Allam Property Group

Acid Sulfate Soils Assessment

Proposed Manufactured Home Estate

40-80 Chapmans Road, Tuncurry

Report No. RGS03137.1-AB

28 October 2022

REGIONAL GEOTECHNICAL SOLUTIONS

REGIONAL GEOTECHNICAL SOLUTIONS

Manning-Great Lakes
Port Macquarie
Coffs Harbour

RGS03137.1-AB

28 October 2022

Allam Property Group
PO Box 7385
BAULKHAM HILLS BC NSW 2153

Attention: Mark Cerone

Dear Mark

RE: Proposed Manufactured Home Estate – 40-80 Chapmans Road, Tuncurry
Acid Sulfate Soils Assessment

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken an Acid Sulfate Soils assessment for the proposed Manufactured Home Estate at 40-80 Chapmans Road, Tuncurry. This report presents the results of the assessment.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

If you have any questions regarding this project, please contact the undersigned.

For and on behalf of

Regional Geotechnical Solutions Pty Ltd

Prepared by

Andrew Hills

Senior Environmental Engineer

Reviewed by

Steve Morton

Principal Geotechnical Engineer

Regional Geotechnical Solutions Pty Ltd
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Table of Contents

Figures

Appendices

1 INTRODUCTION

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken an Acid Sulfate Soils (ASS) assessment for the proposed Manufactured Home Estate (MHE) at 40-80 Chapmans Road, Tuncurry. The site is identified as Lot 1 DP304132 and occupies approximately 6.05 hectares.

It is understand that a Request for Further Information (RFI) from Midcoast Council regarding the proposed development has been received. Item 13 in regard to ASS states the following:

> 13. Acid Sulfate Soils
>
> The geotechnical report test pit logs suggest there a possibility that the basin would be excavated into an area of estuarine organic peat/clay with a high potential for acid sulfate soils. Provide further information on whether the bioretention media in this location will intercept the acid sulfate soil layer and if so, how this may impact the ability to achieve gravity drainage and function of the bioretention.

The purpose of the assessment is to identify if Actual or Potential ASS will be encountered during development of the site and if so, to develop an ASS Management Plan. In addition the ASS assessment is required to address Item 13 of Council's RFI.

2 METHODOLOGY

The assessment of the site was undertaken by an Engineer from RGS and involved:

- Review of previous geotechnical and geo-environmental assessment investigations undertaken at the site;
- Observation of site features and surrounding features relevant to the geotechnical conditions of the site;
- Logging and sampling of six test pits excavated using a track-mounted excavator; and
- Laboratory testing of representative samples.

Four of the test pits were excavated in the proposed stormwater basin footprint in the south-west of the site and an additional two test pits were excavated along the toe of the fill batter in the western part of the site which was previously inaccessible due to thick vegetation and swampy terrain.

Engineering logs of the boreholes are presented in Appendix A. Laboratory test results are presented in Appendix B. Test locations are shown on Figure 1.

3 PREVIOUS INVESTIGATIONS

A previous Geotechnical and Preliminary Site Contamination Assessment report undertaken by RGS, Ref. RGS02673.1-AC, dated 13 July 2022 was reviewed as part of the assessment.

A summary of the key points and concluding remarks in regard to ASS is provided below:

- Reference to the Coolongolook 1:25,000 Acid Sulfate Soil Risk Map indicates that the low-lying swampy western part of the site is situated within an area with a high probability of ASS within 1m of the ground surface;

- The ASS risk map indicates the central and eastern parts of the site to also be within an area with a high probability of ASS between 1m and 3m below the ground surface.

- Eighteen samples obtained from the test pits were screened for the presence of actual or potential ASS using methods 23Af and 22Bf of the ASSMAC Acid Sulfate Soils Manual. The test results are attached. The results indicated:
    - The samples revealed pH_f values of 5.36 to 7.54 in distilled water. In this test, pH <4 can be an indicator of Actual ASS;
    - The samples revealed pH_{FOX} values of 2.12 to 5.27 in hydrogen peroxide. Values of less than 3 can be an indicator of Potential ASS;
- Five samples were submitted for Chromium Reducible Sulphur (CRS) analysis, to differentiate between potential organic or inorganic sources of sulfur;

- Each of the samples from the eastern side of the site recorded Titratable Actual Acidity (TAA) and oxidisable sulfur concentrations below the adopted action criteria and the soils are therefore not considered to be Actual ASS to 1.55m depth. If development will involve excavations to depths of greater than 1.55m from existing surface level, then further ASS assessment will be required;

- Two of the samples, obtained from the western part of the site (low-lying swampy area), recorded S_{cr} results that exceeded the adopted action criteria which indicates the presence of sulphuric acidity and these soils are therefore considered Potential ASS. As such, an ASS Management Plan is required for this part of the site;

- Further sampling and testing will be required prior to development once excavation depths and locations are known; and

- A draft ASS Management Plan previously provided as a guide to the likely requirements for excavations into the natural ground profile on the western part of the site indicates that lime treatment at a rate of 16kg/tonne would be required.

4 SITE CONDITIONS

4.1 Surface Conditions

The site is rectangular in shape and is bound by Chapmans Road to the north, a former landscape supply yard and undeveloped land to the east and by undeveloped land to the south and west. It is located approximately 500m east of the Wallamba River. Site access is via an access road located near the eastern end of the property.

A satellite image that shows the site boundary and the site setting is reproduced below.

***Plate 1**: Aerial image obtained from NSW 'Six Maps' website that illustrates the site location and setting. The subject site boundary is marked by the dashed red line.*

The site is situated on a low-lying Aeolian sandplain with the natural ground level being typically flat. It has been extensively filled including a large stockpile of dredged sand located in the central part of the site. Where fill is present, slope changes are of the order of 1 to 3 degrees in various directions. Stockpiles of fill are generally located on the central part of the site. Several old structures such as sheds and picnic tables are present near the site entrance along with roof sheeting, concrete pipes and bollards, gangways, pontoons, treated pine and vegetation.

The eastern part of the site had recently been cleared of a thick stand of vegetation at the time of the field work. Some surface water was ponding in this area at the time of the field investigations.

Similarly, clearing had recently been undertaken and mulching works were in progress at the western end of the site at the time of the field investigations. This area was previously inaccessible due to the presence of the steep fill batter grading down to the low-lying swampy natural ground level which was heavily vegetated. Surface water was ponding in this area also. Slopes to the west were 8° to 10 °at the southern end of the fill batter, 6° to 8° and 4° to 6° along the central and northern parts of the fill batter respectively.

Site surface elevations vary from about RL1m to about RL5m.

Drainage of the site will be primarily via infiltration into the upper sandy soils. However, given the extensive filling some overland flow is also anticipated.

Vegetation predominantly comprised long grass, weeds, reeds and shrubs in the filled areas. The eastern and western ends had been cleared prior to the field investigations.

Trafficability was poor to average via 4WD vehicle with the majority of the site being inaccessible by vehicle.

Typical site photographs are presented below.

Looking north across the eastern part of the site which had been recently cleared. Surface water was ponding in this area.

Looking across the central part of the site showing the various stockpiles of dredged sand.

Looking north-east from the southern part of the site. Stockpiles of dredged sand were up to 2m in height.

Looking east across the western part of the site which had been recently cleared. Surface water was ponding in this area.

4.2 Subsurface Conditions

Based on the topographic conditions, the site has been divided into two terrain zones. Reference to the MinView website indicates that the underlying geology varies with each terrain as outlined below:

- Terrain Zone 1: The western half of the site is underlain by Holocene freshwater swamp deposits comprising organic mud, peat, clay, silt and marine sand; and
- Terrain Zone 2: The eastern half of the site is underlain by Holocene beach ridge and associated strandplain deposits comprising marine sand, shell and gravel.

The geology of the site is presented in Plate 2 below:

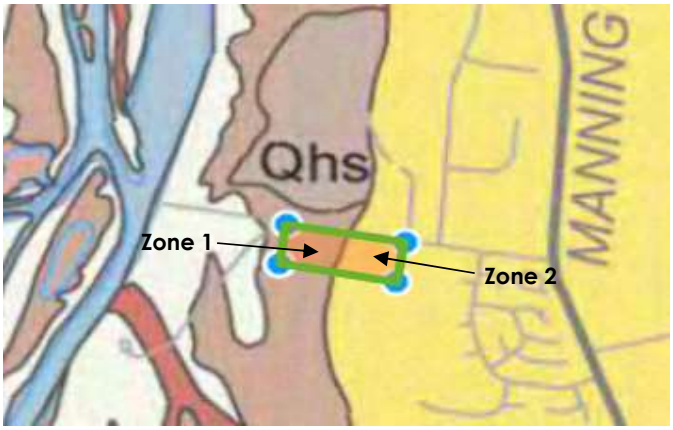

Plate 2: *Reference to the MinView website indicates that Terrain Zone 1 is underlain by Holocene freshwater swamp deposits and Zone 2 is underlain by Holocene beach ridge and associated strandplain deposits.*

The materials encountered during the previous and current investigations are summarised in Table 1, Table 2 and Table 3 respectively. Further details are presented on the attached engineering logs.

Table 1: Summary of Geotechnical Units

Unit	Material	Material Description
UNIT 1A	Fill (Roadbase)	Sandy GRAVEL, fine to coarse grained, sand fine to medium grained, some clay, low plasticity, some roots
UNIT 1B	Fill	Sandy GRAVEL or Gravelly SAND, fine to coarse grained, sand, fine to medium grained, some clay fines, low to medium plasticity, some cobbles, some roots
UNIT 1C	Fill/Topsoil	Silty SAND, fine to medium grained, some roots
UNIT 1D	Fill (Dredged Sand)	SAND, fine to medium grained, some shells
UNIT 2	Topsoil	Clayey SAND, fine to medium grained, clay, low plasticity, some roots; or Silty CLAY, low plasticity, some sand, fine to medium grained, some roots
Unit 3	Aeolian Soil	SAND, fine to coarse grained, medium dense, trace clay, low plasticity, trace roots
UNIT 4	Lightly Indurated Sand	SAND, fine to coarse grained, medium to dense, some clay, low plasticity
UNIT 5	Alluvial Soil	Clayey SAND, fine to coarse grained, clay, low plasticity

Table 2: Summary of Subsurface Profile – Previous Investigation

Test Pit	Depth of Material Layer (m)								
	Terrain Zone	UNIT 1A Fill (Roadbase)	UNIT 1B Fill	UNIT 1C Fill/Topsoil	UNIT 1D Fill (Dredged Sand)	UNIT 2 Topsoil	UNIT 3 Aeolian	UNIT 4 Lightly Indurated Sand	UNIT 5 Alluvial
TP1	2	--	--	--	--	0.0 – 0.15	0.15 – 0.6	0.6 - ≥1.2*	--
TP2	2	--	0.0 – 0.45	--		0.45 – 0.6	0.9 - ≥1.5*	0.6 – 0.9	--
TP3	2	--	--	--	--	0.0 – 0.3	0.8 - ≥1.2*	0.3 – 0.8	--
TP4	2	--	0.0 – 0.85	--	--	0.85 – 1.0	1.0 – 1.6	1.6 - ≥1.9*	--
TP5	2	--	0.0 – 0.3	--	--	0.3 – 0.6	0.6 - ≥1.5*	--	--
TP6	2	0.0 – 0.4	0.4 – 0.65	--	--	0.65 – 0.8	0.8 - ≥1.65*	--	--
TP7	1	--	--	0.0 – 0.15	0.15 – 2.0	2.0 - ≥2.1*	--	--	--
TP8	1	--	--	--	--	0.0 – 0.2	0.2 - ≥1.2*	--	--
TP9	1	--	0.2 – 1.0	0.0 – 0.2	--	--	1.0 – 1.3	1.3 - ≥1.8*	--
TP10	1	--	0.0 – 0.7	--	--	--	0.7 - ≥1.6*	--	--

Note: ≥ Indicates that base of material layer was not encountered
* Indicates that the test pit was terminated due to excavation collapse
-- Indicates that the material was not encountered at the test location

Groundwater was encountered within each of the boreholes (with the exception of TP7) at depths of between 0.5m and 1.8m below ground surface during the limited time they remained open on the day of the field investigations. It should be noted that fluctuations in groundwater levels can occur as a result of seasonal variations, temperature, rainfall, and other similar factors, the influence of which may not have been apparent at the time of the assessment.

Table 3: Summary of Subsurface Profile – Current Investigation

Test Pit	Depth of Material Layer (m)								
	Terrain Zone	UNIT 1A Fill (Roadbase)	UNIT 1B Fill	UNIT 1C Fill/Topsoil	UNIT 1D Fill (Dredged Sand)	UNIT 2 Topsoil	UNIT 3 Aeolian	UNIT 4 Lightly Indurated Sand	UNIT 5 Alluvial
TP48	2	--	--	--	--	0.0 – 0.25	--	--	0.25 - ≥1.6*
TP49	2	--	--	--	--	0.0 – 0.25	--	--	0.25 - ≥1.6*
TP50	2	--	--	--	--	0.0 – 0.25	--	--	0.25 - ≥1.6*
TP51	2	--	--	--	--	0.0 – 0.25	--	--	0.25 - ≥1.9*
TP52	2	--	--	--	--	0.0 – 0.25	--	--	0.25 - ≥2.1*
TP53	2	--	--	--	--	0.0 – 0.3	--	--	0.3 - ≥2.0*

Note: ≥ Indicates that base of material layer was not encountered
* Indicates that the test pit was terminated due to excavation collapse
-- Indicates that the material was not encountered at the test location

Groundwater was encountered within each of the test pits at near surface in test pits TP48 to TP51 and at a depth of 1.1m below ground surface in test pits TP51 and TP52, during the limited time they remained open on the day of the field investigations. It should be noted that fluctuations in groundwater levels can occur as a result of seasonal variations, temperature, rainfall, and other similar factors, the influence of which may not have been apparent at the time of the assessment.

5 ACID SULFATE SOILS

Reference to the Coolongolook 1:25,000 Acid Sulfate Soil Risk Map indicates that the low-lying swampy western part of the site is situated in an area with a high probability of ASS within 1m of the ground surface. The map indicates the central and eastern parts of the site to also be within an area with a high probability of ASS between 1m and 3m below the ground surface.

<table>
<tr>
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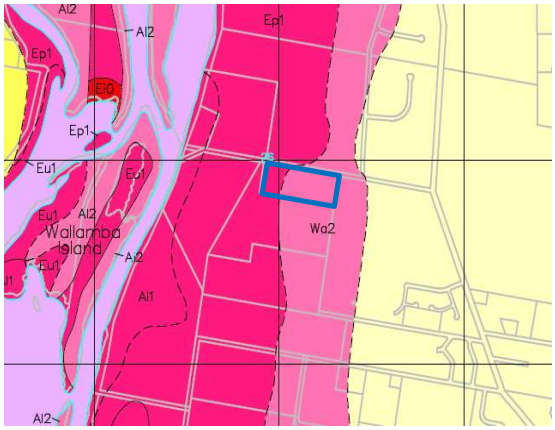
<td> 
</td>
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<tr>
<td>Approximate location of site shown in red as indicated by Google Earth image.</td>
<td>Extract from the Coolongolook 1:25,000 ASS Risk Map indicates the site to be within an area with a high probability of ASS within 1m to 3m below natural ground.</td>
</tr>
</table>

Acid Sulfate Soils (ASS) produce sulphuric acid when exposed to oxygen due to the presence of iron sulphides in the form of pyrite within the soil matrix. These soils form when iron-rich sediments are deposited in saltwater or brackish water environments. Prior to oxidation, these pyritic soils are referred to as Potential ASS. ASS that have produced acid as a result of oxidation are referred to as Actual ASS. They typically occur in natural, low-lying coastal depositional environments below approximately 5m AHD. In the field ASS are generally identified as saline sediments such as alluvial or estuarine soils or bottom sediments in creeks and estuaries.

In environments such as that which exists at the site, the pyrite and resultant acidity (if any) would exist within the fine-grained fraction of the sediment profile.

Twenty-three samples obtained from the test pits were screened for the presence of actual or potential ASS using methods 23Af and 22Bf of the ASSMAC Acid Sulfate Soils Manual. The test results are attached. The results indicated:

- The samples revealed pH_f values of 5.02 to 6.78 in distilled water. In this test, pH <4 can be an indicator of Actual ASS; and

- The samples revealed pH_{FOX} values of 1.90 to 4.46 in hydrogen peroxide. Values of less than 3 can be an indicator of Potential ASS.

To provide a more comprehensive assessment, five samples were submitted for Chromium Reducible Sulphur (CRS) analysis, to differentiate between potential organic or inorganic sources of sulfur. A summary of the test results is presented in Table 4.

Table 4: Summary of ASS CRS Test Results

Test Pit	Depth (m)	Texture	Acid Trail (mol H+/tonne)		Sulfur Trail (mol H+/t)		Net Acidity (mol H+/tonne)	Liming Rate (kg / Tonne)
			TAA	Action Criteria	Scr	Action Criteria		
Western side of site – Terrain Zone 1								
TP48	0.8 – 1.0	Coarse	2	18	0	18	2	0
TP49	0.8 – 1.0	Coarse	3	18	**19**	18	**22**	2
TP51	1.3 – 1.5	Coarse	4	18	4	18	**57**	4
TP51	1.7 – 1.9	Coarse	4	18	**47**	18	**51**	4
TP53	0.0 – 0.2	Medium	**97**	36	17	36	**114**	9

Note: 1. The adopted action criteria assume that >1,000 tonnes of soil is to be disturbed.

2. A texture dependent action criteria has been adopted of 18mol H+/t for coarse grained materials, 36 mol H+/t for medium texture and 62mol H+/t for fine textured materials.

3. Values that are bold exceed the adopted action criteria.

Each of the samples recorded Titratable Actual Acidity (TAA) concentration below the adopted action criteria, with exception of sample TP53 0.0 – 0.2m which exceeded the action criteria indicating the presence of actual acidity.

Oxidisable sulfur concentrations exceeded the adopted action criteria in two of the samples (TP49 0.8 – 1.0m and TP51 1.7 – 1.9m indicating the presence of sulphuric acidity. In addition, one sample TP53 0.0 – 0.2m exceeded the action criteria for net acidity. These soils are therefore considered to be Potential ASS. As such, an ASS Management Plan is required for this part of the site.

It is understood that excavations for the proposed stormwater basin will be to approximately 1.45m below ground surface. The remainder of the site will be filled. As such the ASS Management Plan should be implemented for excavations for the stormwater basin the south-west corner of the site, and for other excavations into natural ground profile in the low-lying swampy area in the western part of the site, and more generally in Terrain Zone 1.

Based on results obtained during the previous RGS assessment, soils within Terrain Zone 2 (eastern part of the site) are not considered to be Actual or Potential ASS to at least 1.55m into the natural ground profile. As mentioned above, the site will be filled for the proposed development so excavations beyond this depth are not expected. If at a later stage of the development excavations to depths of greater than 1.55m from existing surface level will be undertaken, then further ASS investigations should be undertaken.

The ASS Management Plan is presented in Appendix C.

6 LIMITATIONS

This report comprises the results of an investigation carried out for a specific purpose and client as defined in the document. The report should not be used by other parties or for purposes or projects other than those assumed and stated within the report, as it may not contain adequate or appropriate information for applications other than those assumed or advised at the time of its preparation. The contents of the report are for the sole use of the client and no responsibility or liability will be accepted to any third party. The report should not be reproduced either in part or in full, without the express permission of Regional Geotechnical Solutions Pty Ltd.

Geotechnical site investigation is based on data collection, judgment, experience, and opinion. By its nature, it is less exact than other engineering disciplines. The findings presented in this report and used as the basis for the recommendations presented herein were obtained using normal, industry accepted geotechnical design practises and standards. To our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

The recommended depth and properties of any soil, rock, groundwater, or other material referred to in this report is an engineering estimate based on the information available at the time of writing. The estimate is influenced and limited by the fieldwork and testing method carried out in the site investigation, and other relevant information as has been made available. In cases where information has been provided to Regional Geotechnical Solutions for the purposes of preparing this report it has been assumed that the information is accurate and appropriate for such use. No responsibility is accepted by Regional Geotechnical Solutions for inaccuracies within any data supplied by others.

If site conditions encountered during construction vary significantly from those discussed in this report, Regional Geotechnical Solutions Pty Ltd should be contacted for further advice.

This report alone should not be used by contractors as the basis for preparation of tender documents or project estimates. Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of

Regional Geotechnical Solutions Pty Ltd

Prepared by

Andrew Hills

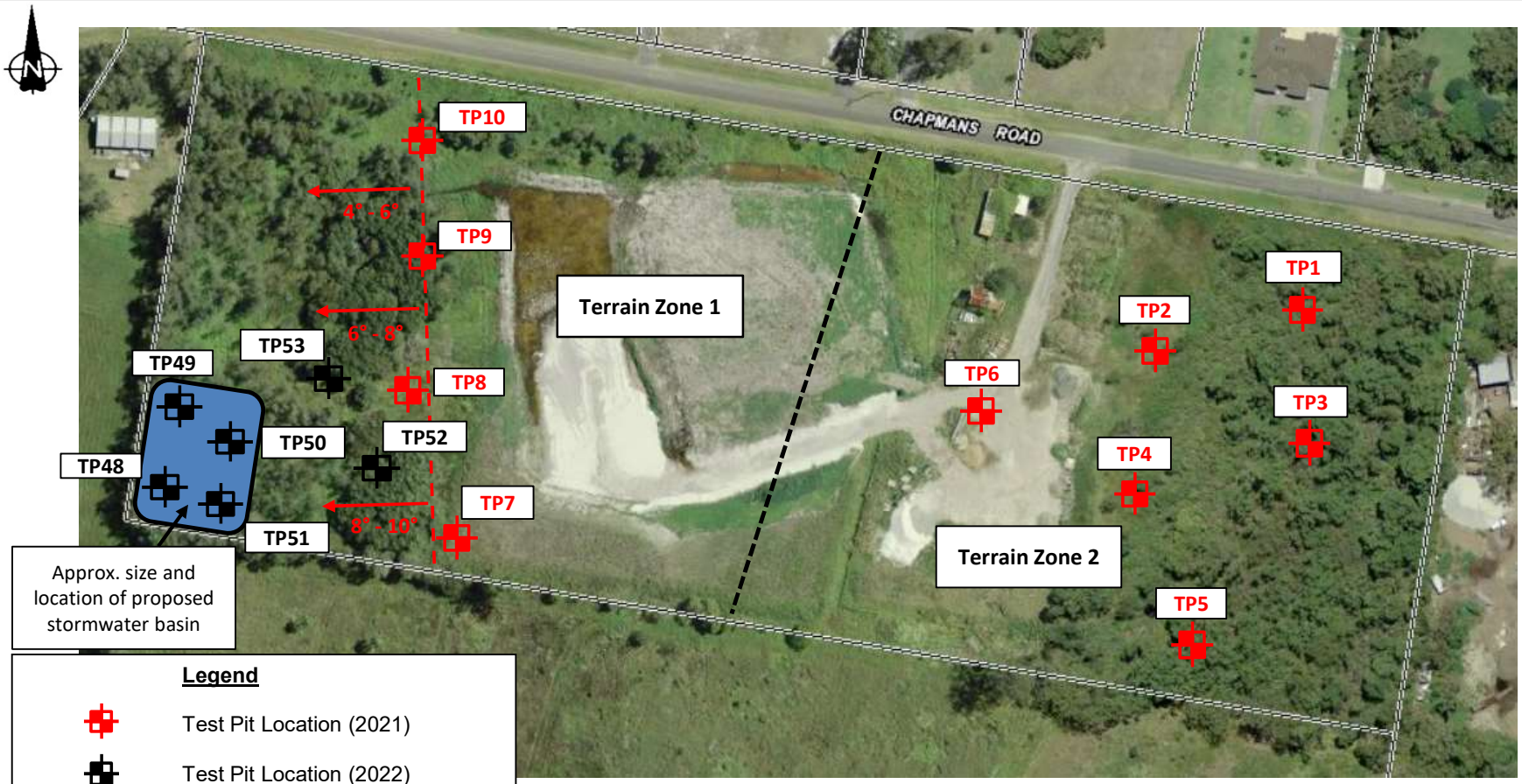
Senior Environmental Engineer

Reviewed by

Steve Morton

Principal Geotechnical Engineer

Figure



REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	Allam Property Group	Job No. RGS03137.1
	Project:	Proposed Manufactured Home Estate 40-80 Chapmans Road, Tuncurry	Drawn By: APH Scale: As Shown Date: 25-Oct-22
	Title:	Test Location Plan	Drawing No. **Figure 1**

Appendix A

Results of Field Investigations

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP48

CLIENT: Allam Property Group | **PAGE:** 1 of 1

PROJECT NAME: Proposed MHE | **JOB NO:** RGS03137.1

SITE LOCATION: 40-80 Chapmans Road, Tuncurry | **LOGGED BY:** APH

TEST LOCATION: See Figure 2 | **DATE:** 5/10/22

EQUIPMENT TYPE: 6T Kubota Excavator | **EASTING:** | **SURFACE RL:**

TEST PIT LENGTH: 1.8 m | **WIDTH:** 0.7 m | **NORTHING:** | **DATUM:** AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	5/10/2022	ES 0.20m				CL	**TOPSOIL:** Silty CLAY, low plasticity, dark grey/black, some sand, fine to medium grained, some roots	W				TOPSOIL
		0.30m					0.25m					
		AMAL 0.50m		0.5		SC	**Clayey SAND:** Fine to coarse grained, pale grey/pale brown, clay, low plasticity, strong sulfuric odour					ALLUVIAL SOIL
		0.80m										
		AMAL 1.00m		1.0								
		1.30m										
		AMAL 1.50m		1.5								
							1.60m					
							Hole Terminated at 1.60 m Excavation collapsing					
				2.0								
				2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP49

CLIENT: Allam Property Group | **PAGE:** 1 of 1

PROJECT NAME: Proposed MHE | **JOB NO:** RGS03137.1

SITE LOCATION: 40-80 Chapmans Road, Tuncurry | **LOGGED BY:** APH

TEST LOCATION: See Figure 2 | **DATE:** 5/10/22

EQUIPMENT TYPE: 6T Kubota Excavator | **EASTING:** | **SURFACE RL:**

TEST PIT LENGTH: 1.7 m | **WIDTH:** 0.7 m | **NORTHING:** | **DATUM:** AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	5/10/2022	ES 0.20m				CL	**TOPSOIL:** Silty CLAY, low plasticity, dark grey/black, some sand, fine to medium grained, some roots	W				TOPSOIL
		0.30m				SC	0.25m **Clayey SAND:** Fine to coarse grained, pale grey/pale brown, clay, low plasticity, strong sulfuric odour					ALLUVIAL SOIL
		AMAL 0.50m		0.5								
		0.80m										
		AMAL 1.00m		1.0								
		1.30m										
		AMAL 1.50m		1.5			1.60m Hole Terminated at 1.60 m Excavation collapsing					
				2.0								
				2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP50

CLIENT: Allam Property Group | **PAGE:** 1 of 1

PROJECT NAME: Proposed MHE | **JOB NO:** RGS03137.1

SITE LOCATION: 40-80 Chapmans Road, Tuncurry | **LOGGED BY:** APH

TEST LOCATION: See Figure 2 | **DATE:** 5/10/22

EQUIPMENT TYPE: 6T Kubota Excavator | **EASTING:** | **SURFACE RL:**

TEST PIT LENGTH: 1.8 m | **WIDTH:** 0.7 m | **NORTHING:** | **DATUM:** AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	5/10/2022	ES 0.20m				CL	**TOPSOIL:** Silty CLAY, low plasticity, dark grey/black, some sand, fine to medium grained, some roots	W				TOPSOIL
		0.30m					0.25m					
		AMAL 0.50m		0.5		SC	**Clayey SAND:** Fine to coarse grained, pale grey/pale brown, clay, low plasticity, strong sulfuric odour					ALLUVIAL SOIL
		0.80m										
		AMAL 1.00m		1.0								
		1.30m										
		AMAL 1.50m		1.5								
							1.60m					
							Hole Terminated at 1.60 m Excavation collapsing					
				2.0								
				2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP51

CLIENT: Allam Property Group | **PAGE:** 1 of 1

PROJECT NAME: Proposed MHE | **JOB NO:** RGS03137.1

SITE LOCATION: 40-80 Chapmans Road, Tuncurry | **LOGGED BY:** APH

TEST LOCATION: See Figure 2 | **DATE:** 5/10/22

EQUIPMENT TYPE: 6T Kubota Excavator | **EASTING:** | **SURFACE RL:**

TEST PIT LENGTH: 1.7 m | **WIDTH:** 0.7 m | **NORTHING:** | **DATUM:** AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	5/10/2022	ES 0.20m				CL	**TOPSOIL:** Silty CLAY, low plasticity, dark grey/black, some sand, fine to medium grained, some roots	W				TOPSOIL
		0.30m				SC	0.25m **Clayey SAND:** Fine to coarse grained, pale brown/pale grey, clay, low plasticity, strong sulfuric odour					ALLUVIAL SOIL
		AMAL 0.50m		0.5								
		0.80m										
		AMAL 1.00m		1.0								
		1.30m										
		AMAL 1.50m		1.5								
		1.70m										
		AMAL 1.90m					1.90m					
				2.0			Hole Terminated at 1.90 m Excavation collapsing					
				2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

TEST PIT NO: TP52

CLIENT: Allam Property Group
PAGE: 1 of 1
PROJECT NAME: Proposed MHE
JOB NO: RGS03137.1
SITE LOCATION: 40-80 Chapmans Road, Tuncurry
LOGGED BY: APH
TEST LOCATION: See Figure 2
DATE: 5/10/22

EQUIPMENT TYPE: 6T Kubota Excavator
EASTING:
SURFACE RL:
TEST PIT LENGTH: 1.8 m **WIDTH:** 0.7 m
NORTHING:
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	5/10/2022	ES 0.20m				CL	**TOPSOIL:** Silty CLAY, low plasticity, dark grey/black, some sand, fine to medium grained, some roots	W				TOPSOIL
		0.30m					0.25m					
		AMAL 0.50m		0.5		SC	**Clayey SAND:** Fine to coarse grained, pale grey/pale brown, clay, low plasticity, strong sulfuric odour					ALLUVIAL SOIL
		0.80m										
		AMAL 1.00m		1.0								
		1.30m										
		AMAL 1.50m		1.5								
		1.80m										
		AMAL 2.00m		2.0			2.10m					
				2.5			Hole Terminated at 2.10 m Excavation collapsing					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP53

CLIENT: Allam Property Group | **PAGE:** 1 of 1

PROJECT NAME: Proposed MHE | **JOB NO:** RGS03137.1

SITE LOCATION: 40-80 Chapmans Road, Tuncurry | **LOGGED BY:** APH

TEST LOCATION: See Figure 2 | **DATE:** 5/10/22

EQUIPMENT TYPE: 6T Kubota Excavator | **EASTING:** | **SURFACE RL:**

TEST PIT LENGTH: 1.8 m | **WIDTH:** 0.8 m | **NORTHING:** | **DATUM:** AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	5/10/2022	ES 0.20m				CL	**TOPSOIL:** Silty CLAY, low plasticity, dark grey/black, some roots	W				TOPSOIL
		AMAL 0.50m		0.5		SC	**Clayey SAND:** Fine to coarse grained, pale brown/pale grey, clay, low plasticity, very strong sulfuric odour					ALLUVIAL SOIL
		0.80m										
		AMAL 1.00m		1.0								
		1.30m										
		AMAL 1.50m		1.5								
		1.70m										
		AMAL 1.90m										
				2.0			2.00m					
							Hole Terminated at 2.00 m Excavation collapsing					
				2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Appendix B

Laboratory Test Result Sheets

RESULTS OF ACID SULFATE SOIL ANALYSIS

23 samples supplied by Regional Geotechnical Solutions Pty Ltd on 7/10/2022. Lab Job No. N3426.
Analysis requested by Andrew Hills. Your Job: RGS03137.1.

44 Bent Street WINGHAM NSW 2429

Sample Identification	EAL Lab Code	Texture	Moisture Content		pH_F and pH_{FOX}			
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	pH_F	pH_{FOX}	pH change	Reaction
Method Info.		**	**		*(In-house method S21)*			
TP 48 0.3-0.5 m	*N3426/1*	Coarse	22.6	0.29	5.81	3.77	-2.04	Medium
TP 48 0.8-1.0 m	*N3426/2*	Coarse	20.5	0.26	6.30	4.38	-1.92	Medium
TP 48 1.3-1.5 m	*N3426/3*	Coarse	19.7	0.25	5.18	2.11	-3.07	Volcanic
TP 49 0.3-0.5 m	*N3426/4*	Coarse	21.0	0.27	5.59	3.49	-2.10	Medium
TP 49 0.8-1.0 m	*N3426/5*	Coarse	23.3	0.30	6.23	1.90	-4.33	Low
TP 49 1.3-1.5 m	*N3426/6*	Coarse	19.3	0.24	5.46	2.10	-3.36	Volcanic
TP 50 0.0-0.2 m	*N3426/7*	Medium	34.0	0.52	5.02	3.28	-1.74	Medium
TP 50 0.3-0.5 m	*N3426/8*	Coarse	18.4	0.23	5.37	3.65	-1.72	Medium
TP 50 0.8-1.0 m	*N3426/9*	Coarse	20.3	0.25	5.94	2.65	-3.30	Medium
TP 50 1.3-1.5 m	*N3426/10*	Coarse	20.7	0.26	5.54	2.06	-3.48	Volcanic
TP 51 0.3-0.5 m	*N3426/11*	Coarse	16.9	0.20	6.18	3.77	-2.41	Low
TP 51 0.8-1.0 m	*N3426/12*	Coarse	24.1	0.32	5.75	2.15	-3.60	Volcanic
TP 51 1.3-1.5 m	*N3426/13*	Coarse	22.9	0.30	6.06	2.20	-3.86	Volcanic
TP 51 1.7-1.9 m	*N3426/14*	Coarse	21.4	0.27	5.75	2.22	-3.53	Volcanic
TP 52 0.3-0.5 m	*N3426/15*	Coarse	15.7	0.19	5.98	4.46	-1.52	Medium
TP 52 0.8-1.0 m	*N3426/16*	Coarse	22.7	0.29	6.25	2.14	-4.11	Volcanic
TP 52 1.3-1.5 m	*N3426/17*	Coarse	16.7	0.20	6.08	2.11	-3.97	Volcanic
TP 52 1.8-2.0 m	*N3426/18*	Coarse	23.0	0.30	6.31	2.21	-4.11	Volcanic
TP 53 0.0-0.2 m	*N3426/19*	Medium	46.7	0.88	5.20	2.79	-2.41	High
TP 53 0.3-0.5 m	*N3426/20*	Coarse	16.8	0.20	6.65	4.28	-2.37	Medium
TP 53 0.8-1.0 m	*N3426/21*	Coarse	22.8	0.30	6.53	2.26	-4.27	Medium
TP 53 1.3-1.5 m	*N3426/22*	Coarse	19.9	0.25	6.63	2.14	-4.49	Volcanic
TP 53 1.4-1.9 m	*N3426/23*	Coarse	21.2	0.27	6.78	2.20	-4.58	Volcanic

NOTES:

1. All analysis is reported on a dry weight (DW) basis, unless wet weight (WW) is specified.
2. Samples are dried and ground immediately upon arrival (unless supplied dried and ground).
3. Analytical procedures are sourced from Sullivan L, Ward N, Toppler N and Lancaster G. 2018. National acid sulfate soils guidance: national acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT. CC BY 4.0.
4. The Acid Base Accounting Equation, where Acid Neutralising Capacity has not been corroborated by other data, is Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity (Eq. 3.2; Sullivan et al. 2018 - full reference above).
5. The Acid Base Accounting Equation for post-limed soil materials is Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity - (post treatment Acid Neutralising Capacity - initial Acid Neutralising Capacity) (Eq. 3.3; Sullivan et al. 2018 - full reference above).
   While the Acid Neutralising Capacity of a soil material may not be included in the Net Acidity calculation (Note 4), it must be measured to give an Initial Acid Neutralising Capacity if verification testing is planned post-liming.
   The Inital Acid Neutralising Capacity must be provided by the client to enable EAL to produce Verification Net Acidity and Liming calculations for post-limed soil materials.
6. The Acid Base Accounting Equation, where Acid Neutralising Capacity has been corroborated by other data, is Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity - Acid Neutralising Capacity (Eq. 3.1; Sullivan et al. 2018 - full reference above).
7. The lime calculation includes a Safety Factor of 1.5 as a safety margin for acid neutralisation (Sullivan et al. 2018). This is only applied to positive values. An increased Safety Factor may be required in some cases.
8. Retained Acidity is required when the pHKCl < 4.5 or where jarosite has been visually observed.
9. A negative Net Acidity result indicates an excess acid neutralising capacity.
10. If insufficient mixing occurs during intial sampling, or during post-liming, or both: the Potential Sulfidic Acidity may be greater in the post-limed sample than in the intial sample; the post-liming Acid Neutralising Capacity may be lower in the post-limed sample than in the intial sample.
11. **An acid sulfate soil management plan is triggered by Net Acidity results greater than the texture dependent criterion: coarse texture ≥ 0.03% S or 18 mol H+/t; medium texture ≥ 0.06% S or 36 mol H+/t; fine texture ≥ 0.1% S or 62 mol H+/t) (Table 1.1; Sullivan et al. 2018 - full reference above)**
12. For projects that disturb > 1000 t of soil material, the coarse trigger of ≥ 0.03% S or ≥ 18 mol H+/t must be applied in accordance with Sullivan et al. (2018) (full reference above).
13. Acid sulfate soil texture triggers can be related to NCST (2009) textures: coarse and peats = sands to loamy sands; medium = clayey sand to light clays; fine = light medium to heavy clays (Sullivan et al. 2018 - full reference above).
14. Bulk density is required to convert liming rates to soil volume based results. Field bulk density rings can be submitted to EAL for bulk density determination.
15. A negative Net Acidity result indicates an excess acid neutralising capacity.
16. '..' is reported where a test is either not requested or not required. Where pHKCl is < 4.5 or > 6.5, zero is reported for SNAS and ANC in Net Acidity calculations, respectively.
17. Results refer to samples as received at the laboratory. This report is not to be reproduced except in full.
18. ** NATA accreditation does not cover the performance of this service.
19. Analysis conducted between sample arrival date and reporting date.
20. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer SCU.edu.au/eal/t&cs or on request).
21. Results relate to the samples tested.
22. This report was issued on 11/10/2022.

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checked: .....
Graham Lancaster
Laboratory Manager

Appendix C

Acid Sulfate Soils Management Plan

ACID SULFATE SOIL MANAGEMENT PLAN

1 INTRODUCTION

The Acid Sulfate Soil Management Plan (ASSMP) outlined below shall be adopted for all works associated with the excavation of soils during the construction of the proposed MHE in Terrain Zone 1 soils in the western part of the site at 40-80 Chapmans Road, Tuncurry. The site is identified as Lot 1 DP304132.

This ASSMP is aimed at remediating or controlling the generation of sulphuric acidity during the excavation of actual and potential Acid Sulfate Soils (ASS) for the proposed stormwater basin to be located in the south-west of the site and where excavations will be undertaken into the natural ground profile elsewhere in Terrain Zone 1 soils (western part of the site).

Attention is drawn to the fact that verification testing of the treated ASS generally takes between 5 and 10 working days and therefore time should be allowed in the earthworks management plan for the site for this process to occur.

2 RESPONSIBILITIES

The project superintendent is responsible for implementing the ASS management protocols detailed within this ASSMP. Only a suitably experienced ASS consultant may vary the procedures detailed herein.

The superintendent shall:

- Record a daily log showing the volume of material that has been excavated and treated;
- Ensure that verification testing is undertaken by an independent monitoring consultant on a regular basis.

The requirements of the ASSMP are in addition to, but do not override any other standard procedures such as safety considerations. Where conflict results, or may result from, the implementation of the ASS management as against other performance criteria, the project superintendent shall obtain directives from the project manager or the ASS consultant as appropriate.

3 NEUTRALISING MATERIALS

Fine Agricultural Lime (aglime) will be used for lining of processing or stockpile areas and for blending within excavated materials. Dolomatic aglime, or magnesium blend aglime, should not be used. The aglime shall have:

- At least 85% by weight passing 1mm, and 100% passing 2.5mm. In general a finer grind is better; and
- Aglime shall have a Neutralising Value (NV) of 90% or better (i.e. NV>90).

4 MANAGEMENT AND PROCESSING OF ASS

4.1 Treatment Area

ASS shall be placed in a prepared treatment area on site or within the road corridor at an approved location. To prevent runoff to other areas of the site the treatment area shall be ringed by a bund wall that has a height of at least 0.5m that comprises soils that are not ASS or are treated ASS. The treatment area should be of sufficient size to treat the excavated materials at the proposed excavation rate and to store material for the period required to undertake the verification testing.

The base of the treatment area and bund wall batters shall be limed at a rate of $9kg_{lime}/tonne_{soil}$.

4.2 Treatment

The ASS shall be placed in the treatment area and spread in layers of not more than 300mm thick with lime being applied across the treatment area at a rate of 9kg/tonne. The lime shall be evenly mixed and be applied within 8 hours of excavation.

4.3 Verification Testing

Verification testing shall be undertaken by an independent ASS consultant. The number of samples to be tested shall be based on the volume of the stockpile or treated soil within the treatment area as outlined in Table C1.

Table C1. Number of verification samples required based on treated soil/stockpile volume

Volume (m^3)	Number of samples
<250	2
251 - 500	3
501 – 1,000	4
>1,000	4 plus one per additional $500m^3$

The samples shall be submitted for testing by the Chromium Reducible Sulfur suite and the Verification Net Acidity compared to ASSMAC Action Criteria. The Verification Net Acidity shall be determined from the test results as outlined below:

> *Verification net acidity = Potential Sulfidic Acidity + Actual Acidity + Retained Acidity – (Post treatment Acid Neutralising Capacity – Initial Acid Neutralising Capacity)*

If testing indicates verification net acidity values that exceed ASSMAC Action Criteria in the processed material, reprocess (potentially requiring variation in the processing methodology) and re-sample to verify that acceptable values have been obtained.

All records applicable to acid sulfate testing and treatment shall be collated to substantiate treatment.

4.4 Water Quality Monitoring

Waters collected in the treatment area (if any) shall be tested for pH on a daily basis during the works. If the recorded pH of any sample is less than 6, it shall be immediately retested. If the pH is again below 6, the pH shall be adjusted by the application of hydrated lime until it is in the range 6 to 8.

Where the pH is less than 4.0, the ASS Consultant shall be engaged within 6 hours to review the site practices and monitoring results and to recommend remedial measures.

Complete records of all monitoring results shall be maintained by the Contractor.

4.5 Post Treatment

Once the ASS materials have been treated in accordance with this ASSMP, the materials may be reused on site, or disposed of at a licensed waste landfill. In accordance with a directive from the EPA, unless a specific order, exemption, or approval is granted from the EPA the treated material may not be reused on another site.