Tender No: MSC-2024-001

Forward Remote Capital Program

APPENDIX 1

26 March 2024

1. The Soil Test reports for each lot are attached. Please note that the Soil Test report for Lot 70 on SP270889, located at 254 Wardirrkan Street, will be provided shortly.

2. The lot and street numbers listed on page 7 are incorrect, as well as the mark-up on page 8. Please refer to the table below for the accurate lot and street numbers and find attached the Site map mark-up plan Rev 01 for further clarification.

Lot 246 on SP270889, 286A Mukakiya Street	- 3 bedroom
Lot 206 on SP270889, 323A Mukakiya Street	- 3 bedroom
~~Lot 2 – 26A~~ now Lot 172 on SP323793, 126A Wengka Street	- 1 bedroom
Lot 70 on SP270889, 254 Wardirrkan Street	- 4 bedroom
Lot 925 on SP270889, 925 Lardill Street	- 3 bedroom
~~Lot 926 – 296~~ now Lot 926 on SP282722, 926 Lardill Street	- 4 x 2 bed singles men

3. The completion date mentioned on page 10 of the Tender Document is incorrect. The accurate completion date for the project is 31 August 2025. The tenderer is required to provide an estimated program in their proposal. The final program and completion date will be mutually agreed upon with the successful tenderer.

Tender documents are available to download via
https://www.mornington.qld.gov.au/council/procurements-tenders/

Tenders Close at 4pm Tuesday 16 April 2024.

All tender responses can be submitted electronically to Tenders@mornington.qld.gov.au

For more information, please contact Tenders@mornington.qld.au

Gary Uhlmann

Chief Executive Officer

30/08/2022 OSE Reference: 22260_2

Mornington Shire Council – Housing and Facilities
1 Mission Road
Gununa QLD 4870

Attention: Geoffrey Rewald

Dear Geoffrey,

Subject: Geotechnical Investigation – 254 Wardirrkan Street, Gununa, Mornington Island

1. INTRODUCTION

1.1. GENERAL

OSE Group was engaged by Mornington Shire Council to undertake a geotechnical investigation for proposed new construction at 254 Wardirrkan Street, Gununa, Mornington Island. It is understood that it is intended to construct a house on the site, however size and style of construction have not been determined at the time of reporting.

The lot previously contained structures of unknown size/construction which have been demolished. The site is in an unkempt state. A concrete slab is visible towards the centre of the site and trees and large shrubs are present around the edge of the site. Beach sand not native to the site is present at the surface and regions of exposed laterite are also visible. Rubbish is also present throughout the site, including some concrete rubble at the rear.

The aim of our investigation is to provide a site classification in accordance with AS2870-2011 *Residential Slabs and Footings* for foundation design, parameters for bored pier design, comment on suitability of excavated material as fill, evaluation of the influence of groundwater and potential geotechnical issues.

1.2. REGIONAL GEOLOGY

Mornington Island is underlain by lateritic geology, described in the 1:250,000 Carpentaria-Karumba Basin map as “Ferruginous laterite, minor silcrete; with sandy 'A' horizon: deep weathered Aurukun surface (younger events).”

Prior experience on the Island indicates that extremely to highly weathered laterite, often with ironstone nodules, is typically encountered within 1.5m of the ground surface.

2. GEOTECHNICAL INVESTIGATION

2.1. METHOD OF INVESTIGATION

The site inspection and field testing was undertaken on 7 July 2022, and comprised the following:

- Verification of underground services in the area where testing was to occur;
- Excavation of one (1) test pit (TP1) within the lot boundary for sampling and logging;
- Undertaking of two (2) Dynamic Cone Penetrometer (DCP) tests, including one adjacent the test pit;
- Collection of one (1) disturbed sample for the purpose of Atterberg Limits testing;
- Collection of one (1) disturbed sample for the purpose of Emerson Class testing;
- Collection of one (1) disturbed sample for the purpose of Particle Size Distribution (PSD) testing.

Test locations are shown in Figure 1. Test locations were limited by the presence of vegetation, rubbish and potential services.

Figure 1 - Test locations

3. INVESTIGATION RESULTS

3.1. ENCOUNTERED SUBSURFACE CONDITIONS

Encountered ground conditions in TP1 were fine grained Sand fill (beach sand) to a depth of 0.2m, dark brown Silty Clay to a depth of 0.3m underlain by Gravelly Silt to refusal depth of 1.3m. The proportion of gravel increased with depth and one cemented cobble was encountered. Exposed laterite was visible at the surface at one location, indicating variable depth to laterite throughout the site. No groundwater was observed in the test pit.

DCP testing generally indicated Dense to Very Dense or Hard soils. DCP refusal was encountered at 0.88m at both DCP locations.

In addition to the exposed slab, it is likely that there are additional buried elements given the poor surface condition of the site.

3.2. LABORATORY TESTING

Laboratory results are summarised in Table 1. Complete laboratory results are presented in Appendix C.

Table 1 - Laboratory results

Sample	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Linear Shrinkage	Emerson Class	Gravel Proportion (%)	Sand Proportion (%)	Fines Proportion (%)
TP1 0.8m	35	15	20	9.5	4	61	16	23

4. RECOMMENDED DESIGN CRITERIA

4.1. SHALLOW FOUNDATION DESIGN

4.1.1. BUILDING CONSTRUCTION AT NATURAL GROUND LEVEL

Classification of a site in accordance with AS2870-2011 *Residential Slabs and Footings* strictly applies only to single story residential structures, but can be used to assist in the design and construction of foundations in similarly designed buildings by providing and approximate indication of possible reactive soil movement.

For the purpose of site classification in accordance with AS2870-2011 *Residential Slabs and Footings*, the site must be considered **Class P** due to the presence of mature trees, buried construction rubbish and presence of non-engineered fill in these area. As such, due to the extent and quantity of vegetation, existing construction and generally messy nature of the site, a provisional classification subject to suitable earthworks cannot be provided. Care must be taken to ensure that soil below the proposed footing locations is suitably compacted and foreign material (pipes etc.) removed.

The **Class P** classification may be improved by a qualified geotechnical engineer following clearing of the site and removal of surface construction and rubbish and further planning of the building footprint relative to the site.

The presence of visible near-surface laterite indicates that ripping may be required in areas. Additionally, the designer must consider the high stiffness in these areas.

4.1.2. BUILDING CONSTRUCTION ON IMPORTED FILL

Filling to above the existing ground level may be considered if shallow foundations are used, or may be required where significant volume of tree roots or rubbish must be removed. Based on observed conditions at the site, it appears likely that filling will be required where vegetation and existing construction are removed. Where poor ground is present, removal and replacement with engineered fill shall be in accordance with Clause 6.2.2 of AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

Where fill is to be placed, all topsoil, loose material, organic material and uncontrolled fill is to be removed from the site prior to importing of any engineered material. Based on the long term loadings anticipated to be present within the proposed buildings, settlement predictions based on the depth of fill may need to be undertaken following receipt of final design levels if the foundations are not keyed into natural ground. Alternatively, building articulation can be integrated into the building's structural design that will allow the building to accommodate such movements.

Notwithstanding, the following will need to be considered in the final design.

- Final fill levels relative to finished floor area;
- Receipt of live loads;
- Building dead loads;
- Fill type and compaction method adopted by contractor.

4.2. BORED PIER FOUNDATION DESIGN

It is unknown whether bored piers are being considered for the proposed construction. Should a combination of bored pier/screw pile and shallow foundations be considered, a method of articulation may be required to account for differential settlement.

Uncased bored piers can usually be constructed in stiff to hard clays using an excavator-mounted boring attachment or a track-mounted short flight hydraulic rotary rig can be used. Due to the nature of the site, it is difficult to comment on stability and practicality of bored pier excavation.

The design of bored pier foundations, with a founding depth of greater than four pier diameters should be based on the preliminary parameters shown in Table 2 below. It is noted that the parameters are based on the observed geotechnical conditions within the conducted test pits and can be refined during construction by a suitably qualified Geotechnical Engineer or Engineering Geologist. Due to the potential for buried rubbish or prior construction, it is recommended to found within the laterite layer and ignore skin friction above this. Additionally, proposed pier locations should be tested for rubbish prior to construction.

Table 2 - Design parameters based on Worst Case Findings

DEPTH RANGE (m)	ULTIMATE STRENGTH		BULK UNIT WEIGHT (kN/m^3)
	END BEARING PRESSURE (kPa)	SHAFT ADHESION (kPa)	
Soils	0	0	22
Laterite/Rock >0.7m	800	45	22

4.3. SCREW PILE FOUNDATION DESIGN

Screw pile design is typically undertaken by the piling contractor, as pile geometry and design methodology may differ between manufacturers. It is recommended that the installation of steel screw piles be undertaken only by experienced contractors, and that load testing is undertaken shortly following installation. It is noted that screw piles are generally unable to penetrate rock and would therefore rely entirely on the bearing capacity at the top of the laterite layer, with minimal lateral resistance.

It is noted that, in order to achieve sufficient lateral restraint, penetration into the presumed underlying laterite layer will likely be required. In the event that screw piles are considered, constructability will need to be considered including the ability of the selected installation plant to penetrate the laterite layer with the screw pile.

Based on the identified conditions and anticipated founding depths, skin friction is to be ignored in the design of screw piles. Where the helix outstand to plate thickness ratio exceeds 10, the possibility of formation of a plastic hinge must be considered, which would reduce the effective diameter of the helix.

4.4. NOTES

RESPONSIBILITIES (A.S. 2870 Supp 1). Footing design and construction involves a number of steps; site classification, selection of the footing system, structural design, construction in accordance with the required design details and construction methods, and proper maintenance. In addition to the builder, this process may involve an engineer, the Building Authority, the owner, and all parties who share responsibilities for any failure. In particular, the owner has a responsibility to ensure the site is properly maintained.

Note: Because the investigation is limited in scope and extent, it is possible that areas may exist which differ from those shown in the test records and used in the site classification. Should any variation from the reported conditions be encountered during excavation work, a Building Services Authority Registered Site Classifier or a Registered Practicing Engineer must be notified immediately so that reappraisal of the classification can be made. Attention is drawn to the present or any future owners of their responsibilities for foundation maintenance as detailed in A.S. 2870 and CSIRO Brochure “Foundation Maintenance and Footing Performance: A Homeowner’s Guide.”

Yours Sincerely,

Adam Huey	Chris Taifalos
Geotechnical Engineer	**Principal Engineer**
OSE Group Pty Ltd	**OSE Group Pty Ltd**

Attachments:

APPENDIX A. TEST PIT/DCP LOGS

APPENDIX B. PHOTOGRAPHS

APPENDIX C. LABORATORY RESULTS

APPENDIX A. TEST PIT/DCP LOGS

LOCATION	EASTING (GDA2020)	NORTHING (GDA2020)
22260_2 TP1/DCP1	305581.86	8156655.60
22260_2 DCP2	305580.03	8156669.97

Sheet: 1 of 1

Client:	Mornington Shire Council	Technician:	AH
Project No.:	22260_2	Date:	7/07/2022
Project:	254 Wardirrkan St	Location:	See report table

Depth from (m)	Depth to (m)	**DCP1**	**DCP2**			
0	0.1	14	5			
0.1	0.2	30	6			
0.2	0.3	25	5			
0.3	0.4	10	9			
0.4	0.5	11	14			
0.5	0.6	9	12			
0.6	0.7	8	12			
0.7	0.8	6	21			
0.8	0.9	12DB/80	20DB/80			
0.9	1					
1	1.1					
1.1	1.2					
1.2	1.3					
1.3	1.4					
1.4	1.5					
1.5	1.6					
1.6	1.7					
1.7	1.8					
1.8	1.9					
1.9	2					
2	2.1					
2.1	2.2					
2.2	2.3					
2.3	2.4					
2.4	2.5					
2.5	2.6					
2.6	2.7					
2.7	2.8					
2.8	2.9					
2.9	3					
3	3.1					
3.1	3.2					
3.2	3.3					
3.3	3.4					

Key:	Notes:
T - Terminated at target depth	
R - Refusal (more than 30 blows/100mm)	
DB - Double bouncing (refusal)	
/ - Depth within interval prior to refusal (mm)	

Test Pit:	TP1	Checked:	CT
Client:	Mornington Shire Council	GW (m):	Not Encountered
Project:	254 Wardirrkan St	Job No:	22260_2
Logged by:	AH	Date:	07/07/22
Machine:	Backhoe (450mm)	Location:	E 305581.9, N 8156655.6 (GDA2020)

Depth (m)	Lithology	Description/Comments	Sample	Density	Dynamic Cone Penetration (per 100mm)	Depth (m)
0.00	FILL	**FILL, SAND,** fine grained, pale brown, moist, contains rootlets.		VL	14	0.00
0.10					30	0.10
0.20	CL	**Silty CLAY,** low plasticity, dark brown, contains rootlets.		H	25	0.20
0.30	GM	**Silty GRAVEL,** fine to medium grained, red, increasing gravel proportion with depth, gravel component comprises rounded ironstone nodules 5-10mm diameter. One cemented cobble encountered.			10	0.30
0.40					11	0.40
0.50					9	0.50
0.60					8	0.60
0.70					6	0.70
0.80			0.8m	D	12DB/80	0.80
0.90						0.90
1.00						1.00
1.10						1.10
1.20						1.20
1.30		Test pit terminated at 1.3m. Material refusal.				1.30
1.40						1.40
1.50						1.50
1.60						1.60
1.70						1.70
1.80						1.80
1.90						1.90
2.00						2.00
2.10						2.10
2.20						2.20
2.30						2.30
2.40						2.40
2.50						2.50
2.60						2.60
2.70						2.70
2.80						2.80
2.90						2.90
3.00						3.00
3.10						3.10
3.20						3.20
3.30						3.30
3.40						3.40
3.50						3.50

APPENDIX B. PHOTOGRAPHS

Photo 1 – Site viewed from Wardirrkan Street

Photo 2 – Exposed laterite at surface

Photo 3 – Exposed concrete slab

Photo 4 – Imported fine grained sand

Photo 5 – Imported fine grained sand

Photo 6 – Imported fine grained sand

Photo 7 – Old car at rear of site and track

Photo 8 – Vegetation at edge of site

Photo 9 – TP1

Photo 10 – Silty gravel from TP1

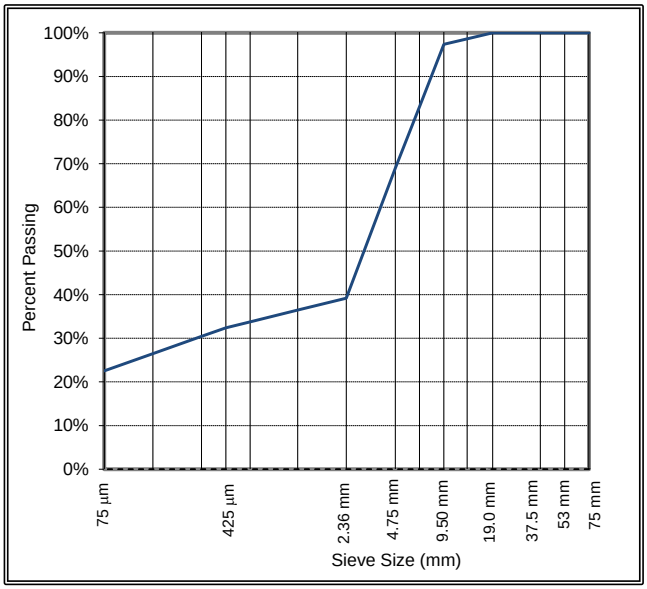
APPENDIX C. LABORATORY RESULTS

HEAD OFFICE – CAIRNS
ETS GEO PTY LTD
ABN: 16 121 817 794
07 4047 8600
07 4047 8699
admin@etsgeo.com.au
PO Box 587
REDLYNCH QLD 4870

23 Knight Street
CAIRNS QLD 4870

Quality of Materials Report

Client:	**OSE Group**	Report Number:	**GT22-305- CS47278 Q**
Client Address:	**36 Abbott St, Cairns QLD 4870**		
Job Number:	**GT22-305**	Report Date:	**22/08/2022**
Project:	**PN: 22260**	Test Request No:	-
Location	**Mornington Shire Council**		
Lab No:	**CS47278**	Sample Location:	
Date Sampled:	**11/08/2022**		**22260_2**
Date Tested:	**22/08/2022**		**TP1**
Sampled By:	**Client**		**0.8m**
Sample Method:	**As Received**		
Material Source:	**As Supplied**	Spec Description:	-
For Use As:	-	Lot Number:	-
Remarks:	**Results apply to samples as received**	Spec Number:	-



Particle Size Distribution

Test Method AS1289.3.6.1

A.S.	Specification		Result
	-		
Sieve Size	Specification Minimum	Result % Passing	Specification Maximum
75mm		**100**	
53mm		**100**	
37.5mm		**100**	
19.0mm		**100**	
9.5mm		**97**	
4.75mm		**69**	
2.36mm		**39**	
0.425mm		**32**	
0.075mm		**23**	

Plasticity Tests Oven Dried - Dry Sieved	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289.3.1.2**		**35**	
Plastic Limit (%)	**AS1289.3.2.1**		**15**	
Plasticity Index	**AS1289.3.3.1**		**20**	
Linear Shrinkage (%)	**AS1289.3.4.1 ***		**9.5**	
P.I. X % Passing 0.425mm (WPI)			**640**	
L.S. X % Passing 0.425mm			**308**	
Ratio of % Passing (0.075 / 0.425)			**0.70**	

* 254mm linear shrinkage mould used, Shrinkage had cracked.

Emerson Class	Test Method	Water Temperature	Emerson Class No	Water Type Used
	AS1289.3.8.1	**23°C**	**4**	**Distilled**
Soil Description :	**Red Sandy CLAY**			

NATA ACCREDITED FOR TECHNICAL COMPETENCE	**Accredited for compliance with ISO/IEC 17025 - Testing**	APPROVED SIGNATORY Jacqui Walmsley - Laboratory Manager **NATA Accreditation No. 20026** **Cairns Laboratory**	FORM NUMBER **FM-RP-120-5**

30/08/2022 OSE Reference: 22260_3

Mornington Shire Council – Housing and Facilities
1 Mission Road
Gununa QLD 4870

Attention: Geoffrey Rewald

Dear Geoffrey,

Subject: Geotechnical Investigation – 126A Wengka Street, Gununa, Mornington Island

1. INTRODUCTION

1.1. GENERAL

OSE Group was engaged by Mornington Shire Council to undertake a geotechnical investigation for proposed new construction at 126A Wengka Street, Gununa, Mornington Island. It is understood that it is intended to construct a house on the site, however size and style of construction have not been determined at the time of reporting.

The lot does not show any signs of prior construction. The site is generally empty and lightly grassed, except for one tree approximately 2m high and a power pole at the front of the site.

The aim of our investigation is to provide a site classification for foundation design, parameters for bored pier design, comment on suitability of excavated material as fill, evaluation of the influence of groundwater and on other potential geotechnical issues.

1.2. REGIONAL GEOLOGY

Mornington Island is underlain by lateritic geology, described in the 1:250,000 Carpentaria-Karumba Basin map as “Ferruginous laterite, minor silcrete; with sandy 'A' horizon: deep weathered Aurukun surface (younger events).”

Prior experience on the Island indicates that extremely to highly weathered laterite, often with ironstone nodules, is typically encountered within 1.5m of the ground surface.

2. GEOTECHNICAL INVESTIGATION

2.1. METHOD OF INVESTIGATION

The site inspection and field testing was undertaken on 7 July 2022, and comprised the following:

- Verification of underground services in the area where testing was to occur;
- Excavation of two (2) test pits (TP1 and TP3) within the lot boundary for sampling and logging;

- Undertaking of three (3) Dynamic Cone Penetrometer (DCP) tests adjacent each test pit and a third location;
- Collection of two (2) disturbed samples for the purpose of Atterberg Limits testing;
- Collection of two (2) disturbed samples for the purpose of Emerson Class testing;
- Collection of two (2) disturbed samples for the purpose of Particle Size Distribution (PSD) testing.

Test locations are shown in Figure 1. A test pit at DCP2 could not be conducted due to an overhead cable.

Figure 1 - Test locations

3. INVESTIGATION RESULTS

3.1. ENCOUNTERED SUBSURFACE CONDITIONS

Typical encountered ground conditions were red-brown Sandy Gravel or Silty Sand to a depth of 0.2-0.35m, overlying brown Sandy or Gravelly Clay to a depth of 0.4 to 0.8m. Below this point was extremely to highly weathered laterite containing ironstone nodules. Exposed laterite was visible towards the west of the site. No groundwater was observed in any of the test pits.

DCP testing generally indicated dense to very dense or very stiff hard soils. DCP refusal was encountered at 0.4-0.8m in the eastern part of the site and less than 0.2m in the western part. Exposed laterite was also common towards the west.

3.2. LABORATORY TESTING

Results of the laboratory testing are summarised in Table 1. An Atterberg A-Line graph is presented as Figure 2. Complete laboratory results are provided in Appendix C.

Table 1 - Laboratory Results

Sample	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Linear Shrinkage	Emerson Class	Gravel Proportion (%)	Sand Proportion (%)	Fines Proportion (%)
TP1 0.6m	22	10	12	4	4	28	32	40
TP3 0.35m	22	12	10	5.5	5	23	31	46

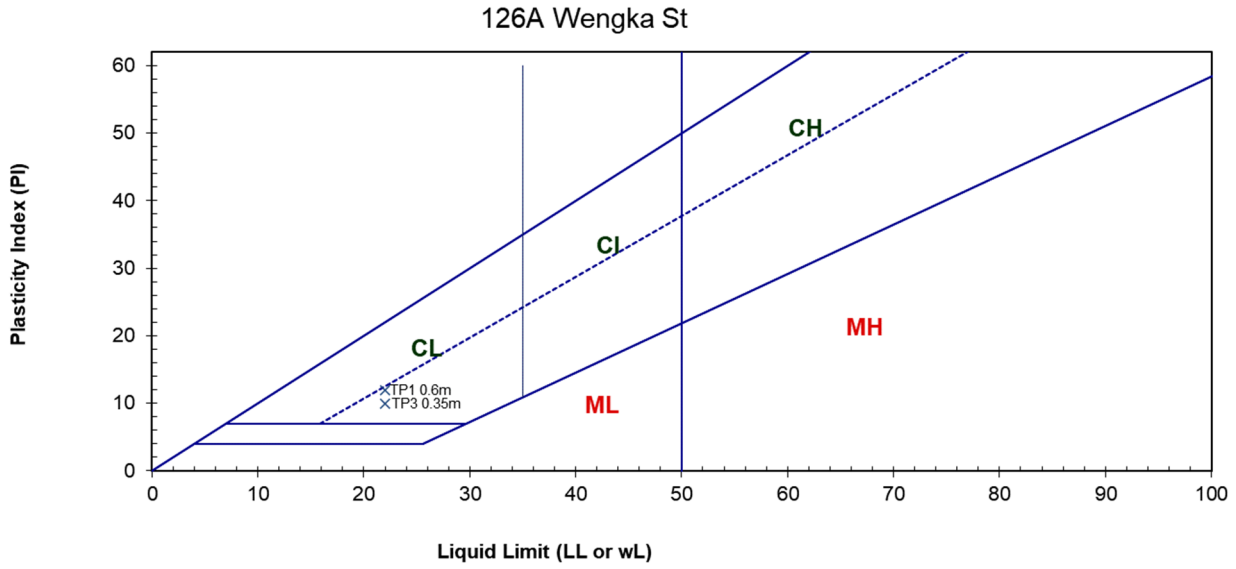


Figure 2 - Atterberg A-line graph

4. RECOMMENDED DESIGN CRITERIA

4.1. SHALLOW FOUNDATION DESIGN

4.1.1. BUILDING CONSTRUCTION AT NATURAL GROUND LEVEL

Classification of a site in accordance with AS2870-2011 *Residential Slabs and Footings* strictly applies only to single story residential structures, but can be used to assist in the design and construction of foundations in similarly designed buildings by providing and approximate indication of possible reactive soil movement.

For the purpose of site classification in accordance with AS2870-2011 *Residential Slabs and Footings*, the site may be considered **Class S** due to the coarse and low plasticity soils overlying laterite and high DCP values

observed. Care must be taken to ensure that soil around the single tree is removed, replaced with suitable material and properly compacted, should the proposed structure overlap this area.

It is considered that, while preliminary designs show an alternative foundation system, high level footing systems such as strip/pad footings are suitable for the building provided the above advice is followed. Strip/pad footings and beams for slab on ground footings founded below the existing surface are effectively able to be designed using an allowable bearing pressure of 100 kPa (based on the DCP results). This bearing pressure has been calculated adopting a geotechnical strength reaction factor of 0.4 for limit state design as previously indicated. At an allowable bearing pressure of 100 kPa or less, total differential settlements within the structures are anticipated to be within 20mm. This assessment is based on the removal of any buried construction rubbish from the uncontrolled fill, and compaction as outlined above.

The presence of visible near-surface laterite indicates that ripping may be required in areas. Additionally, the designer must consider the high stiffness in these areas.

4.1.2. BUILDING CONSTRUCTION ON IMPORTED FILL

While the supplied designs do not indicate filling to above the existing ground level, this may be considered if shallow foundations are used, or may be required where significant volume of tree roots or rubbish must be removed. This does not appear to be necessary at this site. Where poor ground is present, removal and replacement with engineered fill shall be in accordance with Clause 6.2.2 of AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

Where fill is to be placed, all topsoil, loose material, organic material and uncontrolled fill is to be removed from the site prior to importing of any engineered material. Based on the long term loadings anticipated to be present within the proposed buildings, settlement predictions based on the depth of fill may need to be undertaken following receipt of final design levels if the foundations are not keyed into natural ground. Alternatively, building articulation can be integrated into the building's structural design that will allow the building to accommodate such movements.

Notwithstanding, the following will need to be considered in the final design.

- Final fill levels relative to finished floor area;
- Receipt of live loads;
- Building dead loads;
- Fill type and compaction method adopted by contractor.

4.2. BORED PIER FOUNDATION DESIGN

It is unknown whether bored piers are being considered for the proposed construction. Should a combination of bored pier/screw pile and shallow foundations be considered, a method of articulation may be required to account for differential settlement.

Uncased bored piers can usually be constructed in stiff to hard clays using an excavator-mounted boring attachment or a track-mounted short flight hydraulic rotary rig can be used. Excavated trenches suggest cave-in and/or collapse is unlikely.

The design of bored pier foundations, with a founding depth of greater than four pier diameters should be based on the preliminary parameters shown in Table 2 below. It is noted that the parameters are based on the observed geotechnical conditions within the conducted test pits and can be refined during construction by a suitably qualified Geotechnical Engineer or Engineering Geologist. Table 1 results are based on the findings of DCP1/TP1 whereby the ground stiffness is inconsistent to 0.7m below surface.

Table 2 - Design parameters based on Worst Case findings

DEPTH RANGE (m)	ULTIMATE STRENGTH		BULK UNIT WEIGHT (kN/m^3)
	END BEARING PRESSURE (kPa)	SHAFT ADHESION (kPa)	
0 – 0.7	250	0	20
Soils >0.7m	400	15	22
Laterite/Rock	800	45	22

A geotechnical reduction factor (Φ_g) of 0.4 should be applied to the above values of end bearing and shaft adhesion to obtain the design geotechnical strength (R_{ug}) for limit state design of piles, or a factor of safety of 2.5 applied for working stress design.

The parameters given above are reliant on clean rough sockets which are free of loose debris on the base of the hole and smear on the sides of the hole. Debris from the prior construction should also be removed. Excavations should be poured immediately after drilling, prior to any groundwater accumulation and softening of the excavated socket. The shaft adhesion developed over the upper 0.7m should be ignored in pile capacity calculations due to seasonal soil cracking.

4.3. SCREW PILE FOUNDATION DESIGN

Screw pile design is typically undertaken by the piling contractor, as pile geometry and design methodology may differ between manufacturers. The included test data should be sufficient for an experienced pile designer to determine their required design parameters. It is recommended that the installation of steel screw piles be undertaken only by experienced contractors, and that load testing is undertaken shortly following installation. It is noted that screw piles are generally unable to penetrate rock and would therefore rely entirely on the bearing capacity at the top of the laterite layer, with minimal lateral resistance.

It is noted that, in order to achieve sufficient lateral restraint, penetration into the laterite layer will likely be required. In the event that screw piles are considered, constructability will need to be considered including the ability of the selected installation plant to penetrate the laterite layer with the screw pile.

Based on the identified conditions and anticipated founding depths, skin friction is to be ignored in the design of screw piles. Where the helix outstand to plate thickness ratio exceeds 10, the possibility of formation of a plastic hinge must be considered, which would reduce the effective diameter of the helix.

4.4. NOTES

RESPONSIBILITIES (A.S. 2870 Supp 1). Footing design and construction involves a number of steps; site classification, selection of the footing system, structural design, construction in accordance with the required design details and construction methods, and proper maintenance. In addition to the builder, this process may involve an engineer, the Building Authority, the owner, and all parties who share responsibilities for any failure. In particular, the owner has a responsibility to ensure the site is properly maintained.

Note: Because the investigation is limited in scope and extent, it is possible that areas may exist which differ from those shown in the test records and used in the site classification. Should any variation from the reported conditions be encountered during excavation work, a Building Services Authority Registered Site Classifier or a Registered Practicing Engineer must be notified immediately so that reappraisal of the classification can be made. Attention is drawn to the present or any future owners of their responsibilities for foundation maintenance as detailed in A.S. 2870 and CSIRO Brochure “Foundation Maintenance and Footing Performance: A Homeowner’s Guide.”

Yours Sincerely,

Adam Huey
Geotechnical Engineer
OSE Group Pty Ltd

Chris Taifalos
Principal Engineer
OSE Group Pty Ltd

Attachments:

APPENDIX A. TEST PIT/DCP LOGS

APPENDIX B. PHOTOGRAPHS

APPENDIX C. LABORATORY RESULTS

APPENDIX A. TEST PIT/DCP LOGS

LOCATION	EASTING (GDA2020)	NORTHING (GDA2020)
22260_3 TP1/DCP1	306513.50	8156437.64
22260_3 DCP2	306504.41	8156428.37
22260_3 TP3/DCP3	306515.29	8156427.92

Sheet: 1 of 1

Client:	Mornington Shire Council	Technician:	AH
Project No.:	22260_3	Date:	7/07/2022
Project:	126A Kaban St	Location:	See report table

Depth from (m)	Depth to (m)	**DCP1**	**DCP2A**	**DCP2B**	**DCP3**	
0	0.1	11	22	22	7	
0.1	0.2	11		30R/85	18	
0.2	0.3	22			21	
0.3	0.4	9			13	
0.4	0.5	6			7DB/10	
0.5	0.6	11				
0.6	0.7	16DB/80				
0.7	0.8					
0.8	0.9					
0.9	1					
1	1.1					
1.1	1.2					
1.2	1.3					
1.3	1.4					
1.4	1.5					
1.5	1.6					
1.6	1.7					
1.7	1.8					
1.8	1.9					
1.9	2					
2	2.1					
2.1	2.2					
2.2	2.3					
2.3	2.4					
2.4	2.5					
2.5	2.6					
2.6	2.7					
2.7	2.8					
2.8	2.9					
2.9	3					
3	3.1					
3.1	3.2					
3.2	3.3					
3.3	3.4					

Key:	Notes:
T - Terminated at target depth	
R - Refusal (more than 30 blows/100mm)	
DB - Double bouncing (refusal)	
/ - Depth within interval prior to refusal (mm)	

Test Pit:	TP1	Checked:	CT
Client:	Mornington Shire Council	GW (m):	Not Encountered
Project:	126A Wengka St	Job No:	22260_3
Logged by:	AH	Date:	07/07/22
Machine:	Backhoe (450mm)	Location:	E 306513.5, N 8156437.6 (GDA2020)

Depth (m)	Lithology	Description/Comments	Sample	Density	Dynamic Cone Penetration (per 100mm)	Depth (m)
0.00	GW	**Sandy GRAVEL,** coarse grained, angular, red-brown, dry.			11	0.00
0.10		...0.1m Moist.		D-VD	11	0.10
0.20					22	0.20
0.30					9	0.30
0.40	CL	**Silty, Gravelly CLAY,** low plasticity, dark brown, contains rootlets.			6	0.40
0.50					11	0.50
0.60		...0.6m Contains isonstone nodules as rounded gravel, increasing proportion with depth.	0.6m	VSt	16DB/80	0.60
0.70						0.70
0.80		Test pit terminated at 0.8m. Material refusal.				0.80
0.90						0.90
1.00						1.00
1.10						1.10
1.20						1.20
1.30						1.30
1.40						1.40
1.50						1.50
1.60						1.60
1.70						1.70
1.80						1.80
1.90						1.90
2.00						2.00
2.10						2.10
2.20						2.20
2.30						2.30
2.40						2.40
2.50						2.50
2.60						2.60
2.70						2.70
2.80						2.80
2.90						2.90
3.00						3.00
3.10						3.10
3.20						3.20
3.30						3.30
3.40						3.40
3.50						3.50

Test Pit:	TP3	Checked:	CT
Client:	Mornington Shire Council	GW (m):	Not Encountered
Project:	126A Wengka St	Job No:	22260_3
Logged by:	AH	Date:	07/07/22
Machine:	Backhoe (450mm)	Location:	E 306515.3, N 8156427.9 (GDA2020)

Depth (m)	Lithology	Description/Comments	Sample	Density	Dynamic Cone Penetration (per 100mm)	Depth (m)
0.00	SM	**Silty SAND,** fine grained, red-brown, moist, contains rootlets.		VD	7	0.00
0.10					18	0.10
0.20	CL	**Gravelly, Sandy CLAY,** low plasticity, brown with regions of red mottling, moist.	0.35m	H	21	0.20
0.30					13	0.30
0.40	CON	**LATERITE,** extremely to highly weathered, red-brown mottled yellow.		VL-L	7DB/10	0.40
0.50		Test pit terminated at 0.55m. Material refusal.				0.50
0.60						0.60
0.70						0.70
0.80						0.80
0.90						0.90
1.00						1.00
1.10						1.10
1.20						1.20
1.30						1.30
1.40						1.40
1.50						1.50
1.60						1.60
1.70						1.70
1.80						1.80
1.90						1.90
2.00						2.00
2.10						2.10
2.20						2.20
2.30						2.30
2.40						2.40
2.50						2.50
2.60						2.60
2.70						2.70
2.80						2.80
2.90						2.90
3.00						3.00
3.10						3.10
3.20						3.20
3.30						3.30
3.40						3.40
3.50						3.50

APPENDIX B. PHOTOGRAPHS

Photo 1 – Site viewed from Wengka Street

Photo 2 – Overhead cable preventing excavation of TP2

Photo 3 – Rear of site

Photo 4 – Exposed laterite

Photo 5 – TP1

Photo 6 – Silty, Gravelly Clay from TP1

Photo 7 – TP2

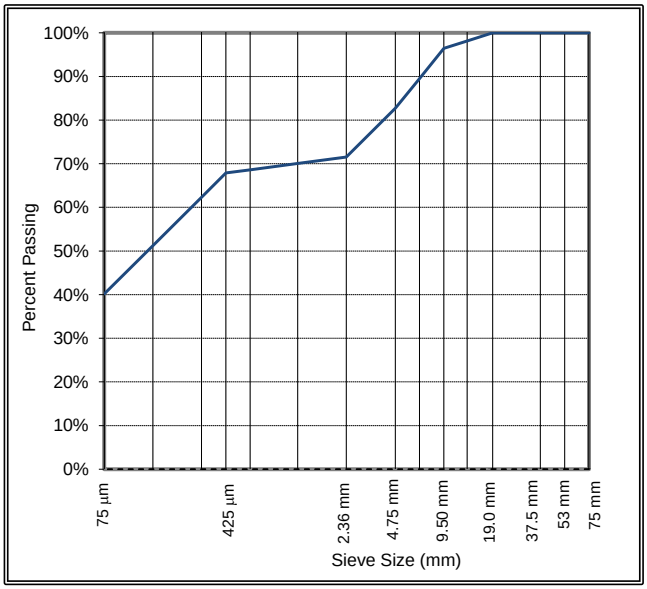
APPENDIX C. LABORATORY RESULTS

HEAD OFFICE – CAIRNS
ETS GEO PTY LTD
ABN: 16 121 817 794
07 4047 8600
07 4047 8699
admin@etsgeo.com.au
PO Box 587
REDLYNCH QLD 4870

23 Knight Street
CAIRNS QLD 4870

Quality of Materials Report

Client:	**OSE Group**	Report Number:	**GT22-305- CS47279 Q**
Client Address:	**36 Abbott St, Cairns QLD 4870**		
Job Number:	**GT22-305**	Report Date:	**22/08/2022**
Project:	**PN: 22260**	Test Request No:	-
Location	**Mornington Shire Council**		
Lab No:	**CS47279**	Sample Location:	
Date Sampled:	**11/08/2022**		**22260_3**
Date Tested:	**22/08/2022**		**TP1**
Sampled By:	**Client**		**0.6m**
Sample Method:	**As Received**		
Material Source:	**As Supplied**	Spec Description:	-
For Use As:	-	Lot Number:	-
Remarks:	**Results apply to samples as received**	Spec Number:	-



Particle Size Distribution

Test Method AS1289.3.6.1

A.S. Sieve Size	Specification - Specification Minimum	Result % Passing	Specification - Specification Maximum
75mm		**100**	
53mm		**100**	
37.5mm		**100**	
19.0mm		**100**	
9.5mm		**96**	
4.75mm		**83**	
2.36mm		**72**	
0.425mm		**68**	
0.075mm		**40**	

Plasticity Tests Oven Dried - Dry Sieved	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289.3.1.2**		**22**	
Plastic Limit (%)	**AS1289.3.2.1**		**10**	
Plasticity Index	**AS1289.3.3.1**		**12**	
Linear Shrinkage (%)	**AS1289.3.4.1 ***		**4**	
P.I. X % Passing 0.425mm (WPI)			**816**	
L.S. X % Passing 0.425mm			**272**	
Ratio of % Passing (0.075 / 0.425)			**0.59**	

* 250mm linear shrinkage mould used, Shrinkage had cracked.

Emerson Class	Test Method	Water Temperature	Emerson Class No	Water Type Used
	AS1289.3.8.1	**23°C**	**4**	**Distilled**
Soil Description :	**Brown Sandy Silty CLAY**			

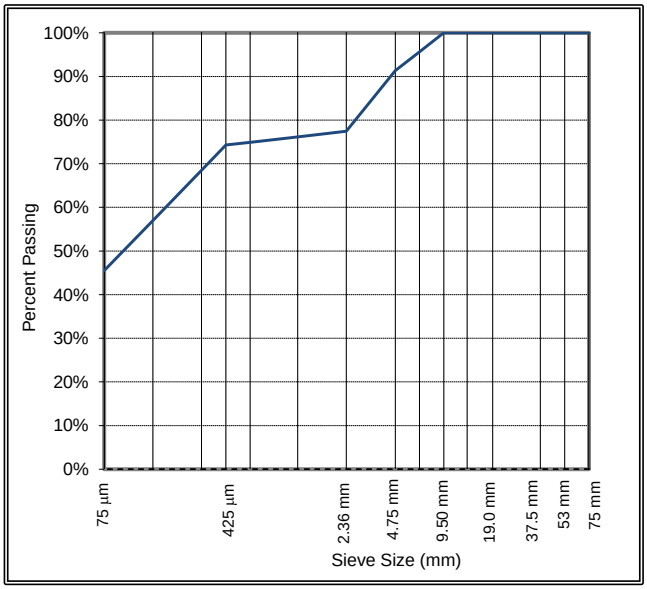
NATA ACCREDITED FOR TECHNICAL COMPETENCE	**Accredited for compliance with ISO/IEC 17025 - Testing**	APPROVED SIGNATORY Jacqui Walmsley - Laboratory Manager **NATA Accreditation No. 20026** **Cairns Laboratory**	FORM NUMBER **FM-RP-120-5**

HEAD OFFICE – CAIRNS
ETS GEO PTY LTD
ABN: 16 121 817 794
07 4047 8600
07 4047 8699
admin@etsgeo.com.au
PO Box 587
REDLYNCH QLD 4870

23 Knight Street
CAIRNS QLD 4870

Quality of Materials Report

Client:	**OSE Group**	Report Number:	**GT22-305- CS47280 Q**
Client Address:	**36 Abbott St, Cairns QLD 4870**		
Job Number:	**GT22-305**	Report Date:	**22/08/2022**
Project:	**PN: 22260**	Test Request No:	**-**
Location	**Mornington Shire Council**		
Lab No:	**CS47280**	Sample Location:	
Date Sampled:	**11/08/2022**		**22260_3**
Date Tested:	**22/08/2022**		**TP3**
Sampled By:	**Client**		**0.35m**
Sample Method:	**As Received**		
Material Source:	**As Supplied**	Spec Description:	-
For Use As:	-	Lot Number:	-
Remarks:	**Results apply to samples as received**	Spec Number:	-



Particle Size Distribution

Test Method AS1289.3.6.1

A.S. Sieve Size	Specification - Specification Minimum	Result % Passing	Specification Maximum
75mm		**100**	
53mm		**100**	
37.5mm		**100**	
19.0mm		**100**	
9.5mm		**100**	
4.75mm		**91**	
2.36mm		**77**	
0.425mm		**74**	
0.075mm		**46**	

Plasticity Tests Oven Dried - Dry Sieved	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289.3.1.2**		**22**	
Plastic Limit (%)	**AS1289.3.2.1**		**12**	
Plasticity Index	**AS1289.3.3.1**		**10**	
Linear Shrinkage (%)	**AS1289.3.4.1 ***		**5.5**	
P.I. X % Passing 0.425mm (WPI)			**740**	
L.S. X % Passing 0.425mm			**409**	
Ratio of % Passing (0.075 / 0.425)			**0.61**	

* 250mm linear shrinkage mould used, Shrinkage had cracked.

Emerson Class	Test Method	Water Temperature	Emerson Class No	Water Type Used
	AS1289.3.8.1	**23°C**	**5**	**Distilled**

Soil Description : **Brown Sandy SILT**

NATA ACCREDITED FOR TECHNICAL COMPETENCE	**Accredited for compliance with ISO/IEC 17025 - Testing**	APPROVED SIGNATORY Jacqui Walmsley - Laboratory Manager **NATA Accreditation No. 20026** **Cairns Laboratory**	FORM NUMBER **FM-RP-120-5**

30/08/2022 OSE Reference: 22260_4

Mornington Shire Council – Housing and Facilities
1 Mission Road
Gununa QLD 4870

Attention: Geoffrey Rewald

Dear Geoffrey,

Subject: Geotechnical Investigation – Lot 925/926 SP270889, Gununa, Mornington Island

1. INTRODUCTION

1.1. GENERAL

OSE Group was engaged by Mornington Shire Council to undertake a geotechnical investigation for proposed new construction at Lot 925/926 SP270889, Gununa, Mornington Island. No specific structure or structures have been proposed at this time and size and style of construction have not been determined at the time of reporting.

The lot previously contained structures of unknown size and style. The site is generally empty and grassed, except for a small number of trees up to 2.5m high at the boundary.

The aim of our investigation is to provide a site classification in accordance with AS2870 *Residential Slab and Footings* for foundation design, parameters for bored pier design, comment on suitability of excavated material as fill, evaluation of the influence of groundwater and on other potential geotechnical issues.

1.2. REGIONAL GEOLOGY

Mornington Island is underlain by lateritic geology, described in the 1:250,000 Carpentaria-Karumba Basin map as “Ferruginous laterite, minor silcrete; with sandy 'A' horizon: deep weathered Aurukun surface (younger events).”

Prior experience on the Island indicates that extremely to highly weathered laterite, often with ironstone nodules, is typically encountered within 1.5m of the ground surface.

2. GEOTECHNICAL INVESTIGATION

2.1. METHOD OF INVESTIGATION

The site inspection and field testing was undertaken on 7 July 2022, and comprised the following:

- Verification of underground services in the area where testing was to occur;
- Excavation of three (3) test pits (TP1 to TP3) within the lot boundary for sampling and logging;

- Undertaking of four (4) Dynamic Cone Penetrometer (DCP) tests adjacent each test pit and a fourth location;
- Collection of three (3) disturbed samples for the purpose of Atterberg Limits testing;
- Collection of three (3) disturbed samples for the purpose of Emerson Class testing;
- Collection of three (3) disturbed samples for the purpose of Particle Size Distribution (PSD) testing.

Test locations are shown in Figure 1.

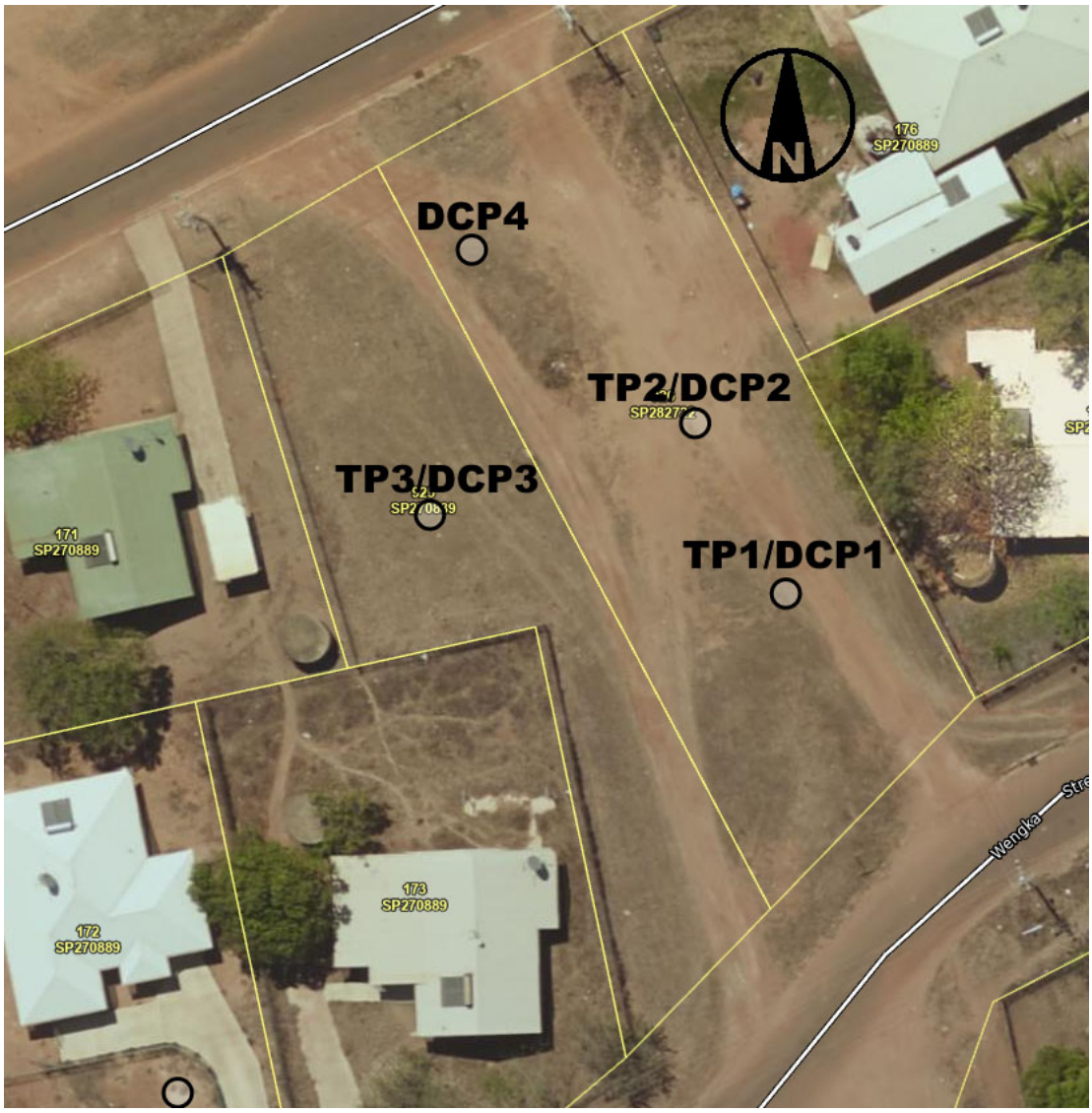


Figure 1 - Test Locations

3. INVESTIGATION RESULTS

3.1. ENCOUNTERED SUBSURFACE CONDITIONS

The eastern part of the combined site, generally corresponding with Lot 926, contains 0.2-0.25m of Silty Sand or Silty Sand and Clayey Silt overlying pale brown Sandy Clay or Sandy, Gravelly Clay to a depth of 0.55-0.6m. Below this point was extremely to highly weathered laterite containing ironstone nodules.

In the western part of the site, generally corresponding to Lot 925, soils were red-brown rather than pale brown and comprised 100mm of Silty Sand overlying Clayey Sand. At 0.7m a 90mm PVC pipe 45 degree elbow was encountered. The surrounding region was excavated and no continuation of the pipe was found. It is assumed that this pipe is a remnant of prior construction.

No groundwater was observed in any of the test pits.

DCP testing generally indicated medium dense or firm to stiff soils. DCP refusal was encountered at 0.61-0.91m.

3.2. LABORATORY TESTING

Results of the laboratory testing are summarised in Table 1. An Atterberg A-Line graph is presented as Figure 2. Complete laboratory results are provided in Appendix C.

Table 1 - Laboratory results summary

Sample	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Linear Shrinkage	Emerson Class	Gravel Proportion (%)	Sand Proportion (%)	Fines Proportion (%)
TP1 0.45m	28	11	17	7.5	4	30	28	42
TP2 0.4m	25	11	14	7	4	29	27	44
TP3 0.6m	19	11	8	5	4	20	49	31

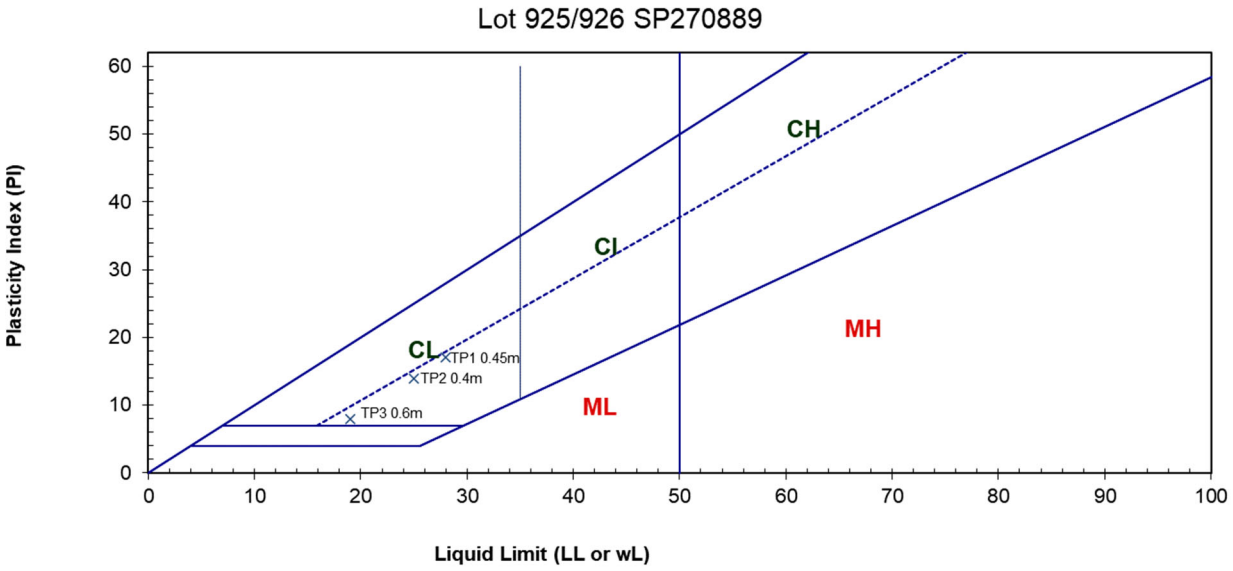


Figure 2 - Atterberg A-line graph

4. RECOMMENDED DESIGN CRITERIA

4.1. SHALLOW FOUNDATION DESIGN

4.1.1. BUILDING CONSTRUCTION AT NATURAL GROUND LEVEL

Classification of a site in accordance with AS2870-2011 *Residential Slabs and Footings* strictly applies only to single story residential structures, but can be used to assist in the design and construction of foundations in similarly designed buildings by providing and approximate indication of possible reactive soil movement.

For the purpose of site classification in accordance with AS2870-2011 *Residential Slabs and Footings*, the site may be considered **Class M** due to the low plasticity soils overlying laterite, however variable DCP values were observed. Care must be taken to ensure that the soil is evenly compacted, soft spots removed and potential variability considered to avoid differential settlement.

It is considered that, while preliminary designs show an alternative foundation system, high level footing systems such as strip/pad footings are suitable for the building provided the above advice is followed. Strip/pad footings and beams for slab on ground footings founded below the existing surface are effectively able to be designed using an allowable bearing pressure of 100 kPa (based on the DCP results). This bearing pressure has been calculated adopting a geotechnical strength reaction factor of 0.4 for limit state design as previously indicated. At an allowable bearing pressure of 100 kPa or less, total differential settlements within the structures are anticipated to be within 20-40mm. This assessment is based on the removal of any buried construction rubbish from the uncontrolled fill, and compaction as outlined above.

The presence of visible near-surface laterite indicates that ripping may be required in areas. Additionally, the designer must consider the high stiffness in these areas.

4.1.2. BUILDING CONSTRUCTION ON IMPORTED FILL

While the supplied designs do not indicate filling to above the existing ground level, this may be considered if shallow foundations are used, or may be required where significant volume of tree roots or rubbish must be removed. Where poor ground is present, removal and replacement with engineered fill shall be in accordance with Clause 6.2.2 of AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

Where fill is to be placed, all topsoil, loose material, organic material and uncontrolled fill is to be removed from the site prior to importing of any engineered material. Based on the long term loadings anticipated to be present within the proposed buildings, settlement predictions based on the depth of fill may need to be undertaken following receipt of final design levels if the foundations are not keyed into natural ground. Alternatively, building articulation can be integrated into the building's structural design that will allow the building to accommodate such movements.

Notwithstanding, the following will need to be considered in the final design.

- Final fill levels relative to finished floor area;
- Receipt of live loads;
- Building dead loads;
- Fill type and compaction method adopted by contractor.

4.2. BORED PIER FOUNDATION DESIGN

It is unknown whether bored piers are being considered for the proposed construction. Should a combination of bored pier/screw pile and shallow foundations be considered, a method of articulation may be required to account for differential settlement.

Uncased bored piers can usually be constructed in stiff to hard clays using an excavator-mounted boring attachment or a track-mounted short flight hydraulic rotary rig can be used. Excavated trenches suggest cave-in and/or collapse is unlikely.

The design of bored pier foundations, with a founding depth of greater than four pier diameters should be based on the preliminary parameters shown in Table 1 below. It is noted that the parameters are based on the observed geotechnical conditions within the conducted test pits and can be refined during construction by a suitably qualified Geotechnical Engineer or Engineering Geologist. Table 1 results are based on the findings of DCP3/TP3 whereby the ground stiffness is inconsistent to DCP refusal at 0.9m.

Table 2 - Design parameters based on Worst Case findings

DEPTH RANGE (m)	ULTIMATE STRENGTH		BULK UNIT WEIGHT (kN/m^3)
	END BEARING PRESSURE (kPa)	SHAFT ADHESION (kPa)	
0 – 0.9	250	0	20
Soils >0.9m	400	15	22
Laterite/Rock	800	45	22

A geotechnical reduction factor (Φ_g) of 0.4 should be applied to the above values of end bearing and shaft adhesion to obtain the design geotechnical strength (R_{ug}) for limit state design of piles, or a factor of safety of 2.5 applied for working stress design.

The parameters given above are reliant on clean rough sockets which are free of loose debris on the base of the hole and smear on the sides of the hole. Debris from the prior construction should also be removed. Excavations should be poured immediately after drilling, prior to any groundwater accumulation and softening of the excavated socket. The shaft adhesion developed over the upper 0.9m should be ignored in pile capacity calculations due to seasonal soil cracking.

4.3. SCREW PILE FOUNDATION DESIGN

Screw pile design is typically undertaken by the piling contractor, as pile geometry and design methodology may differ between manufacturers. The included test data should be sufficient for an experienced pile designer to determine their required design parameters. It is recommended that the installation of steel screw piles be undertaken only by experienced contractors, and that load testing is undertaken shortly following installation. It is noted that screw piles are generally unable to penetrate rock and would therefore rely entirely on the bearing capacity at the top of the laterite layer, with minimal lateral resistance.

It is noted that, in order to achieve sufficient lateral restraint, penetration into the laterite layer will likely be required. In the event that screw piles are considered, constructability will need to be considered including the ability of the selected installation plant to penetrate the laterite layer with the screw pile.

Based on the identified conditions and anticipated founding depths, skin friction is to be ignored in the design of screw piles. Where the helix outstand to plate thickness ratio exceeds 10, the possibility of formation of a plastic hinge must be considered, which would reduce the effective diameter of the helix.

4.4. NOTES

RESPONSIBILITIES (A.S. 2870 Supp 1). Footing design and construction involves a number of steps; site classification, selection of the footing system, structural design, construction in accordance with the required design details and construction methods, and proper maintenance. In addition to the builder, this process may involve an engineer, the Building Authority, the owner, and all parties who share responsibilities for any failure. In particular, the owner has a responsibility to ensure the site is properly maintained.

Note: Because the investigation is limited in scope and extent, it is possible that areas may exist which differ from those shown in the test records and used in the site classification. Should any variation from the reported conditions be encountered during excavation work, a Building Services Authority Registered Site Classifier or a Registered Practicing Engineer must be notified immediately so that reappraisal of the classification can be made. Attention is drawn to the present or any future owners of their responsibilities for foundation maintenance as detailed in A.S. 2870 and CSIRO Brochure "Foundation Maintenance and Footing Performance: A Homeowner's Guide."

Yours Sincerely,

Adam Huey
Geotechnical Engineer
OSE Group Pty Ltd

Chris Taifalos
Principal Engineer
OSE Group Pty Ltd

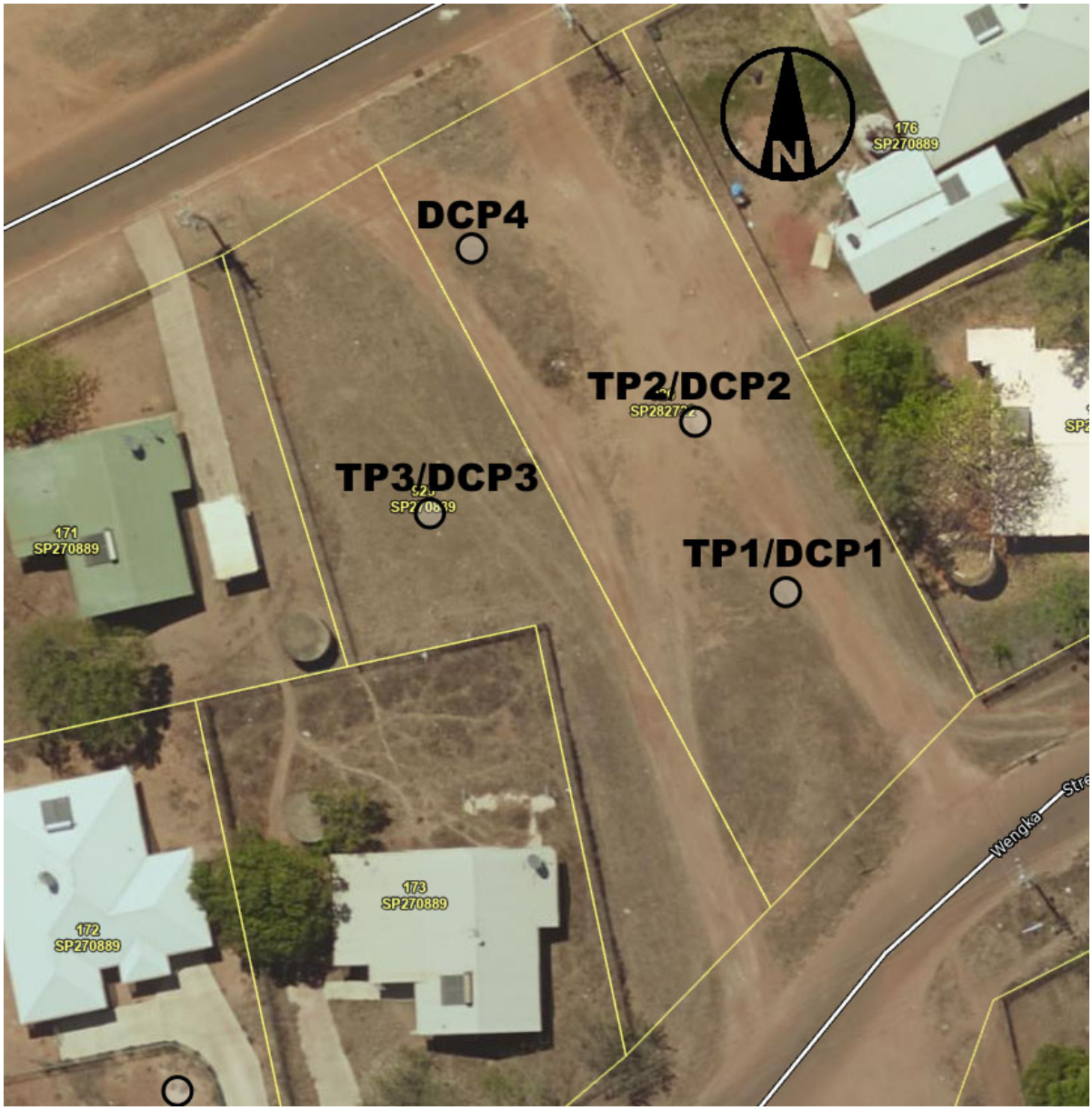
Attachments:

APPENDIX A. TEST PIT/DCP LOGS

APPENDIX B. PHOTOGRAPHS

APPENDIX C. LABORATORY RESULTS

APPENDIX A. TEST PIT/DCP LOGS



LOCATION	EASTING (GDA2020)	NORTHING (GDA2020)
22260_4 TP1/DCP1	306556.80	8156473.67
22260_4 TP2/DCP2	306550.18	8156485.78
22260_4 TP3/DCP3	306531.26	8156478.97
22260_4 DCP4	306534.07	8156497.92

Sheet: 1 of 1

Client:	Mornington Shire Council	Technician:	AH
Project No.:	22260_4	Date:	7/07/2022
Project:	Lot 925/926 SP270889	Location:	See report table

Depth from (m)	Depth to (m)	**DCP1**	**DCP2**	**DCP3**	**DCP4A**	**DCP4B**
0	0.1	6	11	6	11	9
0.1	0.2	20	21	9	24	20
0.2	0.3	20	8	7	30R/90	17
0.3	0.4	11	3	4		10
0.4	0.5	10	4	3		5
0.5	0.6	20	13DB/45	3		6
0.6	0.7	10DB/20		9		6DB/10
0.7	0.8			13		
0.8	0.9			7		
0.9	1			5DB/10		
1	1.1					
1.1	1.2					
1.2	1.3					
1.3	1.4					
1.4	1.5					
1.5	1.6					
1.6	1.7					
1.7	1.8					
1.8	1.9					
1.9	2					
2	2.1					
2.1	2.2					
2.2	2.3					
2.3	2.4					
2.4	2.5					
2.5	2.6					
2.6	2.7					
2.7	2.8					
2.8	2.9					
2.9	3					
3	3.1					
3.1	3.2					
3.2	3.3					
3.3	3.4					

Key:	Notes:
T - Terminated at target depth	
R - Refusal (more than 30 blows/100mm)	
DB - Double bouncing (refusal)	
/ - Depth within interval prior to refusal (mm)	

Test Pit:	TP1	Checked:	CT
Client:	Mornington Shire Council	GW (m):	Not Encountered
Project:	Lot 925/926 SP270889	Job No:	22260_4
Logged by:	AH	Date:	07/07/22
Machine:	Backhoe (450mm)	Location:	E 306556.8, N 8156473.7 (GDA2020)

Depth (m)	Lithology	Description/Comments	Sample	Density	Dynamic Cone Penetration (per 100mm)	Depth (m)
0.00	SM	**Silty SAND,** fine grained, brown, moist, contains rootlets.		D	6	0.00
0.10	ML	**Clayey SILT,** low liquid limit, red-brown, dry.		H	20	0.10
0.20					20	0.20
0.30	CL	**Sandy CLAY,** low plasticity, pale brown, moist.			11	0.30
0.40		...0.4m Contains angular laterite gravel.	0.45m	H	10	0.40
0.50					20	0.50
0.60	CON	**LATERITE,** extremely to highly weathered, red-brown mottled yellow.		VL-L	10DB/20	0.60
0.70		Test pit terminated at 0.65m. Material refusal.				0.70
0.80						0.80
0.90						0.90
1.00						1.00
1.10						1.10
1.20						1.20
1.30						1.30
1.40						1.40
1.50						1.50
1.60						1.60
1.70						1.70
1.80						1.80
1.90						1.90
2.00						2.00
2.10						2.10
2.20						2.20
2.30						2.30
2.40						2.40
2.50						2.50
2.60						2.60
2.70						2.70
2.80						2.80
2.90						2.90
3.00						3.00
3.10						3.10
3.20						3.20
3.30						3.30
3.40						3.40
3.50						3.50

Test Pit:	TP2	Checked:	CT
Client:	Mornington Shire Council	GW (m):	Not Encountered
Project:	Lot 925/926 SP270889	Job No:	22260_4
Logged by:	AH	Date:	07/07/22
Machine:	Backhoe (450mm)	Location:	E 306550.2, N 8156485.8 (GDA2020)

Depth (m)	Lithology	Description/Comments	Sample	Density	Dynamic Cone Penetration (per 100mm)	Depth (m)
0.00 – 0.10	SM	**Silty SAND,** fine grained, red-brown, moist.		VD	11	0.00 – 0.10
0.10 – 0.20					21	0.10 – 0.20
0.20 – 0.30	CL	**Sandy, Gravelly CLAY,** low plasticity, pale brown, moist, trace sand, increasing proportion of angular laterite gravel with depth.			8	0.20 – 0.30
0.30 – 0.40			0.4m	F-St	3	0.30 – 0.40
0.40 – 0.50					4	0.40 – 0.50
0.50 – 0.60	CON	**LATERITE,** extremely to highly weathered, red-brown mottled yellow.		VL-L	13DB/45	0.50 – 0.60
		Test pit terminated at 0.6m. Material refusal.				
0.60 – 3.50						0.60 – 3.50

Test Pit:	TP3	Checked:	CT
Client:	Mornington Shire Council	GW (m):	Not Encountered
Project:	Lot 925/926 SP270889	Job No:	22260_4
Logged by:	AH	Date:	07/07/22
Machine:	Backhoe (450mm)	Location:	E 306531.3, N 8156479.0 (GDA2020)

Depth (m)	Lithology	Description/Comments	Sample	Density	Dynamic Cone Penetration (per 100mm)	Depth (m)
0.00	SM	**Silty SAND,** fine grained, red-brown, moist.		MD	6	0.00
0.10					9	0.10
0.20		**Clayey SAND,** fine grained, red-brown, moist.			7	0.20
0.30					4	0.30
0.40					3	0.40
0.50					3	0.50
0.60	SC		0.6m	MD	9	0.60
0.70		...0.7m Unused PVC pipe encountered, not connected to system.			13	0.70
0.80					7	0.80
0.90					5DB/10	0.90
1.00						1.00
1.10		...1.1m Scraping on rock.				1.10
1.20		Test pit terminated at 1.1m. Material refusal.				1.20
1.30						1.30
1.40						1.40
1.50						1.50
1.60						1.60
1.70						1.70
1.80						1.80
1.90						1.90
2.00						2.00
2.10						2.10
2.20						2.20
2.30						2.30
2.40						2.40
2.50						2.50
2.60						2.60
2.70						2.70
2.80						2.80
2.90						2.90
3.00						3.00
3.10						3.10
3.20						3.20
3.30						3.30
3.40						3.40
3.50						3.50

APPENDIX B. PHOTOGRAPHS

Photo 1 – Lot 925 looking north

Photo 2 – Lot 926 looking north

Photo 3 – TP1

Photo 4 – TP2

Photo 5 – TP3

Photo 6 – PVC pipe extracted from TP3

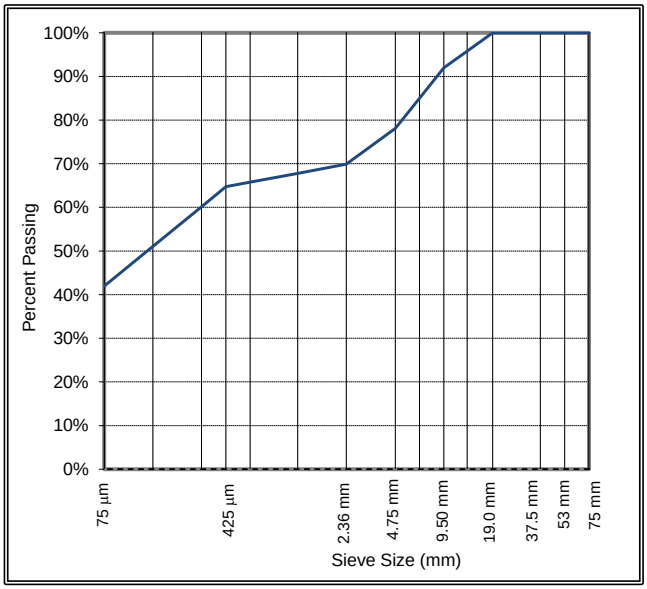
APPENDIX C. LABORATORY RESULTS

HEAD OFFICE – CAIRNS
ETS GEO PTY LTD
ABN: 16 121 817 794
07 4047 8600
07 4047 8699
admin@etsgeo.com.au
PO Box 587
REDLYNCH QLD 4870

23 Knight Street
CAIRNS QLD 4870

Quality of Materials Report

Client:	**OSE Group**	Report Number:	**GT22-305- CS47281 Q**
Client Address:	**36 Abbott St, Cairns QLD 4870**		
Job Number:	**GT22-305**	Report Date:	**22/08/2022**
Project:	**PN: 22260**	Test Request No:	-
Location	**Mornington Shire Council**		
Lab No:	**CS47281**	Sample Location:	
Date Sampled:	**11/08/2022**		**22260_4**
Date Tested:	**22/08/2022**		**TP1**
Sampled By:	**Client**		**0.45m**
Sample Method:	**As Received**		
Material Source:	**As Supplied**	Spec Description:	-
For Use As:	-	Lot Number:	-
Remarks:	**Results apply to samples as received**	Spec Number:	-



Particle Size Distribution

Test Method AS1289.3.6.1

A.S. Sieve Size	Specification Minimum	Result % Passing	Specification Maximum
	Specification -		Result
75mm		**100**	
53mm		**100**	
37.5mm		**100**	
19.0mm		**100**	
9.5mm		**92**	
4.75mm		**78**	
2.36mm		**70**	
0.425mm		**65**	
0.075mm		**42**	

Plasticity Tests Oven Dried - Dry Sieved	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289.3.1.2**		**28**	
Plastic Limit (%)	**AS1289.3.2.1**		**11**	
Plasticity Index	**AS1289.3.3.1**		**17**	
Linear Shrinkage (%)	**AS1289.3.4.1 ***		**7.5**	
P.I. X % Passing 0.425mm (WPI)			**1105**	
L.S. X % Passing 0.425mm			**485**	
Ratio of % Passing (0.075 / 0.425)			**0.65**	

* 250mm linear shrinkage mould used, Shrinkage had cracked.

Emerson Class	Test Method	Water Temperature	Emerson Class No	Water Type Used
	AS1289.3.8.1	**23°C**	**4**	**Distilled**
Soil Description :	**Brown Sandy Silty CLAY**			

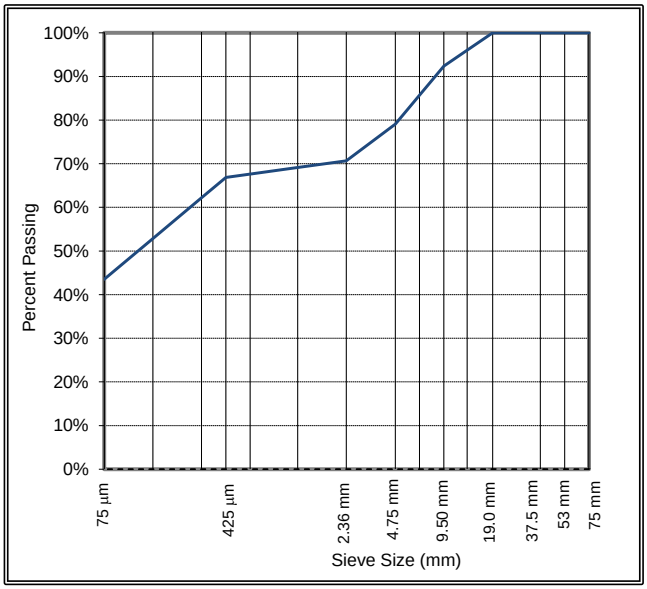
NATA ACCREDITED FOR TECHNICAL COMPETENCE	**Accredited for compliance with ISO/IEC 17025 - Testing**	APPROVED SIGNATORY Jacqui Walmsley - Laboratory Manager **NATA Accreditation No. 20026** **Cairns Laboratory**	FORM NUMBER **FM-RP-120-5**

HEAD OFFICE – CAIRNS
ETS GEO PTY LTD
ABN: 16 121 817 794
07 4047 8600
07 4047 8699
admin@etsgeo.com.au
PO Box 587
REDLYNCH QLD 4870

23 Knight Street
CAIRNS QLD 4870

Quality of Materials Report

Client:	**OSE Group**	Report Number:	**GT22-305- CS47282 Q**
Client Address:	**36 Abbott St, Cairns QLD 4870**		
Job Number:	**GT22-305**	Report Date:	**22/08/2022**
Project:	**PN: 22260**	Test Request No:	-
Location	**Mornington Shire Council**		
Lab No:	**CS47282**	Sample Location:	
Date Sampled:	**11/08/2022**		**22260_4**
Date Tested:	**22/08/2022**		**TP2**
Sampled By:	**Client**		**0.4m**
Sample Method:	**As Received**		
Material Source:	**As Supplied**	Spec Description:	-
For Use As:	-	Lot Number:	-
Remarks:	**Results apply to samples as received**	Spec Number:	-



Particle Size Distribution

Test Method AS1289.3.6.1

A.S. Sieve Size	Specification - Minimum	Result - % Passing	Specification - Maximum
75mm		**100**	
53mm		**100**	
37.5mm		**100**	
19.0mm		**100**	
9.5mm		**92**	
4.75mm		**79**	
2.36mm		**71**	
0.425mm		**67**	
0.075mm		**44**	

Plasticity Tests Oven Dried - Dry Sieved	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289.3.1.2**		**25**	
Plastic Limit (%)	**AS1289.3.2.1**		**11**	
Plasticity Index	**AS1289.3.3.1**		**14**	
Linear Shrinkage (%)	**AS1289.3.4.1 ***		**7**	
P.I. X % Passing 0.425mm (WPI)			**938**	
L.S. X % Passing 0.425mm			**468**	
Ratio of % Passing (0.075 / 0.425)			**0.65**	

* 250mm linear shrinkage mould used, Shrinkage had cracked.

Emerson Class	Test Method	Water Temperature	Emerson Class No	Water Type Used
	AS1289.3.8.1	**23°C**	**4**	**Distilled**
Soil Description :	**Brown Sandy Silty CLAY**			

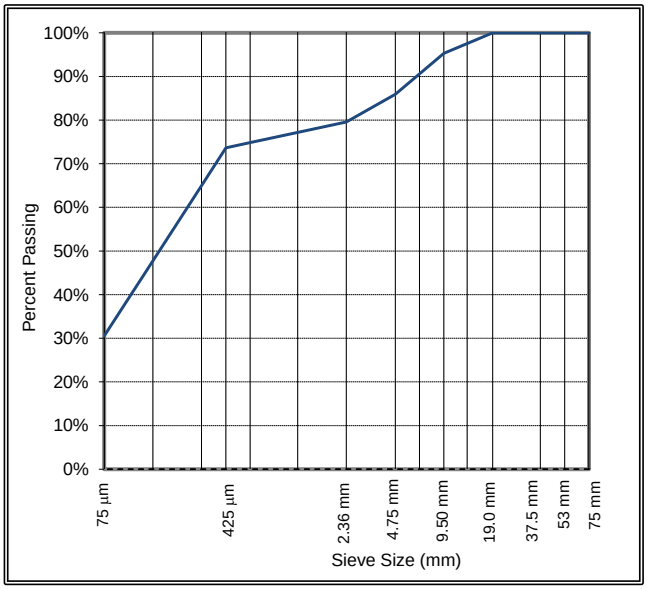
NATA ACCREDITED FOR TECHNICAL COMPETENCE	**Accredited for compliance with ISO/IEC 17025 - Testing**	APPROVED SIGNATORY Jacqui Walmsley - Laboratory Manager **NATA Accreditation No. 20026** **Cairns Laboratory**	FORM NUMBER **FM-RP-120-5**

HEAD OFFICE – CAIRNS
ETS GEO PTY LTD
ABN: 16 121 817 794
☎ 07 4047 8600
07 4047 8699
admin@etsgeo.com.au
PO Box 587
REDLYNCH QLD 4870

23 Knight Street
CAIRNS QLD 4870

Quality of Materials Report

Client:	**OSE Group**	Report Number:	**GT22-305- CS47283 Q**
Client Address:	**36 Abbott St, Cairns QLD 4870**		
Job Number:	**GT22-305**	Report Date:	**22/08/2022**
Project:	**PN: 22260**	Test Request No:	-
Location	**Mornington Shire Council**		
Lab No:	**CS47283**	Sample Location:	
Date Sampled:	**11/08/2022**		**22260_4**
Date Tested:	**22/08/2022**		**TP3**
Sampled By:	**Client**		**0.6m**
Sample Method:	**As Received**		
Material Source:	**As Supplied**	Spec Description:	-
For Use As:	-	Lot Number:	-
Remarks:	**Results apply to samples as received**	Spec Number:	-



Particle Size Distribution

Test Method AS1289.3.6.1

A.S. Sieve Size	Specification - Specification Minimum	Result % Passing	Specification - Specification Maximum
75mm		**100**	
53mm		**100**	
37.5mm		**100**	
19.0mm		**100**	
9.5mm		**95**	
4.75mm		**86**	
2.36mm		**80**	
0.425mm		**74**	
0.075mm		**31**	

Plasticity Tests Oven Dried - Dry Sieved	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289.3.1.2**		**19**	
Plastic Limit (%)	**AS1289.3.2.1**		**11**	
Plasticity Index	**AS1289.3.3.1**		**8**	
Linear Shrinkage (%)	**AS1289.3.4.1 ***		**5**	
P.I. X % Passing 0.425mm (WPI)			**592**	
L.S. X % Passing 0.425mm			**368**	
Ratio of % Passing (0.075 / 0.425)			**0.41**	

* 125mm linear shrinkage mould used, Shrinkage had cracked.

Emerson Class	Test Method	Water Temperature	Emerson Class No	Water Type Used
	AS1289.3.8.1	**23°C**	**4**	**Distilled**
Soil Description : **Brown Sandy SILT**				

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025 - Testing

APPROVED SIGNATORY

Jacqui Walmsley - Laboratory Manager
NATA Accreditation No. 20026
Cairns Laboratory

FORM NUMBER

FM-RP-120-5

30/08/2022 OSE Reference: 22260_5

Mornington Shire Council – Housing and Facilities
1 Mission Road
Gununa QLD 4870

Attention: Geoffrey Rewald

Dear Geoffrey,

Subject: Geotechnical Investigation – 286A Mukakiya St, Gununa, Mornington Island

1. INTRODUCTION

1.1. GENERAL

OSE Group was engaged by Mornington Shire Council to undertake a geotechnical investigation for proposed new construction at 286A Mukakiya Street, Gununa, Mornington Island. It is understood that it is intended to construct a house on the site, however size and style of construction have not been determined at the time of reporting.

The lot does not show any signs of prior construction excluding the driveway and carport and presently acts as the yard for 286 Mukakiya St, with no physical division between the lots. The site is grassed and generally empty, except for three trees up to approximately 2.5m high near the boundary.

The aim of our investigation is to provide a site classification in accordance with AS2870 *Residential Slab and Footings* for foundation design, parameters for bored pier design, comment on suitability of excavated material as fill, evaluation of the influence of groundwater and on other potential geotechnical issues.

1.2. REGIONAL GEOLOGY

Mornington Island is underlain by lateritic geology, described in the 1:250,000 Carpentaria-Karumba Basin map as “Ferruginous laterite, minor silcrete; with sandy 'A' horizon: deep weathered Aurukun surface (younger events).”

Prior experience on the Island indicates that extremely to highly weathered laterite, often with ironstone nodules, is typically encountered within 1.5m of the ground surface.

2. GEOTECHNICAL INVESTIGATION

2.1. METHOD OF INVESTIGATION

The site inspection and field testing was undertaken on 7 July 2022, and comprised the following:

- Verification of underground services in the area where testing was to occur;
- Excavation of one (1) test pit (TP1) within the lot boundary for sampling and logging;
- Undertaking of two (2) Dynamic Cone Penetrometer (DCP) tests, including one adjacent the test pit;
- Collection of one (1) disturbed sample for the purpose of Atterberg Limits testing;
- Collection of one (1) disturbed sample for the purpose of Emerson Class testing;
- Collection of one (1) disturbed sample for the purpose of Particle Size Distribution (PSD) testing.

Test locations are shown in Figure 1.

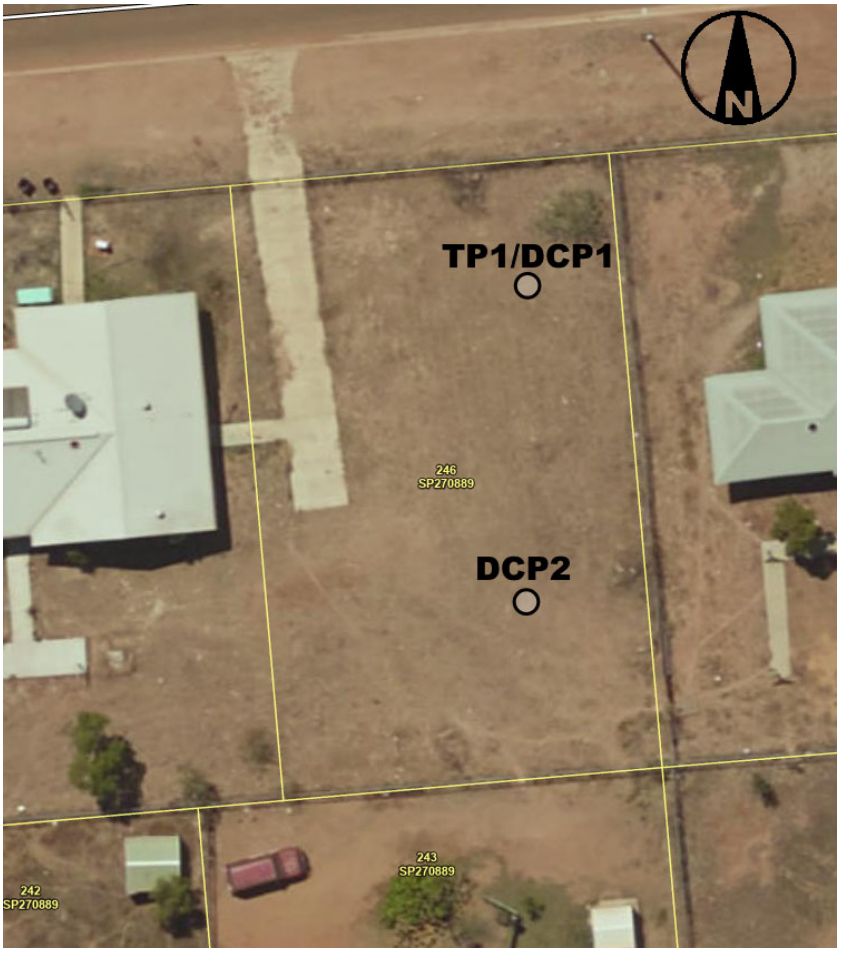


Figure 1 - Test locations

3. INVESTIGATION RESULTS

3.1. ENCOUNTERED SUBSURFACE CONDITIONS

Encountered ground conditions in TP1 were dense Clayey, Silty Sand to a depth of 0.1m, hard Sandy Silt to a depth of 0.3m and extremely to highly weathered laterite below this. Bucket refusal occurred at 0.4m. No groundwater was observed in the test pit.

DCP testing generally indicated Hard soils. DCP refusal was encountered at 0.22-0.34m.

3.2. LABORATORY TESTING

Laboratory results are summarised in Table 1. Complete laboratory results are presented in Appendix C.

Table 1 - Laboratory results

Sample	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Linear Shrinkage	Emerson Class	Gravel Proportion (%)	Sand Proportion (%)	Fines Proportion (%)
TP1 0.2m	16	11	5	1.5	5	26	34	40

4. RECOMMENDED DESIGN CRITERIA

4.1. SHALLOW FOUNDATION DESIGN

4.1.1. BUILDING CONSTRUCTION AT NATURAL GROUND LEVEL

Classification of a site in accordance with AS2870-2011 *Residential Slabs and Footings* strictly applies only to single story residential structures, but can be used to assist in the design and construction of foundations in similarly designed buildings by providing and approximate indication of possible reactive soil movement.

For the purpose of site classification in accordance with AS2870-2011 *Residential Slabs and Footings*, the site may be considered **Class S** due to the coarse and low plasticity soils overlying laterite and high DCP values observed. This classification assumes the proposed structure does not overlap the existing tree root system, in which case the site must be considered **Class P.** In this case, care must be taken to ensure that soil around the trees at the boundary is removed, replaced with suitable material and properly compacted to achieve **Class S**.

It is considered that, while preliminary designs show an alternative foundation system, high level footing systems such as strip/pad footings are suitable for the building provided the above advice is followed. Strip/pad footings and beams for slab on ground footings founded below the existing surface are effectively able to be designed using an allowable bearing pressure of 150 kPa (based on the DCP results). This bearing pressure has been calculated adopting a geotechnical strength reaction factor of 0.4 for limit state design as previously indicated. At an allowable bearing pressure of 150 kPa or less, total differential settlements within the structures are anticipated to be within 20mm. This assessment is based on the removal of any buried construction rubbish from the uncontrolled fill, and compaction as outlined above.

The presence of near-surface laterite indicates that ripping may be required. Additionally, the designer must consider the high stiffness.

4.1.2. BUILDING CONSTRUCTION ON IMPORTED FILL

Filling to above the existing ground level may be considered if shallow foundations are used, or may be required where significant volume of tree roots or rubbish must be removed. Where poor ground is present, removal and replacement with engineered fill shall be in accordance with Clause 6.2.2 of AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

Where fill is to be placed, all topsoil, loose material, organic material and uncontrolled fill is to be removed from the site prior to importing of any engineered material. Based on the long term loadings anticipated to be present within the proposed buildings, settlement predictions based on the depth of fill may need to be undertaken following receipt of final design levels if the foundations are not keyed into natural ground. Alternatively, building articulation can be integrated into the building's structural design that will allow the building to accommodate such movements.

Notwithstanding, the following will need to be considered in the final design.

- Final fill levels relative to finished floor area;
- Receipt of live loads;
- Building dead loads;
- Fill type and compaction method adopted by contractor.

4.2. BORED PIER FOUNDATION DESIGN

It is unknown whether bored piers are being considered for the proposed construction. Should a combination of bored pier/screw pile and shallow foundations be considered, a method of articulation may be required to account for differential settlement.

Uncased bored piers can usually be constructed in stiff to hard clays using an excavator-mounted boring attachment or a track-mounted short flight hydraulic rotary rig can be used. Excavated trenches suggest cave-in and/or collapse is unlikely.

The design of bored pier foundations, with a founding depth of greater than four pier diameters should be based on the preliminary parameters shown in Table 1 below. It is noted that the parameters are based on the observed geotechnical conditions within the conducted test pits and can be refined during construction by a suitably qualified Geotechnical Engineer or Engineering Geologist. Table 1 results are based on the findings of DCP1/TP1.

Table 2 - Design parameters based on Worst Case findings

DEPTH RANGE (m)	ULTIMATE STRENGTH		BULK UNIT WEIGHT (kN/m^3)
	END BEARING PRESSURE (kPa)	SHAFT ADHESION (kPa)	
0 – 0.4	400	0	20
Laterite/Rock	800	45	22

A geotechnical reduction factor (Φ_g) of 0.4 should be applied to the above values of end bearing and shaft adhesion to obtain the design geotechnical strength (R_{ug}) for limit state design of piles, or a factor of safety of 2.5 applied for working stress design.

The parameters given above are reliant on clean rough sockets which are free of loose debris on the base of the hole and smear on the sides of the hole. Debris from the prior construction should also be removed. Excavations should be poured immediately after drilling, prior to any groundwater accumulation and

softening of the excavated socket. The shaft adhesion developed over the upper 0.7m should be ignored in pile capacity calculations due to seasonal soil cracking.

4.3. SCREW PILE FOUNDATION DESIGN

Screw pile design is typically undertaken by the piling contractor, as pile geometry and design methodology may differ between manufacturers. It is recommended that the installation of steel screw piles be undertaken only by experienced contractors, and that load testing is undertaken shortly following installation. It is noted that screw piles are generally unable to penetrate rock and would therefore rely entirely on the bearing capacity at the top of the laterite layer, with minimal lateral resistance.

It is noted that, in order to achieve sufficient lateral restraint, penetration into the presumed underlying laterite layer will likely be required. In the event that screw piles are considered, constructability will need to be considered including the ability of the selected installation plant to penetrate the laterite layer with the screw pile.

Based on the identified conditions and anticipated founding depths, skin friction is to be ignored in the design of screw piles. Where the helix outstand to plate thickness ratio exceeds 10, the possibility of formation of a plastic hinge must be considered, which would reduce the effective diameter of the helix.

4.4. NOTES

RESPONSIBILITIES (A.S. 2870 Supp 1). Footing design and construction involves a number of steps; site classification, selection of the footing system, structural design, construction in accordance with the required design details and construction methods, and proper maintenance. In addition to the builder, this process may involve an engineer, the Building Authority, the owner, and all parties who share responsibilities for any failure. In particular, the owner has a responsibility to ensure the site is properly maintained.

Note: Because the investigation is limited in scope and extent, it is possible that areas may exist which differ from those shown in the test records and used in the site classification. Should any variation from the reported conditions be encountered during excavation work, a Building Services Authority Registered Site Classifier or a Registered Practicing Engineer must be notified immediately so that reappraisal of the classification can be made. Attention is drawn to the present or any future owners of their responsibilities for foundation maintenance as detailed in A.S. 2870 and CSIRO Brochure “Foundation Maintenance and Footing Performance: A Homeowner’s Guide.”

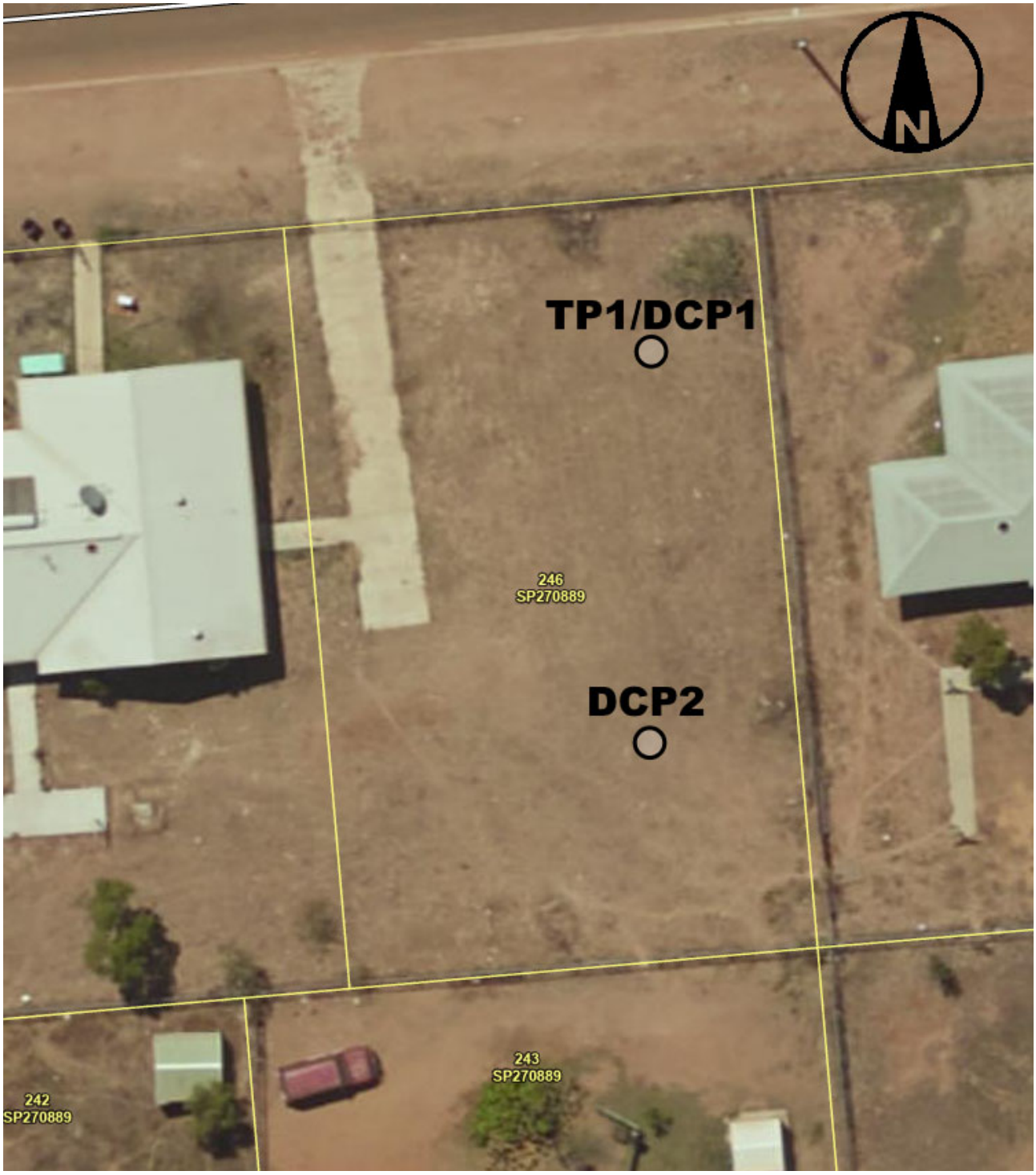
Yours Sincerely,

Adam Huey
Geotechnical Engineer
OSE Group Pty Ltd

Chris Taifalos
Principal Engineer
OSE Group Pty Ltd

Attachments:

APPENDIX A. TEST PIT/DCP LOGS



LOCATION	EASTING (GDA2020)	NORTHING (GDA2020)
22260_5 TP1/DCP1	306612.91	8156792.27
22260_5 DCP2	306612.85	8156810.20

OSE GROUP

Sheet: 1 of 1

Client:	Mornington Shire Council	Technician:	AH
Project No.:	22260_5	Date:	7/07/2022
Project:	286A Mukakiya St	Location:	See report table

Depth from (m)	Depth to (m)	**DCP1**	**DCP2**			
0	0.1	6	15			
0.1	0.2	20	17			
0.2	0.3	27	5DB/2			
0.3	0.4	60DB/40				
0.4	0.5					
0.5	0.6					
0.6	0.7					
0.7	0.8					
0.8	0.9					
0.9	1					
1	1.1					
1.1	1.2					
1.2	1.3					
1.3	1.4					
1.4	1.5					
1.5	1.6					
1.6	1.7					
1.7	1.8					
1.8	1.9					
1.9	2					
2	2.1					
2.1	2.2					
2.2	2.3					
2.3	2.4					
2.4	2.5					
2.5	2.6					
2.6	2.7					
2.7	2.8					
2.8	2.9					
2.9	3					
3	3.1					
3.1	3.2					
3.2	3.3					
3.3	3.4					

Key:	Notes:
T - Terminated at target depth	
R - Refusal (more than 30 blows/100mm)	
DB - Double bouncing (refusal)	
/ - Depth within interval prior to refusal (mm)	

Test Pit:	TP1	Checked:	CT
Client:	Mornington Shire Council	GW (m):	Not Encountered
Project:	286A Mukakiya St	Job No:	22260_5
Logged by:	AH	Date:	07/07/22
Machine:	Backhoe (450mm)	Location:	E 306759.0, N 8156820.5 (GDA2020)

Depth (m)	Lithology	Description/Comments	Sample	Density	Dynamic Cone Penetration (per 100mm)	Depth (m)
0.00	SM	**Clayey, Silty SAND,** fine grained, dark brown, moist, rootlets.		VD	6	0.00
0.10	ML	**Sandy SILT,** low liquid limit, pale brown, dry, fine grained sand component.	0.2m	H	20	0.10
0.20					27	0.20
0.30	CON	**LATERITE,** extremely to highly weathered, red mottled yellow.		VL-L	60DB/40	0.30
0.40		Test pit terminated at 0.4m. Material refusal.				0.40
0.50						0.50
0.60						0.60
0.70						0.70
0.80						0.80
0.90						0.90
1.00						1.00
1.10						1.10
1.20						1.20
1.30						1.30
1.40						1.40
1.50						1.50
1.60						1.60
1.70						1.70
1.80						1.80
1.90						1.90
2.00						2.00
2.10						2.10
2.20						2.20
2.30						2.30
2.40						2.40
2.50						2.50
2.60						2.60
2.70						2.70
2.80						2.80
2.90						2.90
3.00						3.00
3.10						3.10
3.20						3.20
3.30						3.30
3.40						3.40
3.50						3.50

APPENDIX B. PHOTOGRAPHS

Photo 1 – Site viewed from Mukakiya St

Photo 2 – TP1

Photo 3 – Sandy Silt clump

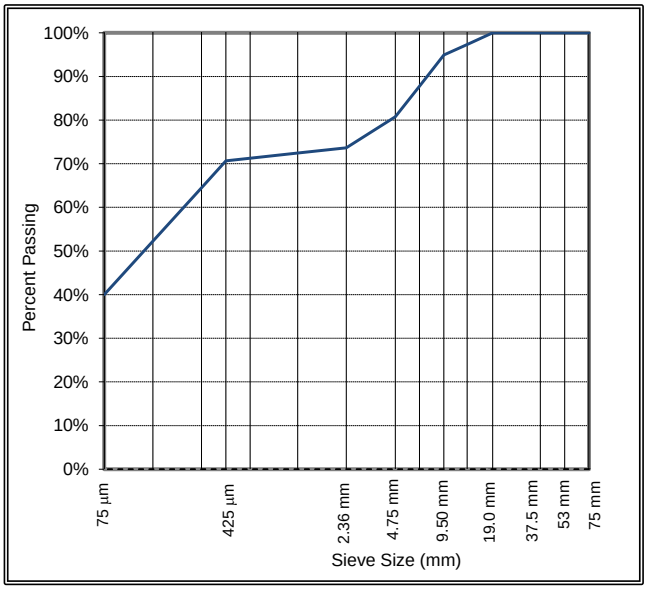
APPENDIX C. LABORATORY RESULTS

HEAD OFFICE – CAIRNS
ETS GEO PTY LTD
ABN: 16 121 817 794
07 4047 8600
07 4047 8699
admin@etsgeo.com.au
PO Box 587
REDLYNCH QLD 4870

23 Knight Street
CAIRNS QLD 4870

Quality of Materials Report

Client:	**OSE Group**	Report Number:	**GT22-305- CS47284 Q**
Client Address:	**36 Abbott St, Cairns QLD 4870**		
Job Number:	**GT22-305**	Report Date:	**22/08/2022**
Project:	**PN: 22260**	Test Request No:	-
Location	**Mornington Shire Council**		
Lab No:	**CS47284**	Sample Location:	
Date Sampled:	**11/08/2022**		**22260_5**
Date Tested:	**22/08/2022**		**TP1**
Sampled By:	**Client**		**0.2m**
Sample Method:	**As Received**		
Material Source:	**As Supplied**	Spec Description:	-
For Use As:	-	Lot Number:	-
Remarks:	**Results apply to samples as received**	Spec Number:	-



Particle Size Distribution

Test Method AS1289.3.6.1

A.S.	Specification		Result
	-		
Sieve Size	Specification Minimum	Result % Passing	Specification Maximum
75mm		**100**	
53mm		**100**	
37.5mm		**100**	
19.0mm		**100**	
9.5mm		**95**	
4.75mm		**81**	
2.36mm		**74**	
0.425mm		**71**	
0.075mm		**40**	

Plasticity Tests Oven Dried - Dry Sieved	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289.3.1.2**		**16**	
Plastic Limit (%)	**AS1289.3.2.1**		**11**	
Plasticity Index	**AS1289.3.3.1**		**5**	
Linear Shrinkage (%)	**AS1289.3.4.1 ***		**1.5**	
P.I. X % Passing 0.425mm (WPI)			**355**	
L.S. X % Passing 0.425mm			**106**	
Ratio of % Passing (0.075 / 0.425)			**0.57**	

* 250mm linear shrinkage mould used, Shrinkage had cracked.

Emerson Class	Test Method	Water Temperature	Emerson Class No	Water Type Used
	AS1289.3.8.1	**23°C**	**5**	**Distilled**
Soil Description :	**Brown Silty SAND**			

NATA ACCREDITED FOR TECHNICAL COMPETENCE	**Accredited for compliance with ISO/IEC 17025 - Testing**	APPROVED SIGNATORY Jacqui Walmsley - Laboratory Manager **NATA Accreditation No. 20026** **Cairns Laboratory**	FORM NUMBER **FM-RP-120-5**

30/08/2022 OSE Reference: 22260_6

Mornington Shire Council – Housing and Facilities
1 Mission Road
Gununa QLD 4870

Attention: Geoffrey Rewald

Dear Geoffrey,

Subject: Geotechnical Investigation – 323A Mukakiya St, Gununa, Mornington Island

1. INTRODUCTION

1.1. GENERAL

OSE Group was engaged by Mornington Shire Council to undertake a geotechnical investigation for proposed new construction at 323A Mukakiya Street, Gununa, Mornington Island. It is understood that it is intended to construct a house on the site, however size and style of construction have not been determined at the time of reporting.

The lot does not show any signs of prior construction excluding the driveway and carport and presently acts as the yard for 323 Mukakiya Street, with no physical division between the lots. The site is grassed and generally empty, except for four trees up to approximately 2.5m high near the boundary.

The aim of our investigation is to provide a site classification in accordance with AS2870 *Residential Slab and Footings* for foundation design, parameters for bored pier design, comment on suitability of excavated material as fill, evaluation of the influence of groundwater and on other potential geotechnical issues.

1.2. REGIONAL GEOLOGY

Mornington Island is underlain by lateritic geology, described in the 1:250,000 Carpentaria-Karumba Basin map as “Ferruginous laterite, minor silcrete; with sandy 'A' horizon: deep weathered Aurukun surface (younger events).”

Prior experience on the Island indicates that extremely to highly weathered laterite, often with ironstone nodules, is typically encountered within 1.5m of the ground surface.

2. GEOTECHNICAL INVESTIGATION

2.1. METHOD OF INVESTIGATION

The site inspection and field testing was undertaken on 7 July 2022, and comprised the following:

- Verification of underground services in the area where testing was to occur;
- Excavation of one (1) test pit (TP1) within the lot boundary for sampling and logging;
- Undertaking of two (2) Dynamic Cone Penetrometer (DCP) tests, including one adjacent the test pit;
- Collection of one (1) disturbed sample for the purpose of Atterberg Limits testing;
- Collection of one (1) disturbed sample for the purpose of Emerson Class testing;
- Collection of one (1) disturbed sample for the purpose of Particle Size Distribution (PSD) testing.

Test locations are shown in Figure 1.

Figure 1 - Test locations

3. INVESTIGATION RESULTS

3.1. ENCOUNTERED SUBSURFACE CONDITIONS

Encountered ground conditions in TP1 were very dense Silty Sand to a depth of 0.1m, very dense Silty, Sandy Gravel to a depth of 0.33m and extremely to highly weathered laterite below this. Bucket refusal occurred at 0.4m. No groundwater was observed in the test pit.

DCP testing generally indicated Hard soils. DCP refusal was encountered at 0.24-0.30m.

3.2. LABORATORY TESTING

Laboratory results are summarised in Table 1. Complete laboratory results are presented in Appendix C.

Table 1 - Laboratory results

Sample	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Linear Shrinkage	Emerson Class	Gravel Proportion (%)	Sand Proportion (%)	Fines Proportion (%)
TP1 0.2m	16	12	4	2.5	5	41	34	25

4. RECOMMENDED DESIGN CRITERIA

4.1. SHALLOW FOUNDATION DESIGN

4.1.1. BUILDING CONSTRUCTION AT NATURAL GROUND LEVEL

Classification of a site in accordance with AS2870-2011 *Residential Slabs and Footings* strictly applies only to single story residential structures, but can be used to assist in the design and construction of foundations in similarly designed buildings by providing and approximate indication of possible reactive soil movement.

For the purpose of site classification in accordance with AS2870-2011 *Residential Slabs and Footings*, the site may be considered **Class S** due to the coarse and low plasticity soils overlying laterite and high DCP values observed. This classification assumes the proposed structure does not overlap the existing tree root system, in which case the site must be considered **Class P.** In this case, care must be taken to ensure that soil around the trees at the boundary is removed, replaced with suitable material and properly compacted to achieve **Class S**.

It is considered that, while preliminary designs show an alternative foundation system, high level footing systems such as strip/pad footings are suitable for the building provided the above advice is followed. Strip/pad footings and beams for slab on ground footings founded below the existing surface are effectively able to be designed using an allowable bearing pressure of 150 kPa (based on the DCP results). This bearing pressure has been calculated adopting a geotechnical strength reaction factor of 0.4 for limit state design as previously indicated. At an allowable bearing pressure of 150 kPa or less, total differential settlements within the structures are anticipated to be within 20mm. This assessment is based on the removal of any buried construction rubbish from the uncontrolled fill, and compaction as outlined above.

The presence of near-surface laterite indicates that ripping may be required. Additionally, the designer must consider the high stiffness.

4.1.2. BUILDING CONSTRUCTION ON IMPORTED FILL

Filling to above the existing ground level may be considered if shallow foundations are used, or may be required where significant volume of tree roots or rubbish must be removed. Where poor ground is present, removal and replacement with engineered fill shall be in accordance with Clause 6.2.2 of AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

Where fill is to be placed, all topsoil, loose material, organic material and uncontrolled fill is to be removed from the site prior to importing of any engineered material. Based on the long term loadings anticipated to be present within the proposed buildings, settlement predictions based on the depth of fill may need to be undertaken following receipt of final design levels if the foundations are not keyed into natural ground. Alternatively, building articulation can be integrated into the building's structural design that will allow the building to accommodate such movements.

Notwithstanding, the following will need to be considered in the final design.

- Final fill levels relative to finished floor area;
- Receipt of live loads;
- Building dead loads;
- Fill type and compaction method adopted by contractor.

4.2. BORED PIER FOUNDATION DESIGN

It is unknown whether bored piers are being considered for the proposed construction. Should a combination of bored pier/screw pile and shallow foundations be considered, a method of articulation may be required to account for differential settlement.

Uncased bored piers can usually be constructed in stiff to hard clays using an excavator-mounted boring attachment or a track-mounted short flight hydraulic rotary rig can be used. Excavated trenches suggest cave-in and/or collapse is unlikely.

The design of bored pier foundations, with a founding depth of greater than four pier diameters should be based on the preliminary parameters shown in Table 1 below. It is noted that the parameters are based on the observed geotechnical conditions within the conducted test pits and can be refined during construction by a suitably qualified Geotechnical Engineer or Engineering Geologist. Table 1 results are based on the findings of DCP1/TP1.

Table 2 - Design parameters based on Worst Case findings

DEPTH RANGE (m)	ULTIMATE STRENGTH		BULK UNIT WEIGHT (kN/m^3)
	END BEARING PRESSURE (kPa)	SHAFT ADHESION (kPa)	
0 – 0.4	400	0	20
Laterite/Rock	800	45	22

A geotechnical reduction factor (Φ_g) of 0.4 should be applied to the above values of end bearing and shaft adhesion to obtain the design geotechnical strength (R_{ug}) for limit state design of piles, or a factor of safety of 2.5 applied for working stress design.

The parameters given above are reliant on clean rough sockets which are free of loose debris on the base of the hole and smear on the sides of the hole. Debris from the prior construction should also be removed. Excavations should be poured immediately after drilling, prior to any groundwater accumulation and

softening of the excavated socket. The shaft adhesion developed over the upper 0.7m should be ignored in pile capacity calculations due to seasonal soil cracking.

4.3. SCREW PILE FOUNDATION DESIGN

Screw pile design is typically undertaken by the piling contractor, as pile geometry and design methodology may differ between manufacturers. It is recommended that the installation of steel screw piles be undertaken only by experienced contractors, and that load testing is undertaken shortly following installation. It is noted that screw piles are generally unable to penetrate rock and would therefore rely entirely on the bearing capacity at the top of the laterite layer, with minimal lateral resistance.

It is noted that, in order to achieve sufficient lateral restraint, penetration into the presumed underlying laterite layer will likely be required. In the event that screw piles are considered, constructability will need to be considered including the ability of the selected installation plant to penetrate the laterite layer with the screw pile.

Based on the identified conditions and anticipated founding depths, skin friction is to be ignored in the design of screw piles. Where the helix outstand to plate thickness ratio exceeds 10, the possibility of formation of a plastic hinge must be considered, which would reduce the effective diameter of the helix.

4.4. NOTES

RESPONSIBILITIES (A.S. 2870 Supp 1). Footing design and construction involves a number of steps; site classification, selection of the footing system, structural design, construction in accordance with the required design details and construction methods, and proper maintenance. In addition to the builder, this process may involve an engineer, the Building Authority, the owner, and all parties who share responsibilities for any failure. In particular, the owner has a responsibility to ensure the site is properly maintained.

Note: Because the investigation is limited in scope and extent, it is possible that areas may exist which differ from those shown in the test records and used in the site classification. Should any variation from the reported conditions be encountered during excavation work, a Building Services Authority Registered Site Classifier or a Registered Practicing Engineer must be notified immediately so that reappraisal of the classification can be made. Attention is drawn to the present or any future owners of their responsibilities for foundation maintenance as detailed in A.S. 2870 and CSIRO Brochure “Foundation Maintenance and Footing Performance: A Homeowner’s Guide.”

Yours Sincerely,

Adam Huey
Geotechnical Engineer
OSE Group Pty Ltd

Chris Taifalos
Principal Engineer
OSE Group Pty Ltd

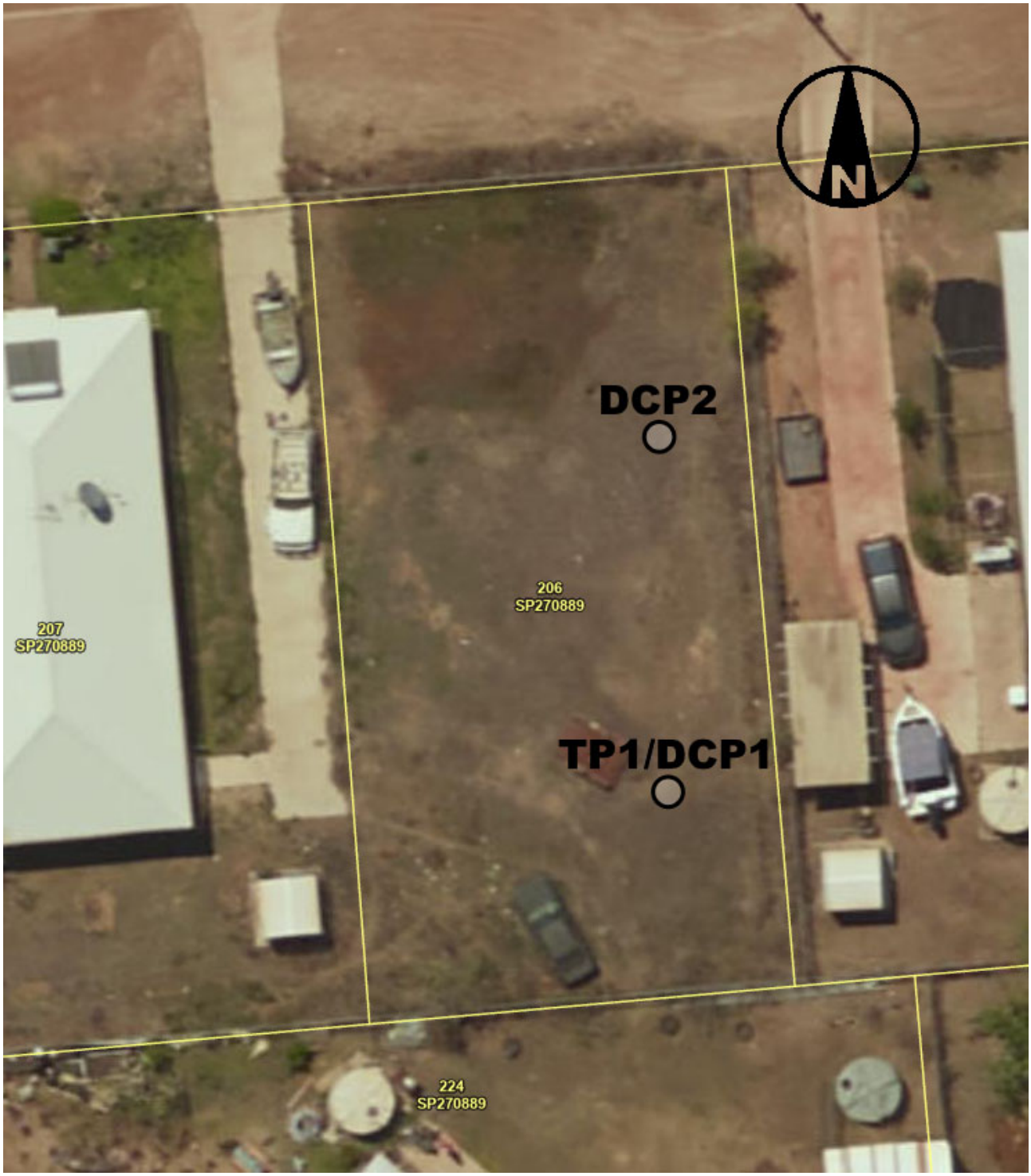
Attachments:

APPENDIX A. TEST PIT/DCP LOGS

APPENDIX B. PHOTOGRAPHS

APPENDIX C. LABORATORY RESULTS

APPENDIX A. TEST PIT/DCP LOGS



LOCATION	EASTING (GDA2020)	NORTHING (GDA2020)
22260_6 TP1/DCP1	306759.02	8156820.49
22260_6 DCP2	306759.58	8156806.21

OSE GROUP

Sheet: 1 of 1

Client:	Mornington Shire Council	Technician:	AH
Project No.:	22260_6	Date:	7/07/2022
Project:	323A Mukakiya St	Location:	See report table

Depth from (m)	Depth to (m)	**DCP1**	**DCP2**			
0	0.1	14	9			
0.1	0.2	15	8			
0.2	0.3	12DB/40	11			
0.3	0.4		3DB/0			
0.4	0.5					
0.5	0.6					
0.6	0.7					
0.7	0.8					
0.8	0.9					
0.9	1					
1	1.1					
1.1	1.2					
1.2	1.3					
1.3	1.4					
1.4	1.5					
1.5	1.6					
1.6	1.7					
1.7	1.8					
1.8	1.9					
1.9	2					
2	2.1					
2.1	2.2					
2.2	2.3					
2.3	2.4					
2.4	2.5					
2.5	2.6					
2.6	2.7					
2.7	2.8					
2.8	2.9					
2.9	3					
3	3.1					
3.1	3.2					
3.2	3.3					
3.3	3.4					

Key:	Notes:
T - Terminated at target depth	
R - Refusal (more than 30 blows/100mm)	
DB - Double bouncing (refusal)	
/ - Depth within interval prior to refusal (mm)	

Test Pit:	TP1	Checked:	CT
Client:	Mornington Shire Council	GW (m):	Not Encountered
Project:	323A Mukakiya St	Job No:	22260_5
Logged by:	AH	Date:	07/07/22
Machine:	Backhoe (450mm)	Location:	E 306759.0, N 8156820.5 (GDA2020)

Depth (m)	Lithology	Description/Comments	Sample	Density	Dynamic Cone Penetration (per 100mm)	Depth (m)
0.00	SM	**Silty SAND,** fine grained, brown, moist, rootlets.		VD	14	0.00
0.10	GM	**Silty, Sandy GRAVEL,** medium grained, angular, pale brown.			15	0.10
0.20			0.2m	VD	12DB/40	0.20
0.30	CON	**LATERITE,** extremely to highly weathered, red-brown mottled yellow, prominent ironstone nodules.		VL-L		0.30
0.40		Test pit terminated at 0.4m. Material refusal.				0.40
0.50						0.50
0.60						0.60
0.70						0.70
0.80						0.80
0.90						0.90
1.00						1.00
1.10						1.10
1.20						1.20
1.30						1.30
1.40						1.40
1.50						1.50
1.60						1.60
1.70						1.70
1.80						1.80
1.90						1.90
2.00						2.00
2.10						2.10
2.20						2.20
2.30						2.30
2.40						2.40
2.50						2.50
2.60						2.60
2.70						2.70
2.80						2.80
2.90						2.90
3.00						3.00
3.10						3.10
3.20						3.20
3.30						3.30
3.40						3.40
3.50						3.50

APPENDIX B. PHOTOGRAPHS

Photo 1 – Site viewed from Mukakiya St

Photo 2 – TP1

Photo 3 – Laterite extracted as cobble

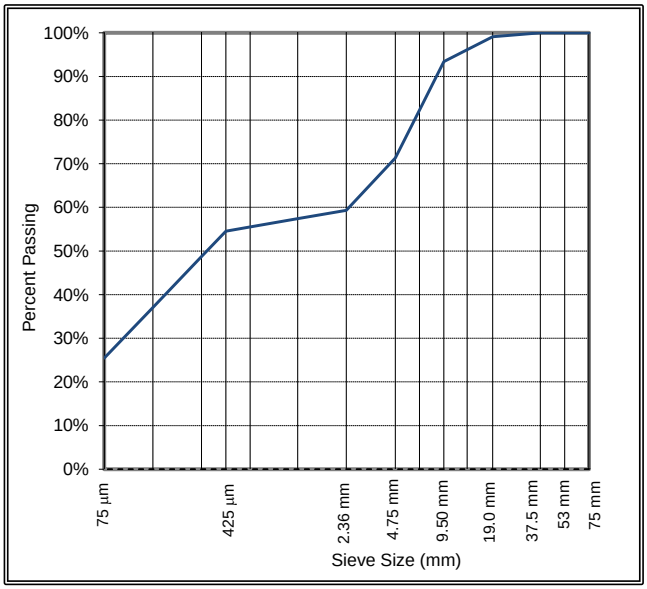
APPENDIX C. LABORATORY RESULTS

HEAD OFFICE – CAIRNS
ETS GEO PTY LTD
ABN: 16 121 817 794
07 4047 8600
07 4047 8699
admin@etsgeo.com.au
PO Box 587
REDLYNCH QLD 4870

23 Knight Street
CAIRNS QLD 4870

Quality of Materials Report

Client:	**OSE Group**	Report Number:	**GT22-305- CS47285 Q**
Client Address:	**36 Abbott St, Cairns QLD 4870**		
Job Number:	**GT22-305**	Report Date:	**22/08/2022**
Project:	**PN: 22260**	Test Request No:	-
Location	**Mornington Shire Council**		
Lab No:	**CS47285**	Sample Location:	
Date Sampled:	**11/08/2022**		**22260_6**
Date Tested:	**22/08/2022**		**TP1**
Sampled By:	**Client**		**0.2m**
Sample Method:	**As Received**		
Material Source:	**As Supplied**	Spec Description:	-
For Use As:	-	Lot Number:	-
Remarks:	**Results apply to samples as received**	Spec Number:	-



Particle Size Distribution

Test Method AS1289.3.6.1

A.S.	Specification		Result
	-		
Sieve Size	Specification Minimum	Result % Passing	Specification Maximum
75mm		**100**	
53mm		**100**	
37.5mm		**100**	
19.0mm		**99**	
9.5mm		**93**	
4.75mm		**71**	
2.36mm		**59**	
0.425mm		**55**	
0.075mm		**25**	

Plasticity Tests Oven Dried - Dry Sieved	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289.3.1.2**		**16**	
Plastic Limit (%)	**AS1289.3.2.1**		**12**	
Plasticity Index	**AS1289.3.3.1**		**4**	
Linear Shrinkage (%)	**AS1289.3.4.1 ***		**2.5**	
P.I. X % Passing 0.425mm (WPI)			**220**	
L.S. X % Passing 0.425mm			**136**	
Ratio of % Passing (0.075 / 0.425)			**0.47**	

* 250mm linear shrinkage mould used, Shrinkage had cracked.

Emerson Class	Test Method	Water Temperature	Emerson Class No	Water Type Used
	AS1289.3.8.1	**23°C**	**5**	**Distilled**
Soil Description :	**Brown Sandy SILT**			

NATA ACCREDITED FOR TECHNICAL COMPETENCE	**Accredited for compliance with ISO/IEC 17025 - Testing**	APPROVED SIGNATORY Jacqui Walmsley - Laboratory Manager **NATA Accreditation No. 20026** **Cairns Laboratory**	FORM NUMBER **FM-RP-120-5**

Map 1 - The Site Rev 01