Eccleston	Stephen Kelly	23 October 2025

DISTRIBUTION

Revision	Electronic	Paper	Issued to
0	1	0	Michael Meuleners, Tim Stead - DoT

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EXECUTIVE SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Floreat Beach in the Town of Cambridge, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 930m corridor of coastal beach and dune formation along Floreat Beach which has been identified as an at-risk site as Hotspot #26.

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:

- Where observed, seismic velocities Interpreted as rock substrata was generally observed across the site at levels below 0m AHD.
- Sand thickness across the site ranged from 4m to greater than 8m with the majority of the site exhibiting sand thickness of >6m.

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1 INTRODUCTION

At the request of The Government of Western Australia Department of Transport (DoT), GBG Group carried out a geotechnical investigation at Floreat Beach, Town of Cambridge in September and October 2025. During the investigation seismic geophysical testing and intrusive geotechnical testing was conducted within a 660m corridor of coastal beach and dune formation which has been identified as an at-risk site as Hotspot #26.

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 720m corridor of coastal beach and dune formation along Floreat beach. 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 1mAHD to 14mAHD. A topographic map showing surface level are provided in Appendix C drawing 3177E-06.



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

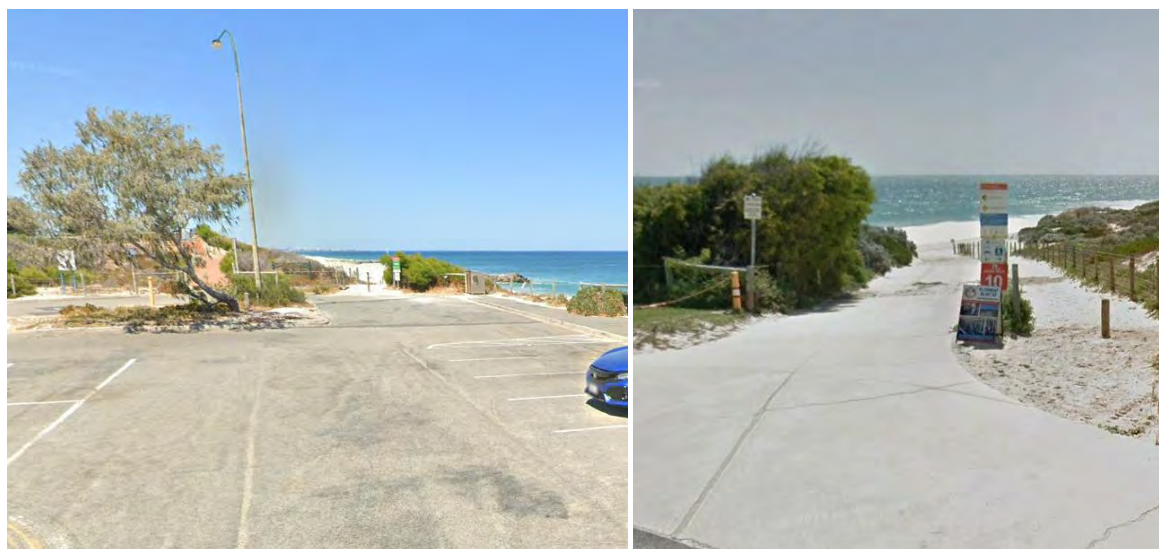


Figure 2: Site conditions at Floreat Beach including the along-shore transect across southern carpark (left image) and northern cross-shore beach access (right image).

3 INVESTIGATION METHODOLOGY

3.1 FIELD SURVEY LOGISTICS

Geophysical data acquisition was carried out on 13 September and 13 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 13 October 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 1,518m of MASW profiling acquired as 3 along-shore transects (parallel to the coast) and 4 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 3177E-01.

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

Transect ID	Orientation	Start Coordinate		End Coordinate		Length (m)
		East	North	East	North	
MASW-01	Along-shore	382314.90	6466172.00	382320.60	6466860.00	658
MASW-02	Along-shore	382340.56	6466382.60	382347.96	6466546.29	168
MASW-03	Along-shore	382395.51	6466553.54	382419.84	6466857.31	312
MASW-04	Cross-shore	382307.09	6466211.79	382391.99	6466164.91	100
MASW-05	Cross-shore	382306.16	6466404.91	382334.11	6466378.76	40
MASW-06	Cross-shore	382310.15	6466600.38	382358.13	6466545.10	80
MASW-07	Cross-shore	382301.10	6466835.00	382424.10	6466733.00	160

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 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.

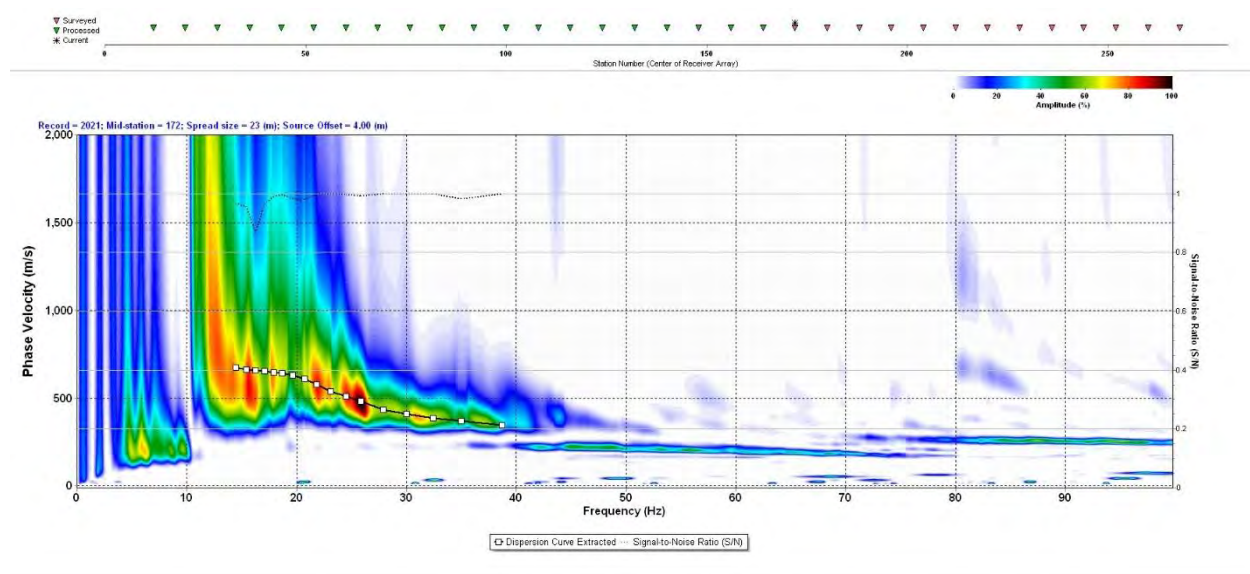


Figure 4: MASW overtone image with high signal to noise ratio and picked dispersion curve.

3.3 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 22 tonne track-truck mounted, 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 were 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 $\pm 0.2\text{m}$ 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 survey marker station in named **SSM Wembley 26** for the base corrections. Details of the Survey marker station used for this investigation are provided in Table 3.

Table 3 – Details of AUSCORS station

Parameter	Value
Mount Point	WEM26
Latitude	S 31° 56" 00.70368'
Longitude	E 115° 45" 23.18827"
Ellipsoidal height (m)	-23.318m

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*.

<https://map-viewer-plus.app.landgate.wa.gov.au/index.html>,
<https://gola.es.landgate.wa.gov.au/Gola/gola.exe/getpointinfo?PointNo=102418&context=gda2020>

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 Floreat Beach, Town of Cambridge are presented in Appendices B and C of this report as follows:

Appendix B – Geophysical and Interpreted Sections

- **3177E-02.** Transect 1 seismic S-wave velocity model and interpreted geological section.
- **3177E-03.** Transect 2 and Transect 3 seismic S-wave velocity model and interpreted geological section.
- **3177E-04.** Transect 4 and Transect 5 seismic S-wave velocity model and interpreted geological section.
- **3177E-05.** Transect 6 and Transect 7 seismic S-wave velocity model and interpreted geological section.

Appendix C – Modelled Level to Surface and Sediment Thickness

- **3177E -06.** Contoured surface level models derived from aerial photogrammetry.
- **3177E -07.** Contoured level to modelled top of rock.
- **3177E -08.** Class post map level to modelled top of rock.
- **3177E -09.** Contoured modelled sand thickness over rock / Depth to top of rock.
- **3177E -10.** Class post map modelled sand thickness over rock / Depth to top of rock.

4.2 SEISMIC SHEAR WAVE VELOCITY SECTIONS

The seismic S-wave velocity (V_s) 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 V_s 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** ($V_s < 250\text{m/s}$). 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** ($V_s 250\text{--}450\text{m/s}$). 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 sediment weathered from the underlying Limestone.
3. **Moderate seismic S-wave velocity** ($V_s 450\text{--}650\text{m/s}$). 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** ($V_s > 650\text{m/s}$). 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 megapascals 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-02 on Transect 03** – Refusal (89MPa) at depth of 7.44m.
- **CPT-03 on Transect 03** – No Refusal at target depth of 10.2m.
- **CPT-04 on Transect 02** – No Refusal at target depth of 10.2m.

- **CPT-05 on Transect 02** – No Refusal at target depth of 10.2m.
- **CPT-06 on Transect 04** – Refusal (94MPa) at depth of 8.98m.

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 have been generated by digitising the interface between the interpreted sediment and underlying 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 3177E-06)** – 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 3177E-07)** – this presents the level to the top of rock substrate ranging from <-8mAHD to 5mAHD.
- **Classed Post Map Level to Top of Rock Substrate (3177E-08)** – this presents the level to the top of rock substrate along the acquired transects at 2m level increments from <-8mAHD to >4mAHD.
- **Contoured Sand Thickness / Depth to Top of Rock (3177E-09)** – 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 (3177E-10)** – this presents the thickness of sand overlying the rock substrate along the acquired transects at 2m depth increments from <4mBGL to >9mBGL.

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 $\pm 0.5\text{m AHD}$. Similarly, an accuracy of $\pm 0.5\text{m}$ is expected for the modelled sand thickness over rock. The quoted accuracies have been based on consideration to the accuracy of the GNSS receivers used 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 Floreat Beach in the Town of Cambridge Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 930m corridor of coastal beach and dune formation along Floreat beach which has been identified as an at-risk site as Hotspot #26.

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

INVESTIGATION SITE MAP



Legend

- Acquired geophysical transect (along-shore)
- Acquired geophysical transect (cross-shore)
- 200m Distance along transect
- Cone penetration test point

NOTES
Drawing to be used in conjunction with GBG report 3177E.
Map Projection GDA2020 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.



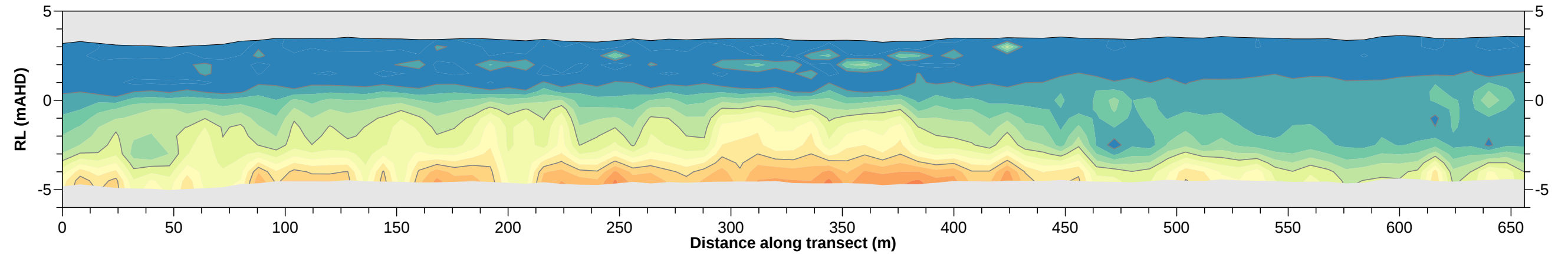
Date	15 October 2025	Paper Size	A3
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DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT.
FLOREAT BEACH, TOWN OF CAMBRIDGE WA

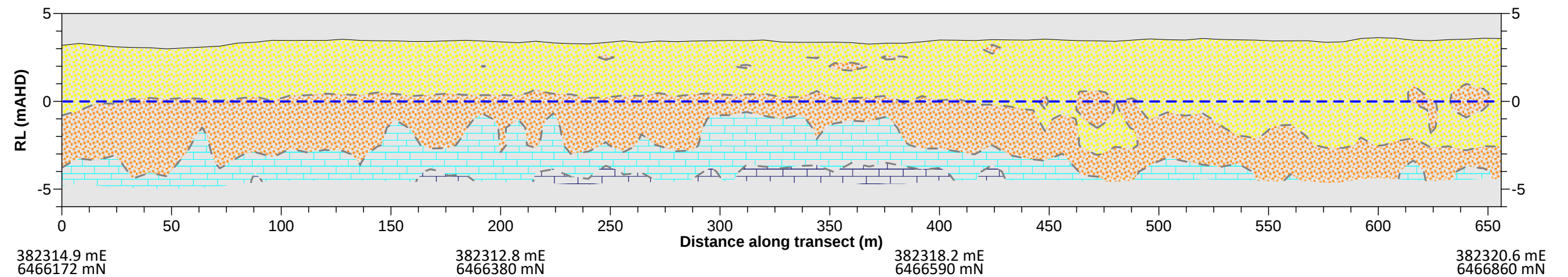
APPENDIX B – GEOPHYSICAL AND INTERPRETED SECTIONS

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT FLOREAT BEACH, TOWN OF CAMBRIDGE WESTERN AUSTRALIA

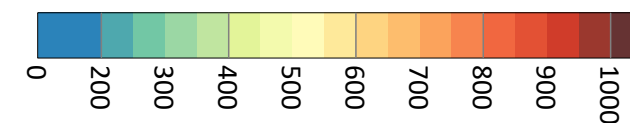
TRANSECT 1 (0-600m) - SEISMIC SHEAR WAVE VELOCITY MODEL



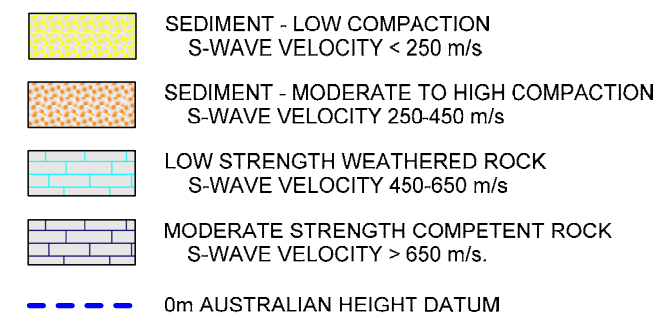
TRANSECT 1 (0-600m) - INTERPRETED GEOLOGICAL SECTION



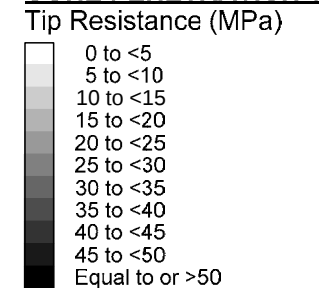
SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE



CONE PENETRATION TEST



NOTES

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

CLIENT **DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA**

**GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
FLOREAT BEACH, TOWN OF CAMBRIDGE WA**

Date 20 October 2025

Scale 1:2000H, 1:250V

Drawing 3177E-02

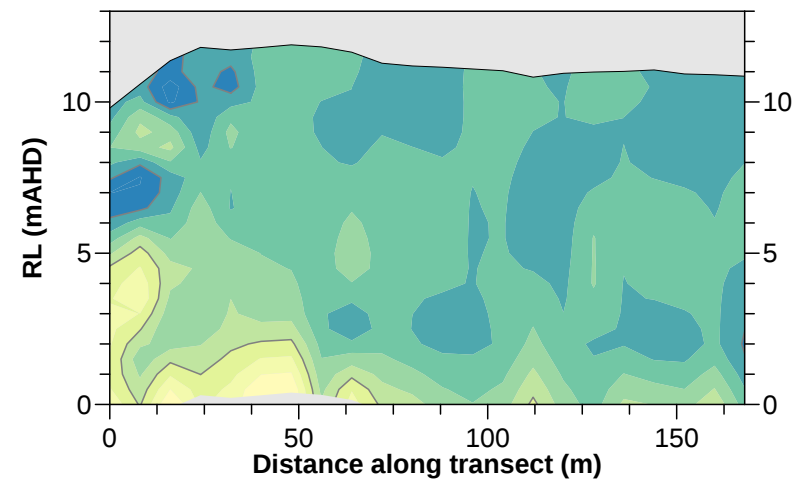
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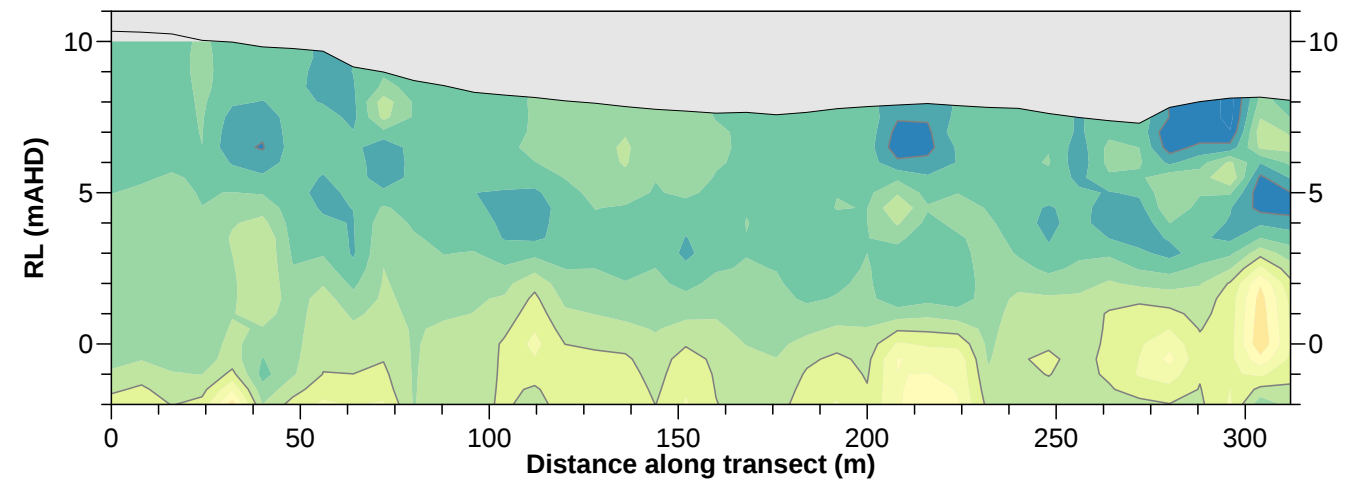
Revision 0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT FLOREAT BEACH, TOWN OF CAMBRIDGE WESTERN AUSTRALIA

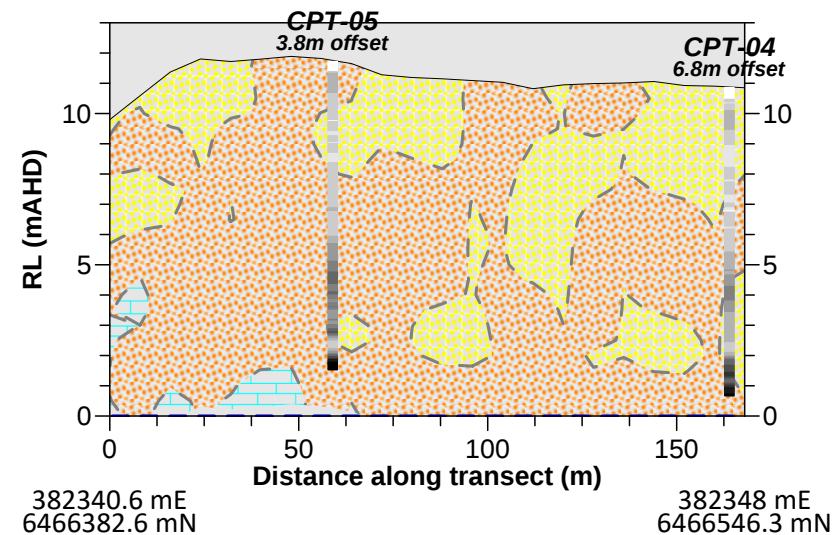
TRANSECT 2 - SEISMIC SHEAR WAVE VELOCITY MODEL



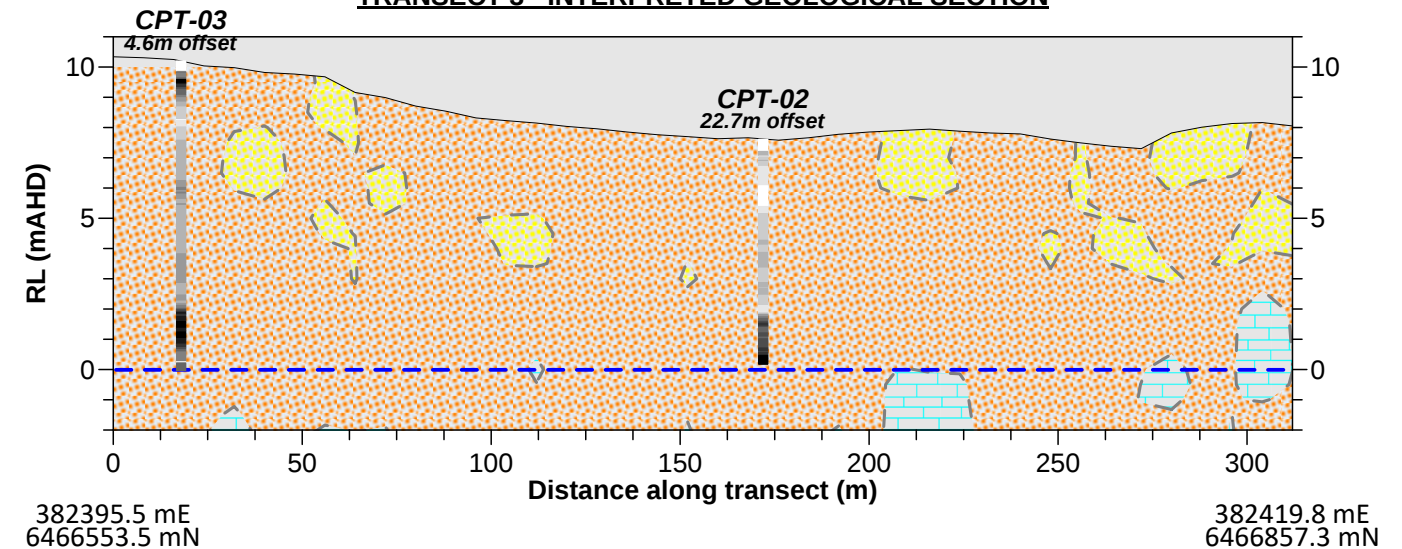
TRANSECT 3 - SEISMIC SHEAR WAVE VELOCITY MODEL



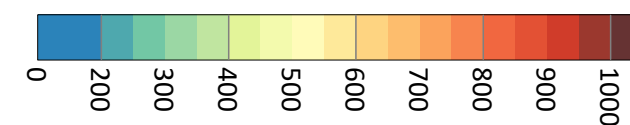
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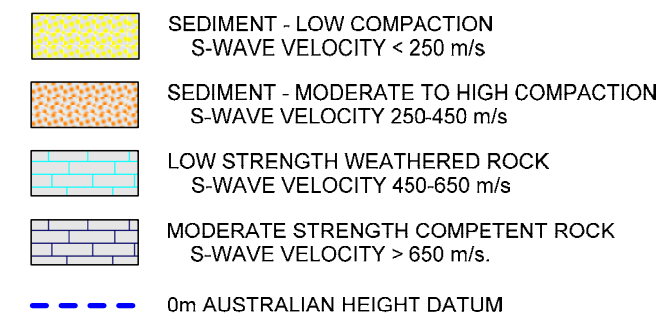
TRANSECT 3 - INTERPRETED GEOLOGICAL SECTION



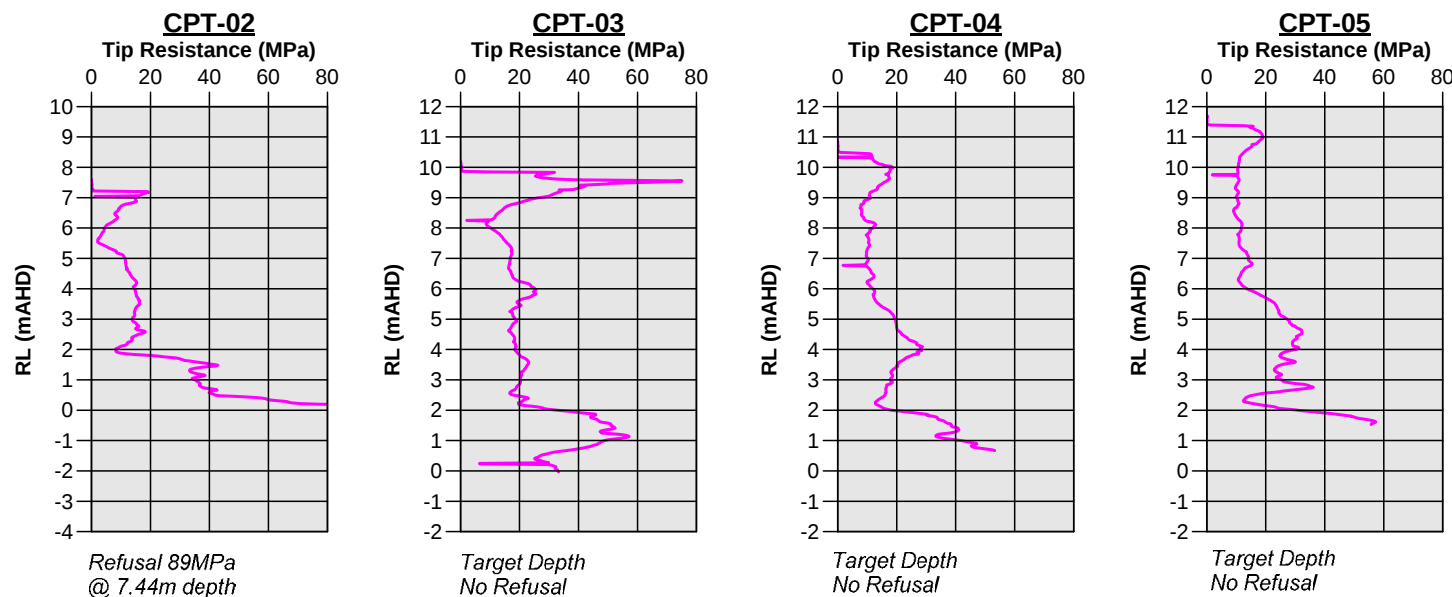
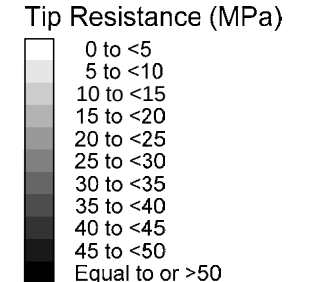
SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE



CONE PENETRATION TEST



NOTES

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

CLIENT **DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA**

**GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
FLOREAT BEACH, TOWN OF CAMBRIDGE WA**

Date 20 October 2025

Scale 1:2000H, 1:250V

Drawing 3177E-03

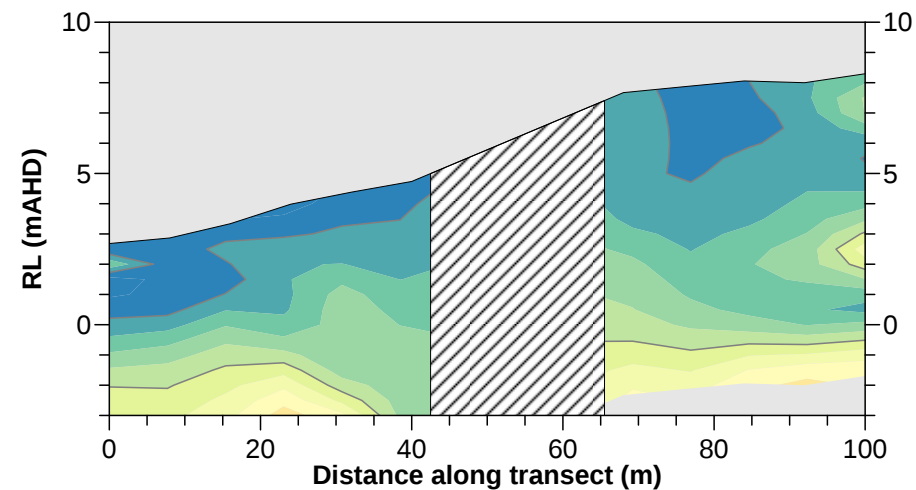
Paper Size A3

Drawn PJE

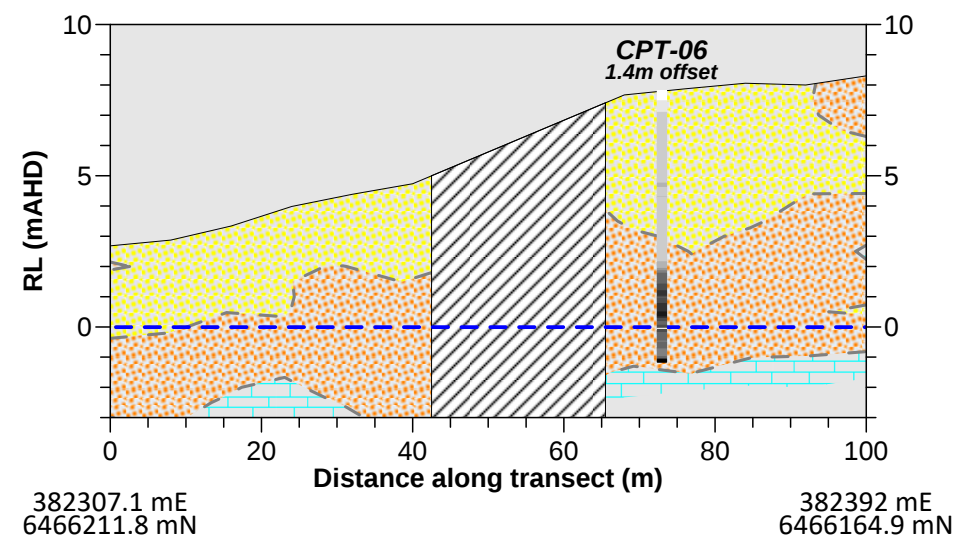
Revision 0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT FLOREAT BEACH, TOWN OF CAMBRIDGE WESTERN AUSTRALIA

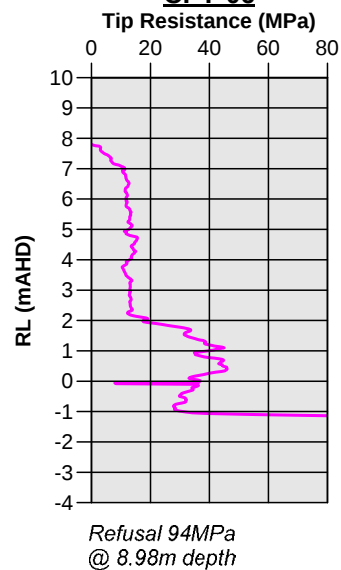
TRANSECT 4 - SEISMIC SHEAR WAVE VELOCITY MODEL



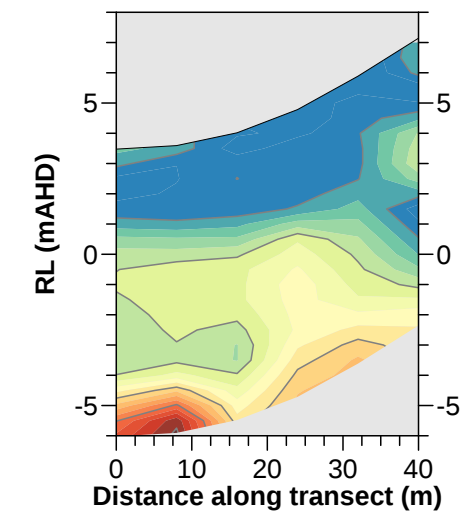
TRANSECT 4 - INTERPRETED GEOLOGICAL SECTION



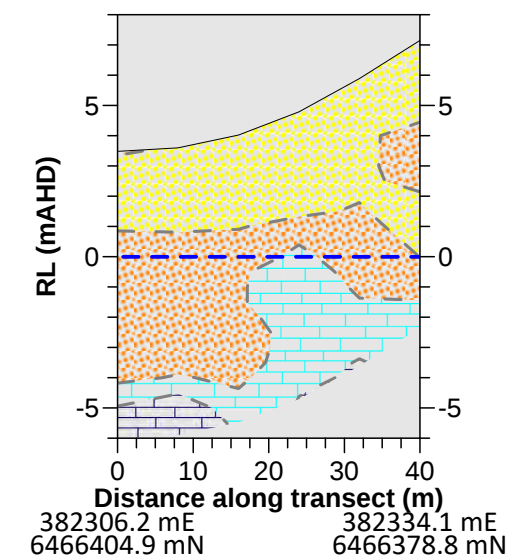
CPT-06



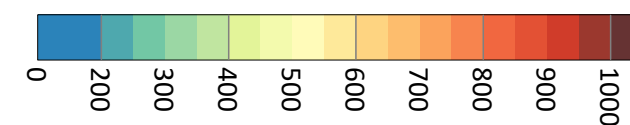
TRANSECT 5 - SEISMIC SHEAR WAVE VELOCITY MODEL



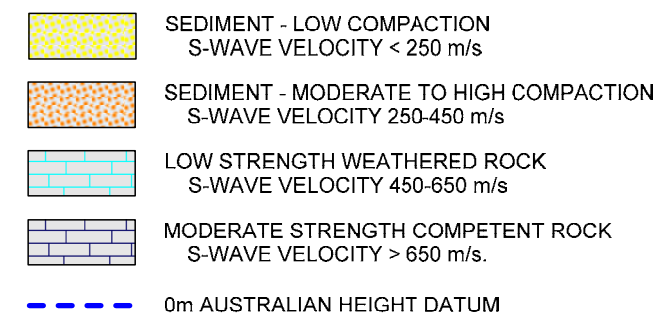
TRANSECT 5 - INTERPRETED GEOLOGICAL SECTION



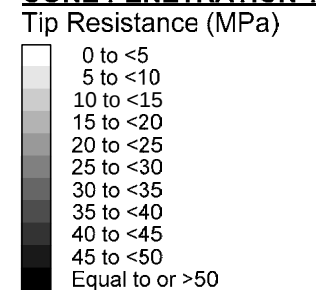
SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE



CONE PENETRATION TEST



NOTES

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

CLIENT **DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA**

**GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
FLOREAT BEACH, TOWN OF CAMBRIDGE WA**

Date 20 October 2025

Scale 1:1000H, 1:250V

Drawing 3177E-04

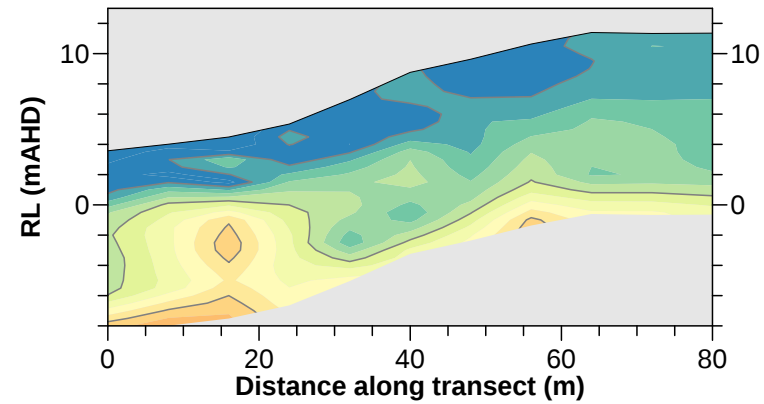
Paper Size A3

Drawn PJE

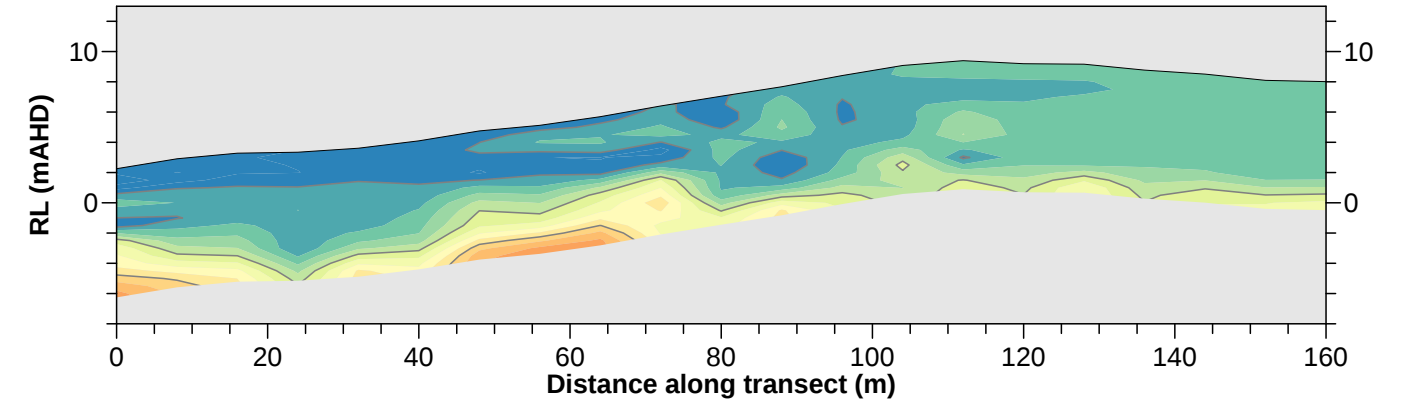
Revision 0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT FLOREAT BEACH, TOWN OF CAMBRIDGE WESTERN AUSTRALIA

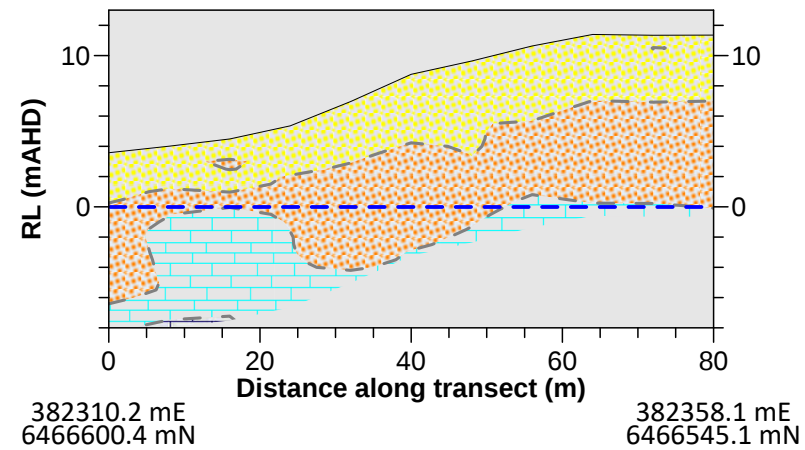
TRANSECT 6 - SEISMIC SHEAR WAVE VELOCITY MODEL



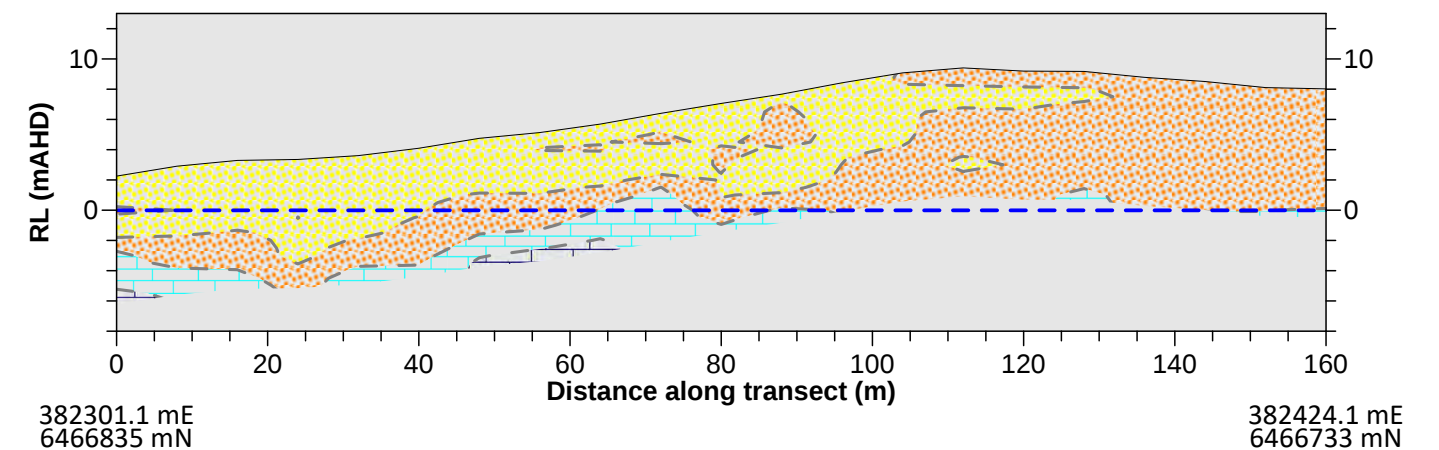
TRANSECT 7 - SEISMIC SHEAR WAVE VELOCITY MODEL



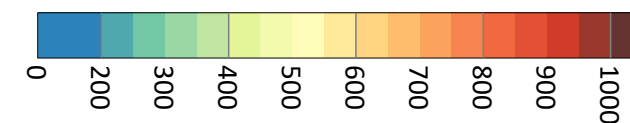
TRANSECT 6 - INTERPRETED GEOLOGICAL SECTION



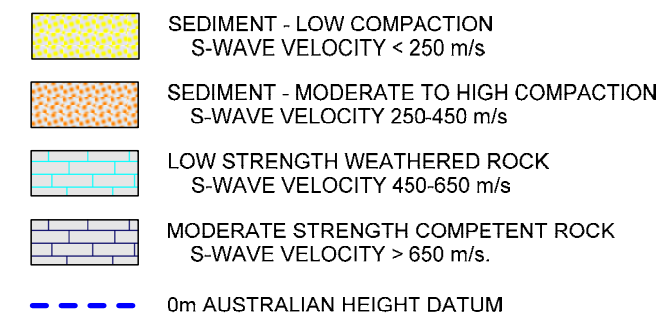
TRANSECT 7 - INTERPRETED GEOLOGICAL SECTION



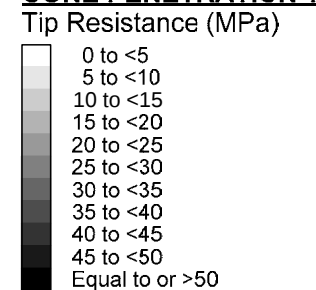
SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE



CONE PENETRATION TEST



NOTES

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

CLIENT **DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA**

**GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
FLOREAT BEACH, TOWN OF CAMBRIDGE WA**

Date 20 October 2025

Scale 1:1000H, 1:500V

Drawing 3177E-08

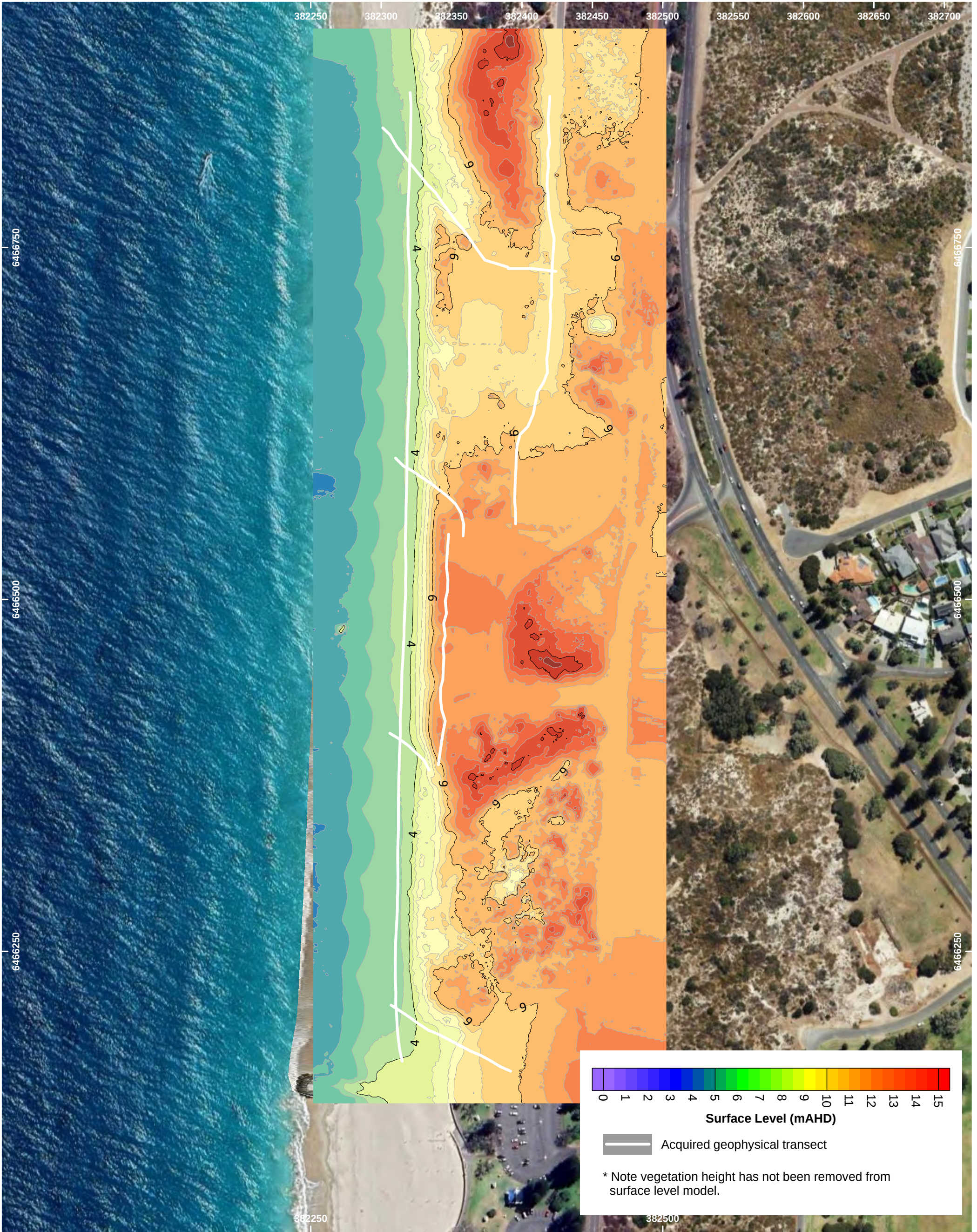
Paper Size A3

Drawn PJE

Revision 0

APPENDIX C – MODELLED SURFACE LEVEL AND SEDIMENT THICKNESS

SURFACE LEVEL MODEL



NOTES

Drawing to be used in conjunction with GBG report 3177E.
Map Projection GDA2020 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.



Date	20 October 2025
Scale	1:2500
Drawing	3177E-06

Paper Size	A3
Drawn	PJE
Revision	0

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

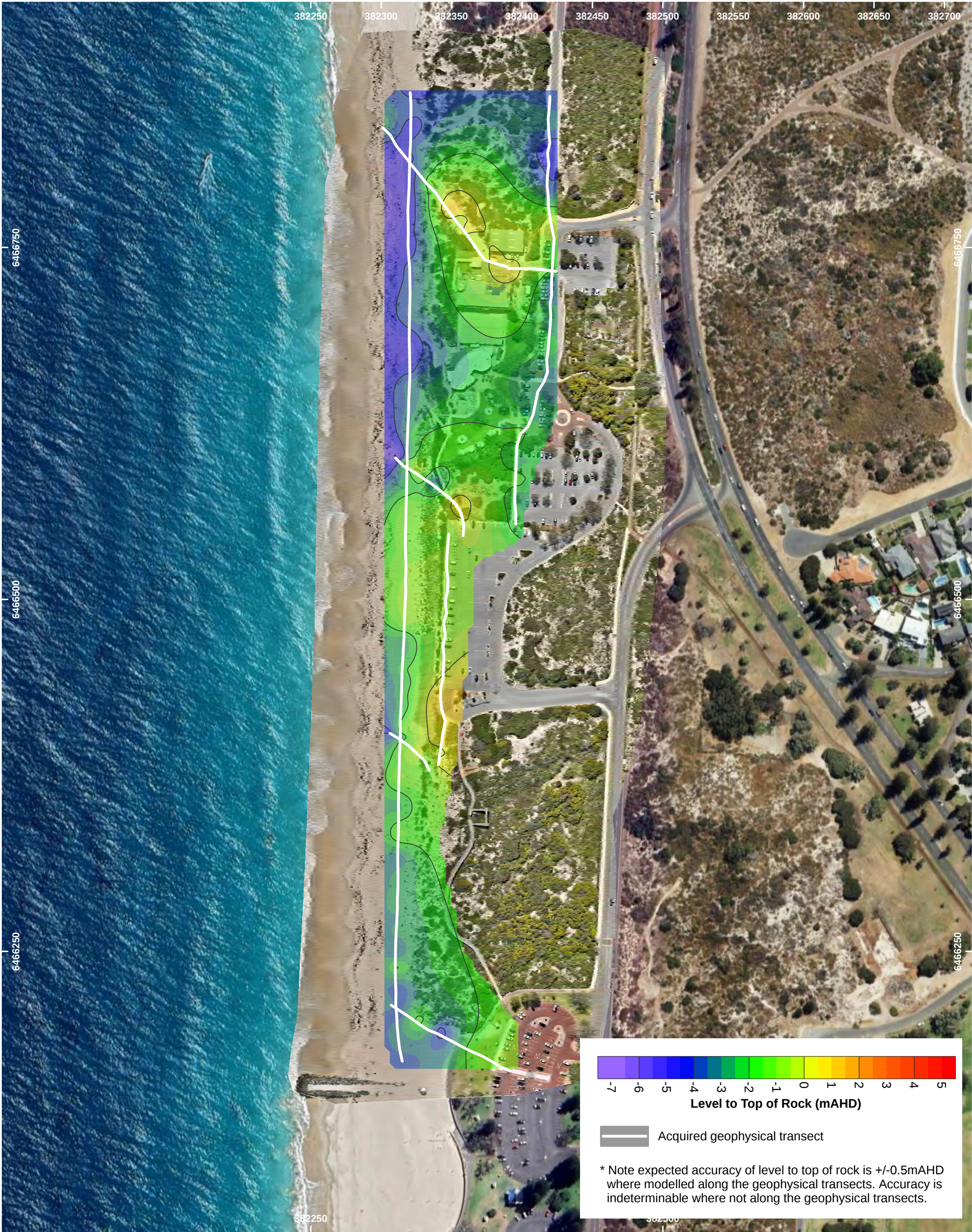
**GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT.
FLOREAT BEACH, TOWN OF CAMBRIDGE WA**



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Web: gbgoz-group.com.au

CONTOURED LEVEL TO TOP OF ROCK



NOTES

Drawing to be used in conjunction with GBG report 3177E.
Map Projection GDA2020 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.



Date	20 October 2025
Scale	1:2500
Drawing	3177E-07

Paper Size	A3
Drawn	PJE
Revision	0

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

**GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT.
FLOREAT BEACH, TOWN OF CAMBRIDGE WA**



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Email: info@gbgoz.com.au
Web: gb-group.com.au

CLASSED POST MAP LEVEL TO TOP OF ROCK



CONTOURED SAND THICKNESS OVER ROCK



NOTES
Drawing to be used in conjunction with GBG report 3177E.
Map Projection GDA2020 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.



Date	20 October 2025	Paper Size	A3
Scale	1:2500	Drawn	PJE
Drawing	3177E-09	Revision	0

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT.
FLOREAT BEACH, TOWN OF CAMBRIDGE WA

CLASSED POST MAP SAND THICKNESS OVER ROCK



NOTES

Drawing to be used in conjunction with GBG report 3177E.
Map Projection GDA2020 MGA Zone 50.
Aerial image from Google Earth Pro
and GBG photogrammetry.



Date	20 October 2025
Scale	1:2500
Drawing	3177E-10

Paper Size	A3
Drawn	PJE
Revision	0

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. FLOREAT BEACH, TOWN OF CAMBRIDGE WA

APPENDIX D – CONE PENETRATION TEST PLOTS

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3177

PROJECT: Coastal Survey Stage 4

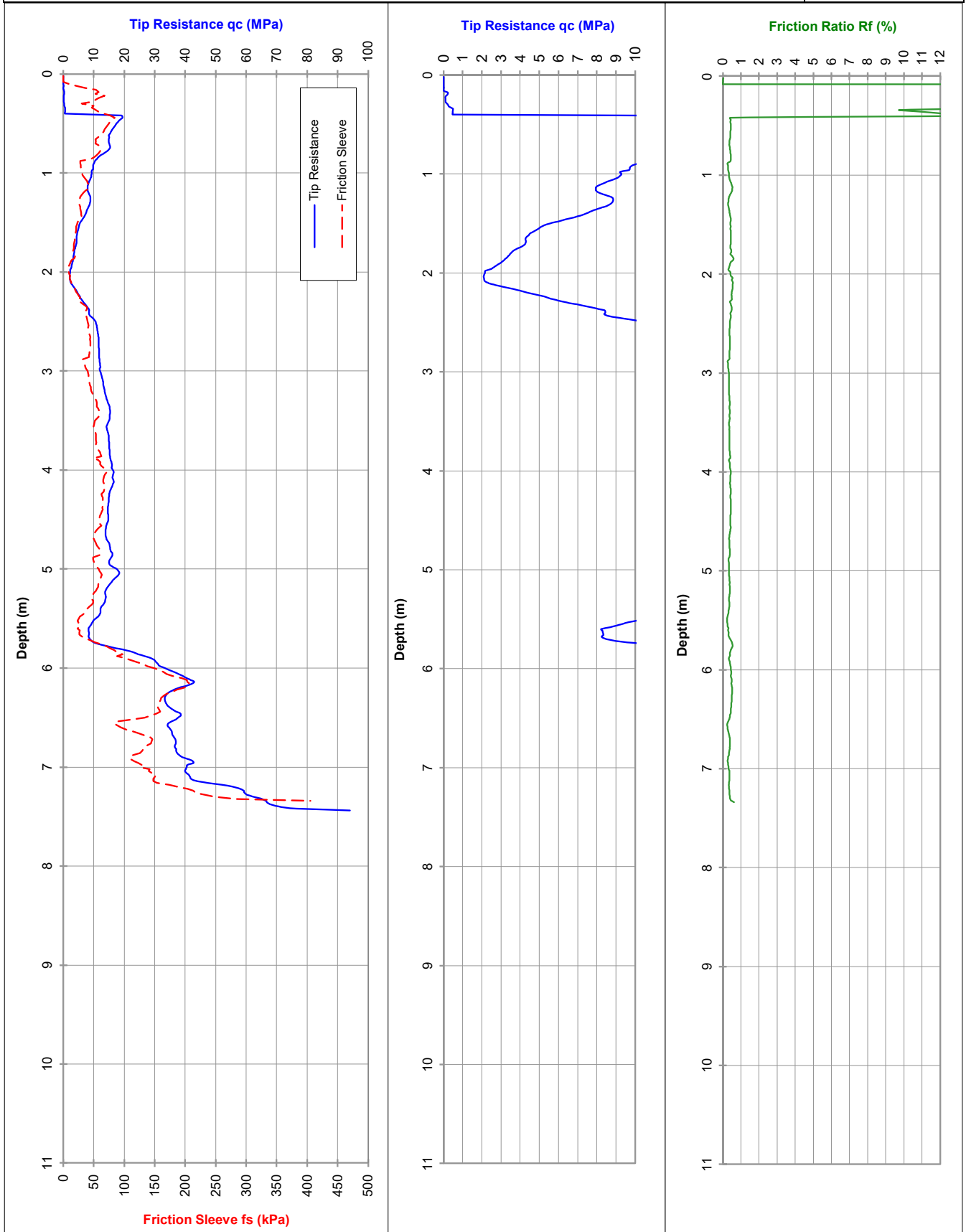
RL (m): 7.51

LOCATION: Floreat Beach

Co-ords: 382443.96mE, 6466722.6mN

CPT 02

13-Oct-25



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

Approx. water (m): 6.8

Dummy probe to (m): 0.36

Refusal: 94 MPa

Cone I.D.: EC14

File: GB0099TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3177

PROJECT: Coastal Survey Stage 4

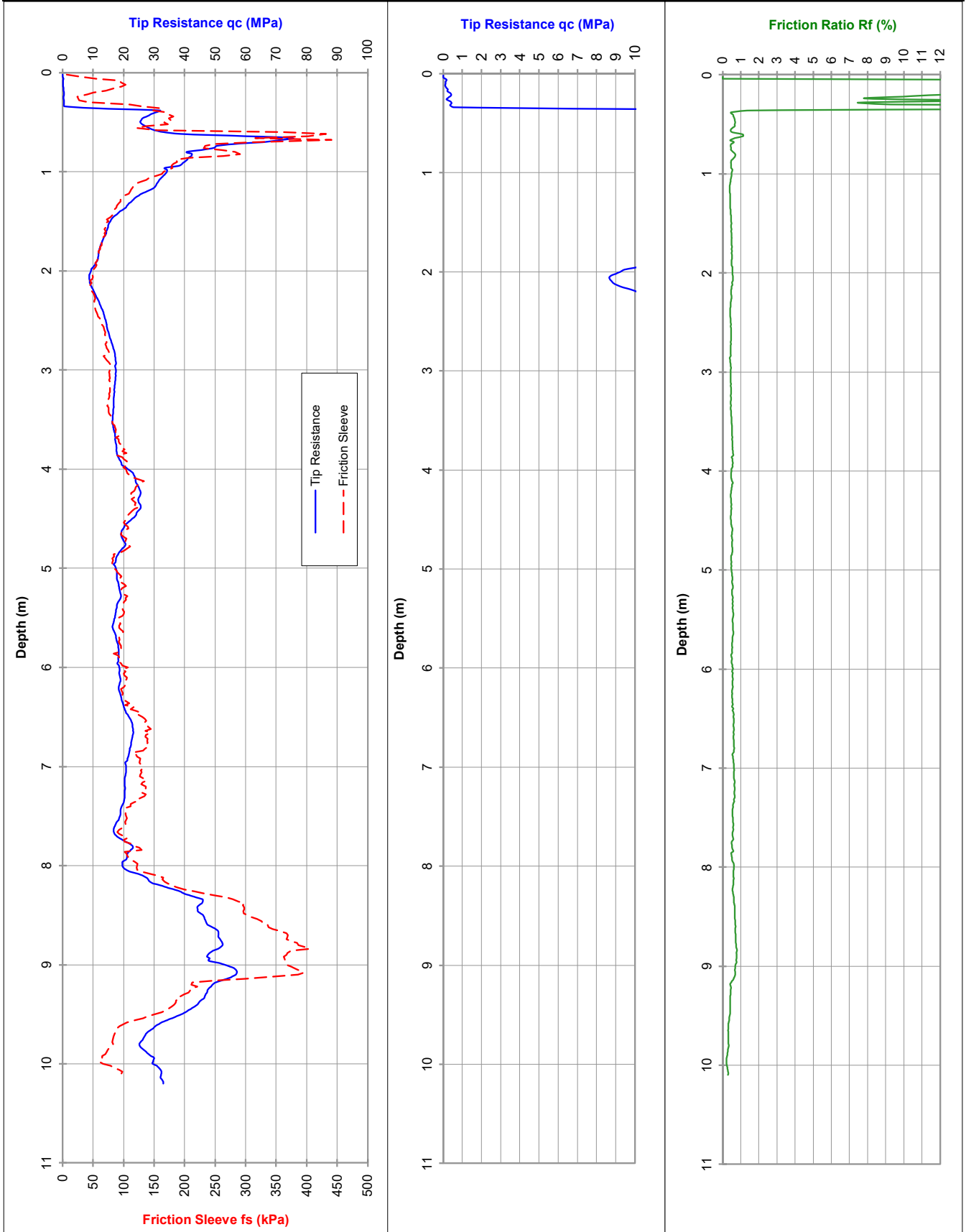
RL (m): 9.99

LOCATION: Floreat Beach

Co-ords: 382399.97mE, 6466571.11mN

CPT 03

13-Oct-25



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

Approx. water (m): Dry to 5.3

Dummy probe to (m): 0.36

Refusal:

Cone I.D.: EC14

File: GB0100TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3177

PROJECT: Coastal Survey Stage 4

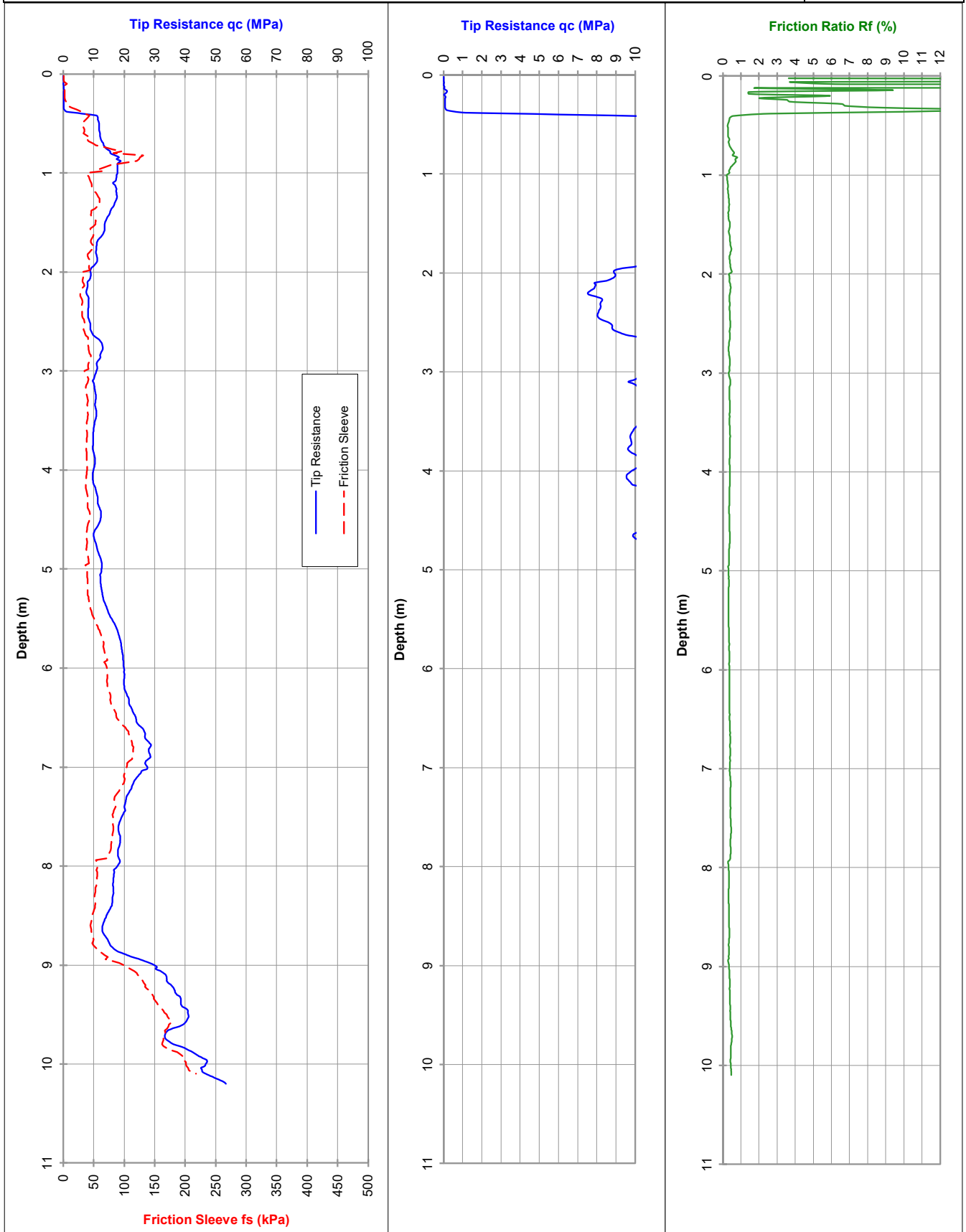
RL (m): 11.52

LOCATION: Floreat Beach

Co-ords: 382354.66mE, 6466541.06mN

CPT 04

13-Oct-25



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

Approx. water (m): Dry to 9.4

Dummy probe to (m): 0.36

Refusal:

Cone I.D.: EC46

File: GB0102TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3177

PROJECT: Coastal Survey Stage 4

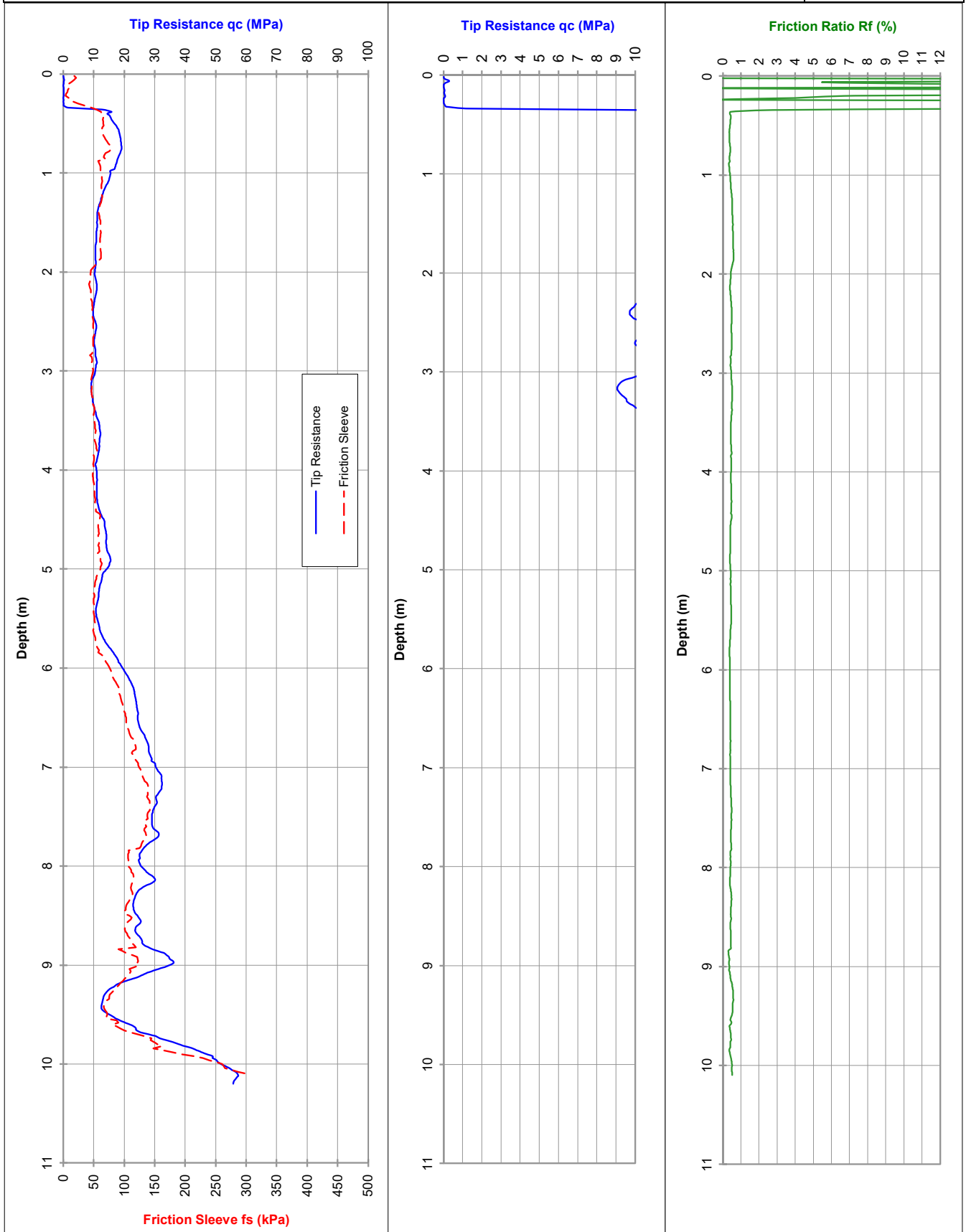
RL (m): 11.38

LOCATION: Floreat Beach

Co-ords: 382346.18mE, 6466439.95mN

CPT 05

13-Oct-25



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

Approx. water (m): Dry to 7.7

Dummy probe to (m): 0.36

Refusal:

Cone I.D.: EC46

File: GB0101TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3177

PROJECT: Coastal Survey Stage 4

RL (m): 8.23

LOCATION: Floreat Beach

Co-ords: 382368.03mE, 6466178.87mN

CPT 06

13-Oct-25

