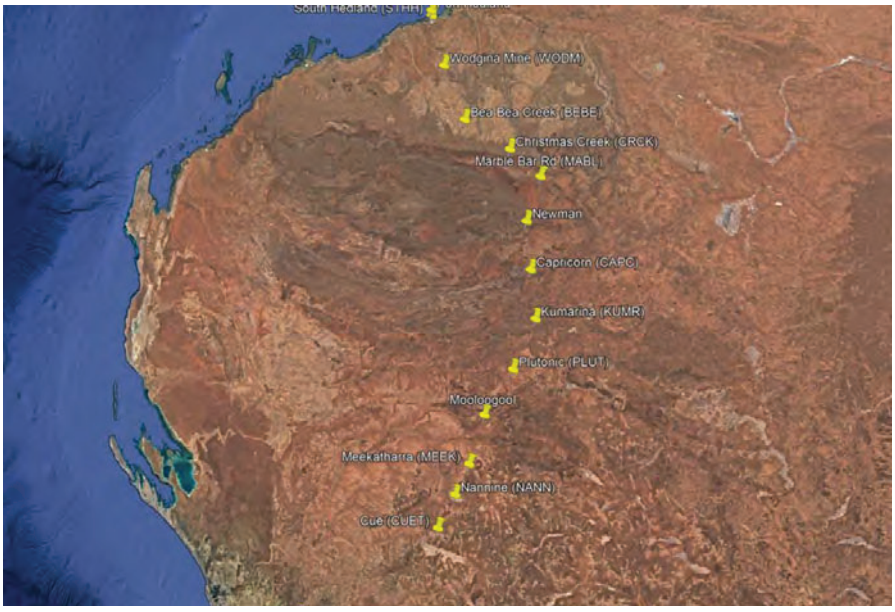
STATS Australia
Specialist Testing and Technical Services

PROPOSED TELCO PROJECTS IN THE PILBARA – GROUP 2 (MOOLOOGOOL)



Geotechnical Investigation Work

Prepared for:

VERTIV

Perth Add
Unit 1/16 Production Road, Canning Vale, WA 6155
T: 08 9455 3654
F: 08 9455 3709

Karratha Add
1938 Pyramid Rd Karratha, WA 6714
T: 08 9144 4637
F: 08 9144 2665

www.statsaustralia.com.au

STATS Australia

Perth
Unit 1/16 Production Road, Canning Vale, WA 6155
Karratha
1938 Pyramid Road, Karratha, WA 6714
Singapore
71 Toh Guan Rd East, #02-01/02/06 Techcentre, SG 602598
www.statsaustralia.com.au ABN 43 155 668 269

Document History and Status

Title:	Proposed Telco Projects in the Pilbara – Group 2 (Mooloogool)
Job Number:	102717
Issue Date:	06 Jun 2023
Internal File ID:	Stats WA\Company - Documents\1. Clients - Projects\Vertiv\102717(Quo6261)_ GI@Proposed Telco Projects(Group2)\6. Report\Mooloogool
Revision:	0
Status:	Final
Issued to:	VERTIV
Author:	YZ
Reviewer:	AS
Approval:	AS

Distribution List for this Report	Hard Copy	Soft Copy
VERTIV	Nil	1 pdf, Email
STATS	Nil	1 pdf, Server

IMPORTANT NOTE

Please refer to STATS "Notes about Your Report"

Table of Contents

Figures

Appendices

Photographic Survey

EXECUTIVE SUMMARY

Specialist Testing and Technical Services (STATS) was engaged by Mr. Nick Oresti on behalf of VERTIV (the Client), to conduct a Geotechnical Investigation Work for fourteen (x14) Proposed Telco Project sites from Port Hedland to Newman, Western Australia. This report covers Group 2 – Mooloogool, the site location and tests carried out are presented in Figures 1.

A total of five (x5) test pits to the depth of 2.5m or refusal, five (x5) DCP tests to the depth of 1.05m and one (x1) array of electrical resistivity test (x-x and y-y direction) were completed.

The site investigation work for Mooloogool site was carried out on 16th May 2023.

Findings

A summary of the sites corresponding to the type of tests annotation is presented below:

Test Pit Logs

The site soil profiles encountered across all test pits are similar, which comprises of a Clay - Sand Mixtures (Sandy CLAY): fine to medium grained, brown/grey/white, moist, stiff to hard, trace of fine to medium grained gravels.

All test pits terminated at the target depth of 2.5m.

Dynamic Cone Penetrometer

Based on the Soils Testing Handbook of Australian Standard, Table 6.4.6.1 (A), the density of the soils for the fine grained materials (Sandy CLAY) over the proposed development area was generally "**very stiff**" with an average of 10 blows per 100mm of penetration. In accordance with the Soils Testing Handbook of Australian Standard, Table 6.4.6.1(C) (Correlation of DCP Blow Counts to CBR), an average Field CBR value of over 22% was obtained.

Soil Electrical Resistivity Tests

Two measurement lines with a diagonal array pattern were conducted. It consists of the x-x direction, Southwest to Northeast and the y-y direction, Northwest to Southeast.

For the x-x direction, Southwest to Northeast:

- The soil electrical resistivities of the subsurface soil/rock have fluctuated between 16.34 Ωm to 1.01 Ωm when the probe spacing increased from 0.5m to 20.0m gradually.

For the y-y direction, Northwest to Southeast:

- The soil electrical resistivities of the subsurface soil/rock have fluctuated between 14.07 Ωm to 1.01 Ωm when the probe spacing increased from 0.5 to 20.0m gradually.

Geotech Site Classification

The site is currently assigned a Site Classification of "**M**" in accordance with the definitions provided in the Australian Standard AS2870 -2011, on the assumption that the house pad shall be prepared and compacted to the specified requirements under Section 7 of the report. For Site Classification S, the characteristic surface movement (Ys Value) for the site was assessed as 20 to 40mm due to seasonal moisture change would occur.

Soils Bearing and Settlement Assessments

Findings revealed pad footings of size 3m by 4m and 3m by 3m are adequate against an allowable soil bearing capacity of up to 250kPa, assuming an embedment depth of up to 1.5m.

Short and long term settlement estimations are estimated as up to 32mm at the centre of flexible footing for a 4m by 3m and up to 29 mm at the centre of flexible footing for 3m by 3m pad footings, assuming the soils has been compacted to 95% MDR. A Factor of Safety of 3 is allowed in the assessment.

Any further earthworks for site preparation shall be carried out in accordance with AS 3798-2007.

1.0 INTRODUCTION

1.1 Specialist Testing and Technical Services (STATS) was engaged by Mr. Nick Oresti on behalf of VERTIV (the Client), to conduct a Geotechnical Investigation Work for fourteen (x14) Proposed Telco Project sites from Port Hedland to Newman, Western Australia. This report covers Group 2 – Mooloogool, the site location and tests carried out are presented in Figures 1.

1.2 The objective was to obtain information on the subsurface conditions to classify the site in accordance with the definitions provided in Australian Standard AS2870 – 2011, and AS 1726 for the proposed construction work at each site, which shall comprise of substation structures and solar panel arrays.

1.4 The site consists of five (x5) test pits to the depth of 2.5m or refusal, five (x5) DCP tests to the depth of 1.05m and one (x1) array of electrical resistivity test (x-x and y-y direction).

1.6 The site investigation work was conducted on 16th May 2023.

2.0 SCOPE OF INVESTIGATION

2.1 The scope of investigation was as follows:

- Undertook Dial Before U Dig information, including review of existing underground services.
- Provision of all existing underground services or engaging a cable locator to scan for services, if required, shall be arranged by the Client. If STATS is required to organise, this shall be at Cost +10%.
- Mobilisation and demobilisation of STATS Engineering Crew (x2) and Equipment.
- Mobilisation and demobilisation of a 8T excavator with a 300mm auger and tooth bucket options and an operator.
- Provision of GPS coordinate for four corners of each site based on handheld GPS unit or mobile phone app.
- Carried out up to five (x5) test pits, to depth of 2.5m to 3.0m or refusal.
- Carried out one (x1) set of Field Electrical Resistivity measurements along x-x and y-y direction, at spacings of 0.5m, 1m, 2m, 4m, 8m, 16m and 20m.
- USC of soil profiles, sampling including DCP up to depth of 1m or refusal, to determine soil consistency versus depth as well as estimation of insitu CBR.
- Observation and logging of the presence of any ground water.
- Areas of reinstated should be carried out using excavated spoils and compacted with plate compactor.
- STATS should be guided by Dial Before U Dig information on the presence of underground services and shall not be held responsible if our investigation hit or damage any services.
- Carried out the following laboratory tests on representative soil samples:

    - Particle Size Distribution Tests,
    - Plasticity Index Tests,
    - Modified Maximum Dry Density Tests,
    - 4 days soaked CBR Tests,
    - Multi Stage Direct Shear (Cohesion and Frictional angle) for nominated soils.

- The laboratory tests are required as part of AS 1726 requirements to be able to carry out a proper Unified Soil Classification of the materials encountered, and also to advice the suitability of the insitu materials for use as structural fill, or the need to import filling materials.
- Based on the laboratory and field findings, provide a Geotech report on site preparation, excavation conditions (depths to bedrocks), footing pads, material suitability, earthwork preparation, subsoil drainage requirements and compaction requirements and Geotech Site Classification for the footing at the shed area.
- Provide soils bearing capacity estimations and settlement estimations for each site.
- Provide recommendations on Suitable and Unsuitable soils encountered.

3.0 SITE CHARACTERISTICS

3.1 Geology

3.1.1 A review of the 1:250,000 Geological Survey map of Glengarry indicates that the site is situated on colluvium and alluvium, red-brown sandy and clayey loam as sheetwash deposits.

3.2 Groundwater

3.2.1 No groundwater was encountered during the test pitting program.

4.0 SITE DESCRIPTION

4.1 A review of the Landgate information and aerial photography of the various sites revealed the site located at the western side of the Great Northern Highway.

5.0 FIELD PROGRAMME

5.1 Test Pit Logs

5.1.1 The site soil profiles encountered across all test pits are similar, which comprises of a Clay - Sand Mixture (Sandy CLAY): fine to medium grained, brown/grey/white, moist, stiff to hard, trace of fine to medium grained gravels.

5.1.2 All test pits terminated at the target depth of 2.5m.

5.1.3 The laboratory test results are presented in Appendix 6.

5.2 Dynamic Cone Penetrometer

5.2.1 Based on the Soils Testing Handbook of Australian Standard, Table 6.4.6.1 (A), the density of the soils for the fine-grained materials (Sandy CLAY) over the proposed development area was generally "very stiff" with an average of 10 blows per 100mm of penetration.

5.2.2 The DCP results are presented in Appendix 3.

5.2.3 In accordance with the Soils Testing Handbook of Australian Standard, Table 6.4.6.1(C) (Correlation of DCP Blow Counts to CBR), an average Field CBR value of over 22% was obtained.

5.2.4 The Correlation of DCP Blow Counts to CBR Values are presented in Appendix 4 of this report.

5.3 Soil Electrical Resistivity Tests

5.3.1 Two measurement lines with a diagonal array pattern were conducted. It consists of the x-x direction, Southwest to Northeast and the y-y direction, Northwest to Southeast.

5.3.2 For the x-x direction, Southwest to Northeast:

- The soil electrical resistivities of the subsurface soil/rock have fluctuated between 16.34 Ωm to 1.01 Ωm when the probe spacing increased from 0.5m to 20.0m gradually.

5.3.3 For the y-y direction, Northwest to Southeast:

- The soil electrical resistivities of the subsurface soil/rock have fluctuated between 14.07 Ωm to 1.01 Ωm when the probe spacing increased from 0.5 to 20.0m gradually.

5.3.4 The Soil Electrical Resistivity test results are presented in Appendix 5.

6.0 LABORATORY TESTS

6.1 Laboratory Tests

6.1.1 Representative soil samples were taken from the test pit to determine the soil properties. Laboratory tests based on Australian Standards 1289 were conducted on the samples, at STATSWA Laboratory, Canning Vale, Perth.

6.1.2 The laboratory test program consists of the following:

- Particle Size Distribution Tests,
- Plasticity Index Tests,
- Modified Maximum Dry Density Tests,
- 4 days soaked CBR Tests,
- Multi Stage Direct Shear (Cohesion and Frictional angle) for nominated soils.

6.1.3 The laboratory test results are presented in Appendix 6. A summary of the laboratory test findings is presented in the Tables below.

Table 1: Summary of Laboratory Tests

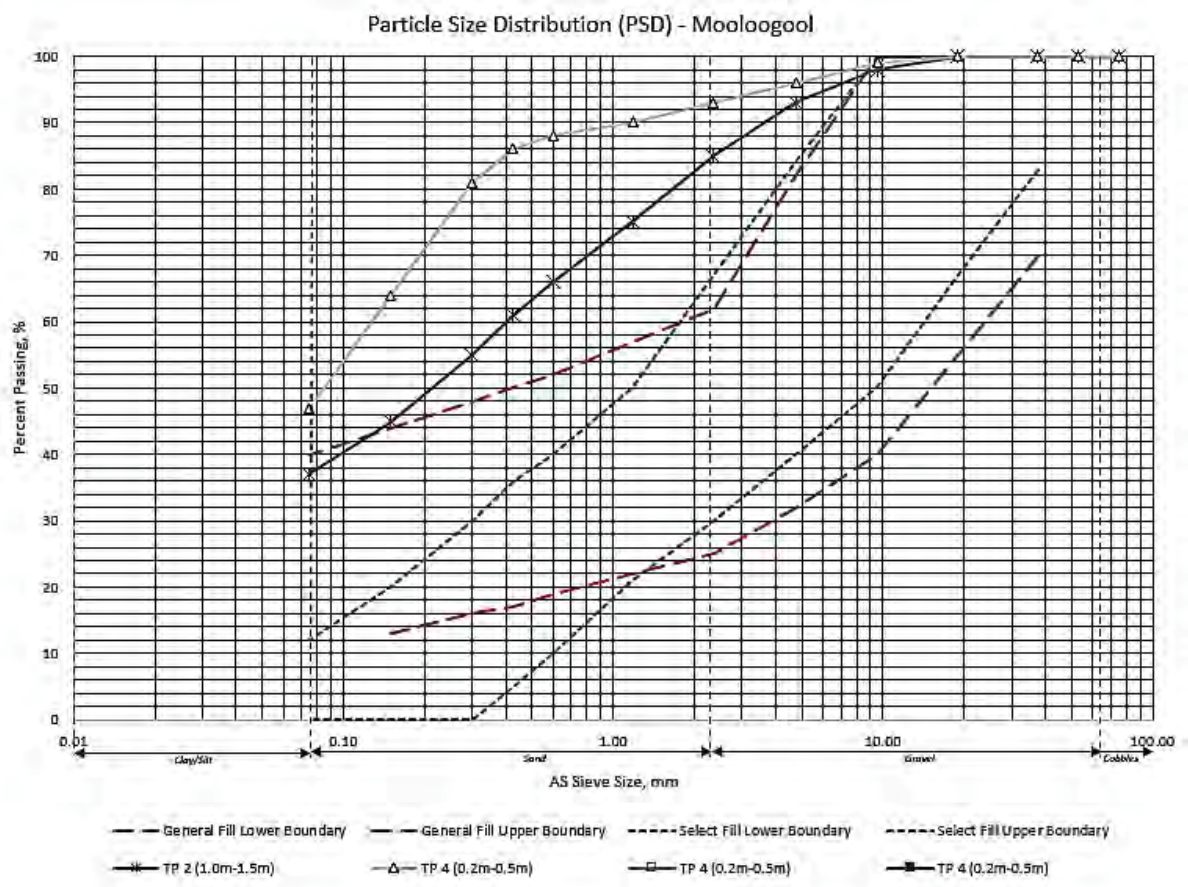
Test Pit ID	TP2	TP4
Depth (m)	1.0-1.5m	0.2-0.5m
USC	CL	CL
Passing 2.36mm (%)	85	93
Passing 75µm (%)	37	47
Liquid Limit (%)	43	26
Plastic Limit (%)	26	14
Plasticity Index (%)	17	12
Linear Shrinkage (%)	9.5	7.0
Opt. Moisture Content (%)	18.5	-
Modified Maximum Dry Density (t/m^3)	1.73	-
4 days soaked CBR (%)	2.5@5mm	-

Table 2: Summary of Laboratory Tests – Multistage Drained Direct Shear Test

Test Pit ID	TP2	
Depth (m)	1.0 – 1.5m	
	Peak	Ultimate/Residual
Cohesion, C′ (kPa)	76.02	58.48
Angle of Shear Resistance, ϕ′ (°)	27.92	22.29

6.1.4 A summary of the Particle Size Distribution (PSD) for all the materials encountered at Mooloogool was plotted against General and Select Fill criteria and presented in Graph 1 below.

Graph 1: Particle Size Distribution (PSD) for materials encountered at Mooloogool against General and Select Fill requirements



6.1.4.1 The findings revealed that the materials encountered on site are not suitable for use as a General FILL material.

7.0 GEOTECH SITE CLASSIFICATION

7.1 Based on the type of materials encountered, a summary of the Geotechnical Site Classifications is provided in the table below:

7.1.1 The site is currently assigned a Site Classification of "M" in accordance with the definitions provided in the Australian Standard AS2870 -2011, on the assumption that the house pad shall be prepared and compacted to the specified requirements under Section 7 of the report. For Site Classification S, the characteristic surface movement (Ys Value) for the site was assessed as 20 to 40mm due to seasonal moisture change would occur.

7.2 The explanation of the site classification is outlined in the Table below (source: tables 2.1 & 2.3 AS2870 2011).

Table 3: Classification by Characteristic Surface Movement Ys

Site Class	Soil Description Based on Reactivity	Characteristic Surface movement *Ys (mm)*
A	Most Sand & Rock Sites with little or no ground movement from moisture changes	0
S	Slightly reactive clay sites which may experience slight ground movements from moisture changes	$0 < Ys \leq 20$
M	Moderately reactive clay or silt sites which may experience moderate ground movements from moisture changes	$20 < Ys \leq 40$
H1	Highly reactive clay sites which may experience high ground movements from moisture changes	$40 < Ys \leq 60$
H2	Highly reactive clay sites which may experience very high ground movements from moisture changes	$60 < Ys \leq 75$
E	Extremely reactive sites which may experience extreme ground movements from moisture changes	$Ys > 75$
P	Sites with inadequate bearing capacity or is affected by factors other than Reactivity of the soil eg. soft soils, landslip, mine subsidence, uncontrolled fill, coastal erosion and the site cannot be classified based on soil reactivity	-

8.0 SOIL BEARING AND SETTLEMENT ASSESSMENTS

8.1 A Soil Bearing Capacity and Settlement estimations for different sizes of pad footings were carried out based on the soil properties at the uppermost depth.

8.2 Findings revealed pad footings of size 3m by 4m and 3m by 3m are adequate against an allowable soil bearing capacity of up to 250kPa, assuming an embedment depth of up to 1.5m.

8.3 Short and long term settlement estimations are estimated as up to 32mm at the centre of flexible footing for 4m by 3m and up to 29 mm at the centre of flexible footing for 3m by 3m pad

footings, assuming the soils has been compacted to 95% MDR. A Factor of Safety of 3 is allowed in the assessment.

8.4 A summary of the settlement assessment is presented in the table below. The computed soil bearing capacity and settlement estimations are presented in Appendix 7.

Table 4: Summary of the Settlement Assessments

Type	Weight (ton)	Size	Loading (kPa)	Max. Long-term Settlement (mm)		Max. Short-term Settlement (mm)	
				Flexible Footing	Rigid Footing	Flexible Footing	Rigid Footing
I	30	4m x 3m	250	32.23 at centre	24.49	25.78 at centre	19.59
II	22.5	3m x 3m	250	28.88 at centre	21.14	23.10 at centre	16.91

9.0 CONSTRUCTION STAGE SUPERVISION AND CERTIFICATION

9.1 The site investigation and subsequent classification has been carried out using a limited amount of test pits, visual inspection, sampling, and testing programme.

9.2 To achieve a full coverage of the site to ensure all variations are investigated and coverage is not practical and is seldom done due to cost and time constraints.

9.3 Due to the inherent nature of “natural ground” it is very possible that subsurface conditions may vary over short distances within the site. STATS is to be informed if the findings differ from that reported here during the excavation works.

9.4 It is essential that during the earthworks, a qualified Engineer/Technician be further engaged to inspect the foundation material and excavation work, including providing certification that the compaction works are completed satisfactory. This enables verification of the information contained in this report, and to advise on any changes to the design that may be needed, based on any variations encountered. Thus, the foundation material can then be certified as complying with the requirements of this report and the proposed design.

10.0 GENERAL EARTHWORKS

10.1 Any loose or areas of weakness should be removed and backfilled with approved granular fill. If boulders, rocks, or building rubble (>300mm) is encountered, they should be removed from the works.

10.2 Where there is the presence of minor organics and tree roots the material should be raked and removed using a rake with a 50mm grid spacing.

10.3 The base of the building pads shall be compacted using a 700kg vibrating plate compactor prior to importing of fill.

10.4 For this development, excavate to 0.5m below existing level, stockpile the excavated materials, compact at this base level until satisfactory, then backfill in two layers (max. 250mm lift each) and compact.

10.5 Backfill Materials

10.5.1 Any imported structural fill material to support footings should be clean sand with maximum 10% passing 0.075mm sieve.

10.5.2 All fill import is to be compacted in maximum layers of 250mm (loose) and compacted to achieve the specified minimum density ratio by an approved method.

10.5.3 Compaction required to achieve the density requirements is set out in the following tables and shall be conducted in accordance with AS 1289.5.1.1.

Table 5: Compaction Requirements for Fill

Item	Application	Compaction Criteria	
		Min Density Ratio (Cohesive Soils)	Min Density Index (Cohesion less Soils)
1	Commercial: To support minor loadings, including floor loadings up to 120kPa and isolated pad or strip footings to 100kPa	98%	75%

10.5.4 The plasticity index shall be < 5%.

10.6 Drainage and Stormwater Disposal

10.6.1 If construction works were to take place during the rainy seasons, the perimeter around the site and areas of proposed earthworks should be constructed with a shallow gradient to allow drainage to a sump and to allow water to be discharged from the site. It is important that the conditions under the footings remain relatively dry. Where required, drains should be constructed to divert water from the site and to ensure no erosion or premature saturation occurs around the footings.

10.6.2 Storm water should be collected and stored as the surface runoff controlled to prevent scour and loss of soil during periods of high intensity rainfall.

10.6.3 Based on the topography on sites, discharge of stormwater on site is not recommended. Stormwater discharge shall be channeled to detention basins or swales.

10.6.4 It is recommended that the sitework along the Great Northern Highway shall not to be carried out during wet weather e.g. seasonal cyclone events, whereby the site and road may be impacted by heavy rainfall, localized flash flooding and ponding.

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 Based on the soils we encountered, it is currently assigned a Site Classification of “M” in accordance with the definitions provided in the Australian Standard AS2870 -2011, on the

assumption that the house pad shall be prepared and compacted to the specified requirements under Section 7 of the report. For Site Classification S, the characteristic surface movement (Ys Value) for the site was assessed as 20 to 40mm due to seasonal moisture change would occur.

11.2 It is recommended that the site is prepared in accordance with the recommendations given in Australian Standard AS 3798-2011, "Guidelines on Earthworks for Commercial and Residential Developments".

11.3 Storm water should be collected and stored as the surface runoff controlled to prevent scour and loss of soil during periods of high intensity rainfall.

11.4 Based on the type of soils encountered, stormwater shall be channelled and discharged offsite into Swale Drains.

11.5 It is highly recommended that ongoing geotechnical supervision, sampling and testing be carried out throughout the different stages during the course of construction to verify the level of compaction prior to pouring concrete.

11.6 Findings revealed pad footings of size 3m by 4m and 3m by 3m are adequate against an allowable soil bearing capacity of up to 250kPa, assuming an embedment depth of up to 1.5m.

11.7 Short and long term settlement estimations are estimated as up to 32mm at the centre of flexible footing for 4m by 3m and up to 29 mm at the centre of flexible footing for 3m by 3m pad footings, assuming the soils has been compacted to 95% MDR. A Factor of Safety of 3 is allowed in the assessment.

12.0 REFERENCES

- AS 1289 -2000, "Methods of Testing Soils for Engineering Purposes".
- AS 1726 - 2017, "Geotechnical Site Investigations".
- AS 2870 - 2011, "Residential Slabs and Footings".
- AS 3798 - 2007, "Guidelines on earthworks for commercial and residential developments".

STATS AUSTRALIA

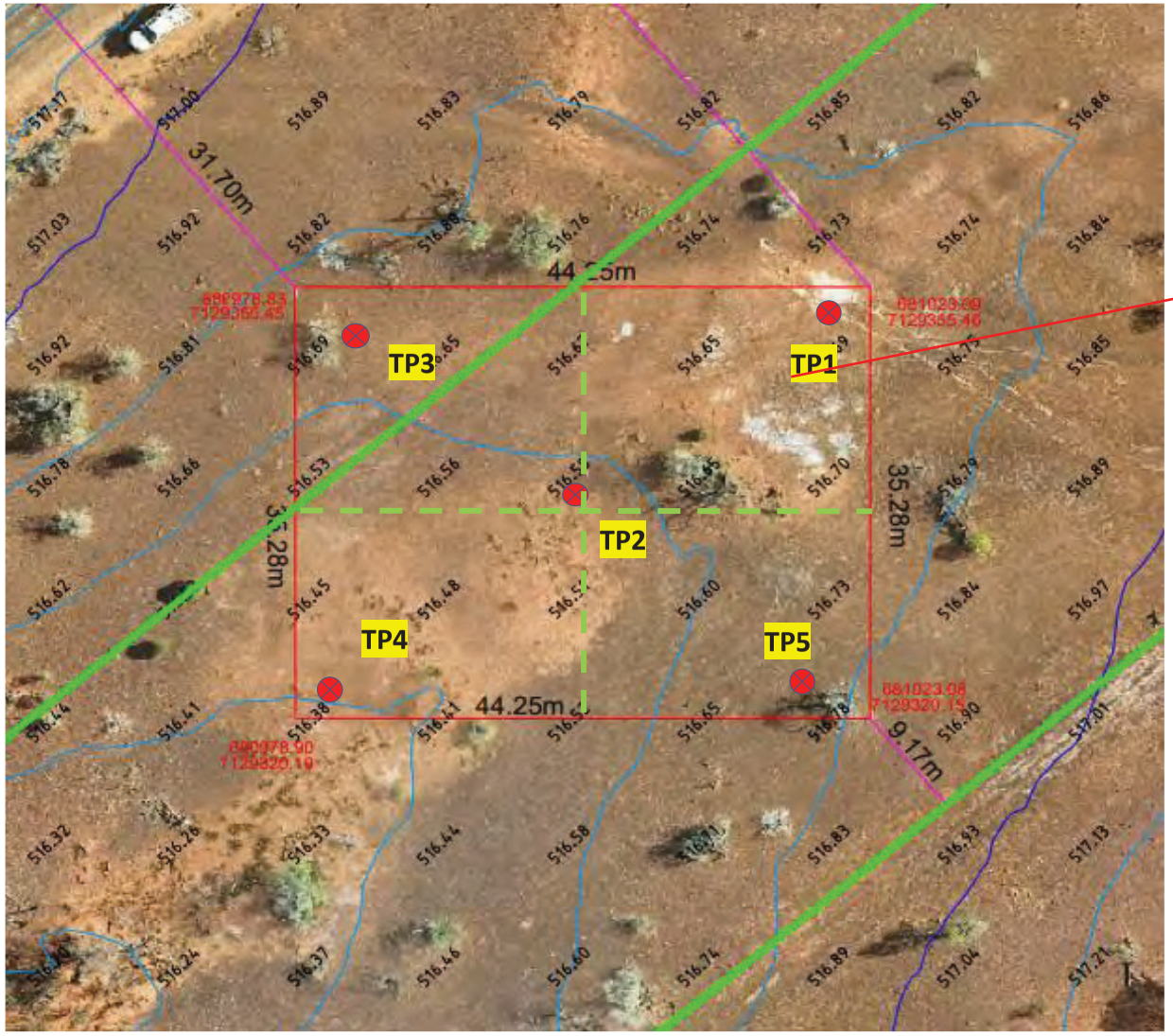
Kevin Loh
MEng(Civil), BSc(Eng), MIE(Aust)
Civil Engineer

Aidan Seck
BEng (Civil), MIE(Aust), CPeng, NPER
Principal Engineer/Manager

Figures

Figure 1: Proposed Test Locations

(No of pages including this page: 02)



Site Location	Coordinate
Mooloogool	25°56'35.56"S, 118°48'27.98"E

Legend

- Proposed Test Pit Locations (x5) to depth 2.5m or refusal.
- Field Electrical Resistivity (x2) @0.5m, 1m, 2m, 4m, 8m, 16m and 20m spacing.

Project Title:
Proposed Telco Projects (Mullewa and Mooloogool)
- **Geotechnical Investigation Work**

Title: Proposed test locations Layout (Mooloogool)	
Figure: 1	**Scale: NTS**
Date: 01 June 2023	**Drawn: KL**
Checked: AS	**Approved: AS**
Drawing No: 102717	**Rev: 2**

STATS AUSTRALIA
Unit 1/16 Production Road,
CANNING VALE WA 6155

Tel: 08 9455 3654
Fax: 08 9455 3709
www.statsaustralia.com.au