GEOID Geotechnical Engineering

GEOTECHNICAL INVESTIGATION REPORT

No.10 Raven Circuit Warriewood NSW

Prepared For: IED

Reference: 8792

Revision: 0

Date: 13 April 2025

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Document Control

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Document Status and Review History			
Revision	Author:	Date Issued	Comments
0	Prageeth Edirisinghe	13 April 2025	First Release

As behalf of GEOID Engineering,

Prageeth Edirisinghe

Associate Geotechnical Engineer

BSc ENG, MIE Aust, CPEng, NER, PE 0013785, PRE0002276

Contents

1. Introduction

This report presents the results of a geotechnical investigation undertaken by Geoid Engineering Pty Ltd for the proposed residential development at No.10 Raven Circuit Warriewood NSW.

The aim of this investigation was to assess the subsurface soil conditions to report on the Site classification as per AS 2870-2011 and provide a suitable footing recommendation for proposed structure.

1.1 Referenced Standards/ Guidelines

Throughout the scope of work, the Australian Standards listed below were referenced.

- AS 1726-2017, Geotechnical site investigations, Standards Australia, Sydney, Retrieved from SAI Global
- AS 2159-2009, Piling-Design and Installation, Standards Australia, Sydney, Retrieved from SAI Global
- AS 2870-2011, Residential slabs and footings, Standards Australia, Sydney, Retrieved from SAI Global
- AS 3798-2007, Guidelines on earthworks for commercial and residential developments, Standards Australia, Sydney, Retrieved from SAI Global
- AS 4678-2002, Earth-retaining structures, Standards Australia, Sydney, Retrieved from SAI Global

2. Site Description

No.10 Raven Circuit Warriewood NSW is near rectangular shaped residential allotment covering an approximate 482 square meters. The site is relatively level with no significant fall across the site. The site at the time of the investigation was in vacate possession. The ground cover mainly consisted of bare ground.

3. Desktop Assessment

3.1 Site Geology

Reference to the Geological Survey of NSW seamless geology extracted from MinView indicates the site is located in an area of Fluvially-deposited quartz-lithic sand, silt, gravel, clay from Quaternary age. The subsurface conditions encountered during the field works is considered to be consistent with the geological map indications presented in Figure 1.

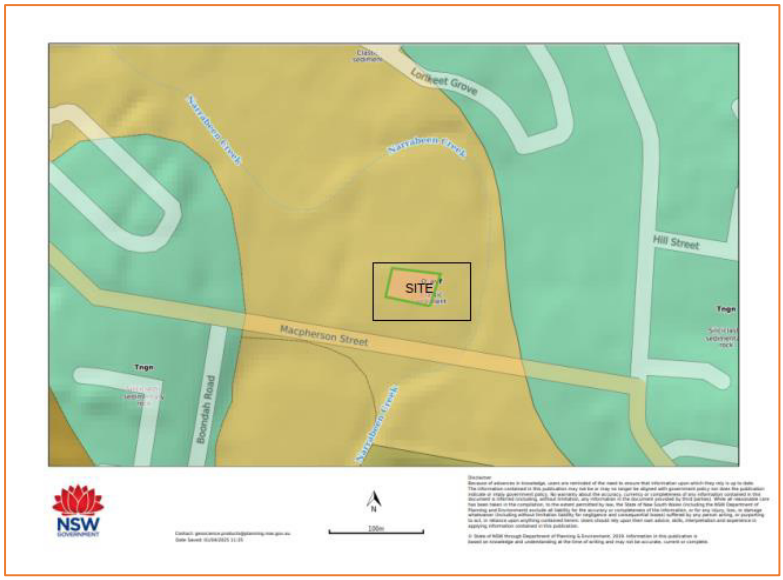

Figure 1: Local Geology (Extracted NSW seamless geology from MinView)

4. Scope of Work

The field work was carried out on 01 March 2025 and comprised the drilling and sampling of two (2) borehole. The bores were drilled using a mechanical auger drilling rig mounted on a ute. Samples were collected at 0.5 m depth intervals from BH01 for assessment of acid sulphate soils. Performance of screening tests on each soil sample collected comprising pHf (PH in water), and pHfox (PH following chemical oxidation by hydrogen peroxide).

Dynamic Cone Penetration (DCP) test was conducted adjacent to BH01.

4.1 In-situ Findings

Details of the borehole logs are given in Appendix A including the AS 1726 classification definitions and relevant descriptive terms. Relatively uniform conditions were encountered underlying the site, with the succession of strata broadly summarized as follows:

Fill – Silty Gravelly SAND

Natural - Silty SAND

The ground conditions encountered in the boreholes drilled at the time of the investigation typically comprised of 3.5 m of fill overlying natural soils originated from residual.

4.2 Ground Water

At the time of the investigation permanent water table was not intersected within bore holes up to drilled depth. However, it is pointed out that standing groundwater and seepages may fluctuate with variations in rainfall, temperature and other factors.

4.3 Laboratory tests

Disturbed samples were collected during the investigation for subsequent laboratory assessment. The testing was undertaken at ALS NATA accredited environmental laboratory and consisted of:

- 3 x PH/EC
- 3 x PHf/PHfox

The test records are appended in the Appendix B

4.4 Acid Sulphate Soil Risk

Published acid sulphate soil risk mapping indicates that the area encompassing the proposed residential development is located near mapped as “high probability of occurrence of acid sulfate soil materials between 1 to 3 meter below the ground surface”.

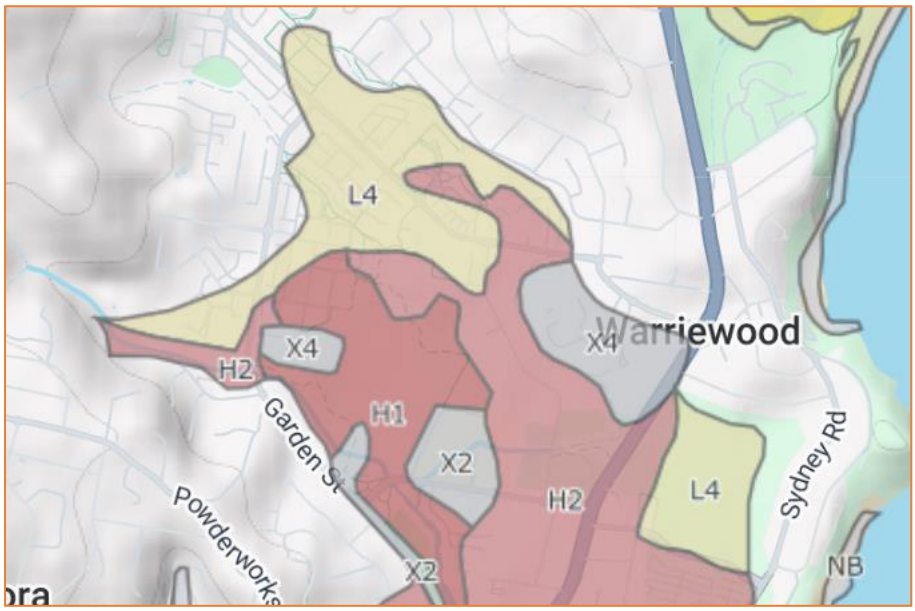

Figure 2: Acid sulphate soil probably map (extract from eSPADE, NSW)

5. Geotechnical Assessment

5.1 Soil Acid Sulfate Assessment

5.1.1 Acid sulfate soil laboratory analysis

Initial acid sulphate soil screening tests were undertaken on all soil samples by ALS laboratory in accordance with the method as described in Ahern CR, EcElnea AE, Sullivan LA (2004), acid sulphate soils Laboratory Methods Guidelines. The screening tests comprised measurement of pH of the soil in water (pHf) and pH of the soil after oxidation with 30% solution of hydrogen peroxide (pHfox). The results of these tests provide an indication as to the presence of actual and potential acid sulphate soils and should be considered as qualitative only. The acid sulphate soil laboratory results are presented in Appendix B, together with the laboratory reports and associated chain of custody reports.

Table 1: Summary of Screening results

Test Location	Sample ID	Depth (m)	EC (µS/cm)	PH	Screening Tests			
					pH_f	pH_{fox}	Reaction Intensity	Δ pH
BH01	ES2509629-001	0.5	126	8.6	8.1	5.1	2	3.0
BH01	ES2509629-002	1.0	82	5.2	6.1	3.8	2	2.3
BH01	ES2509629-003	1.5	98	7.7	7.4	4.6	2	2.8

Reaction Intensity: 1= no reaction, 2= mild reaction, 3= vigorous reaction, 4= violent reaction

5.1.2 Acid sulfate soils

The screening test results were assessed for the possible presence of Actual Acid Sulphate Soil (AASS) or Potential Acid Sulphate Soil (PASS) on the basis of the following guidance indicators specified in the DWER (June 2015), namely:

- pH_F measures the existing acidity of the soil and is used to help identify whether the site contain actual ASS is present. If pH_F is less than 4 is indication of that the site is contain ASS. All tested samples are greater than indicate that the site actual ASS is not presented in the site.

- pH_{FOX} <3 , is high PASS potential, given that the tested samples indicate pH_{FOX} is in the range of 3.8 to 5.1

indicates moderate potential for PASS.

DWER (June 2015) specifies texture-based action criteria to initiate management of acid sulphate soils. These are summarized in Table 2.

Table 2: Texture-based action criteria

Type of Material		Net Acidity Action Criteria	
		<1000 tonnes of material is disturbed	>1000 tonnes of material is disturbed
Texture range McDonald et al (1990)	Approx. Clay content (%)	Equivalent sulphur (%S)	
Coarse texture sands to loamy sands	<5	0.03	0.03
Medium texture sandy loams to light clays	5 - 40	0.06	0.03
Fine texture medium to heavy clays and silty clays	>40	0.1	0.03

5.1.3 Interpretation of the results

The acid sulphate soil results of samples collected at the BH01 are presented in Appendix B and indicate the following:

- The results for pH_F were not indicative of actual acid sulphate soil conditions to the testing depth of 1.5m;
- The results for pH_{FOX} were indicative of moderate potential acid sulphate soil conditions to the testing depth of 1.5m.

5.2 Site Classification

In accordance with AS2870-2011, "Residential Slabs and Footings - Construction" a class P site classification is appropriate for this site due to fill. It is anticipated that the characteristic surface movement under normal moisture condition of approximately, Ys, of 40mm.

Note: the above site classification and was established based on

- Identification of the site soil profile and with reference to Section 2 and Appendix D of AS2870-2011.
- The site conditions present at the time of the geotechnical investigation.
- The information supplied to this office by the client pertaining to this site.
- Past experiences of the writers in the same area.

5.3 Wind Rating

Wind rating for this site has been assessed as N1 in accordance with Section 2 of AS4055-2012. The maximum design gust ultimate limit state wind speed (Vh,u) for this site is considered as 34m/s.

5.4 Recommended Foundation Options

5.4.1 Waffle/ Stiffened Raft Foundation

Based on the site classification and filling encountered during drilling, a floor slab footings system complying with minimum reinforced and dimension requirement of **class M** site classification suspended on bored piers considered suitable for this site. Such piers must be founded a minimum 800mm into naturally clay soils. Please refer section **5.4.2** for further design recommendations for deep foundation.

5.4.2 Pile Foundation

Considering the geological profile encountered in the subject area, bored or screw piles may be implemented in combination with an engineer designed suspended ground floor slab where required. The piles will distribute loads through slab beams to the underlying naturally occurring Silty SAND.

The allowable base resistance and shaft adhesion values presented in Table 3 can be adopted for designing the minimum embedded depth of the piles.

Table 3: Allowable pile design parameters

Material Type	Minimum founding depth (m) – BESL (Below existing surface level)	Allowable Shaft Adhesion (kPa)	Allowable Base Resistance (kPa)
Silty SAND	800 mm into layer	7	250

No skin friction should be adopted for FILL soils or soils within 1.4 m of surface level.

The allowable bearing capacity values provided in this report are maximum values without further geotechnical investigation or detailed analysis of foundation designs.

It should be noted that given the depth of fill and natural soil being silty SAND, the upper fill and some part of the natural sand may likely collapse during bored pier excavation. For that reason, we recommend adopting screw pile or keep provision for using casing during excavation bored piers.

6. Construction Methodology

The site should be constructed by following the below given items and all relevant specifications and standards provided by the other parties.

- Site should be scrapped a minimum 100mm to remove any organic materials and vegetation within the proposed building envelope.
- Site should be track rolled after initial site scrape to unveil any soft spots, these soft areas to be removed and then properly compact with suitable fill material as described in AS2870-2011, Clause 6.4.2.
- Item 1 and 2 must be completed by following AS3798-2007 Guidelines on earthworks for commercial and residential developments.
- Site drainage is very important at sites has a reactive soil profile, thereby we recommended that ground surface immediately next to the perimeter footings be graded away from the slab at a minimum of 1:20 grade for a minimum distance of 1.5m.
- A second soil test should be conducted on this site if the site cut is more than 400mm clay soil and 800mm for sandy soil.
- Any filling placed across the site for leveling benchmark prior to slab construction should conform with requirement for either Controlled fill, Clause 2.5.3 or Rolled fill, Clause 6.4.2 AS 2870-2011.
- As soon as the roof is constructed the roof drainage should be carried away from the slab to avoid water ponding around the slab perimeter.

7. Report Limitations

This report must be read in conjunction with the below limitations.

- This report has been prepared for use by IED in relation to the proposed development in accordance with generally accepted consultancy practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than IED and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.

- This report is not a detailed geotechnical investigation. It complies with the requirements of AS2870-2011 and is limited to the items required under Clause 2.2.2(a).
- This report was compiled on basic geotechnical investigation only, if the subsurface soil conditions encountered during construction stage is different substantially from what described on the soil report,
- This report does not assess the potential contamination, landslide, slope stability or aggressive soil.
- Geoid Engineering Pty Ltd endeavor to assess the pre-site history with available sources. However, Geoid Engineering Pty Ltd cannot be held responsibility for any financial loss in relation to the structure and future performances of the footing if the site history has not been supplied to this office in writing by the client.
- The soil and fill depths are given in the report are to a tolerance of +/-200mm
- If the site cut is greater than 400 for clay soil and 600mm for sand soil the given recommendation and soil classification may not applicable anymore. There by a second soil test must be undertaken for such site.
- If the site conditions at the time of construction differ from those described in this report then this office must be contacted immediately. As such, a site inspection can be carried out prior to any footing being poured. The owner/builder will be responsible for any fees associated with this additional work.

APPENDIX A
SITE PLAN AND BOREHOLE LOGS

GEOID
Geotechnical Engineering

Title: Site plan
No. 10 Raven Circuit Warriewood NSW

Project No: 8792

Sheet: 1 of 1

Rev: 0

Client: IED

Date: 01.04.2025

GEOID Geotechnical Engineering

GEOID Engineering

Phone: +61 452 323 222

Geotechnical Log - Borehole

BH01

UTM	:	**Drill Rig**	: Drillman GT10	**Job Number**	: 8792
Latitude	:	**Driller Supplier**	:	**Client**	: IED
Longitude	:	**Logged By**	: UB	**Project**	: Geotechnical Investigation Report
Ground Elevation	: Not Surveyed	**Reviewed By**	: PE	**Location**	: 10 Raven Circuit Warriewood NSW
Total Depth	: 3 m BGL	**Date**	: 01/04/2025	**Loc Comment**	:

Drilling Method	DCP Graph (0 5 10 15 20 25)	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Material Description	Consistency	Moisture	Remarks
			1 2	Fill		SM	Fill Gravelly to silty SAND SM: medium dense, red brown grey, fine to coarse grained, fine to medium sized gravel, moist.	MD	M	
							BH01 Terminate at 3m (End of borehole, target depth achieved)			

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

GEOID Geotechnical Engineering

GEOID Engineering

Phone: +61 452 323 222

Geotechnical Log - Borehole

BH02

UTM	:	**Drill Rig**	: Drillman GT10	**Job Number**	: 8792
Latitude	:	**Driller Supplier**	:	**Client**	: IED
Longitude	:	**Logged By**	: UB	**Project**	: Geotechnical Investigation Report
Ground Elevation	: Not Surveyed	**Reviewed By**	: PE	**Location**	: 10 Raven Circuit Warriewood NSW
Total Depth	: 4.5 m BGL	**Date**	: 01/04/2025	**Loc Comment**	:

Drilling Method	DCP Graph ● (0 5 10 15 20 25)	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Material Description	Consistency	Moisture	Remarks
			1	Fill		SM	Fill Gravelly to silty SAND SM: medium dense, red brown grey, fine to coarse grained, fine to medium sized gravel, moist.	MD	M	
			2							
			3							
			3.5	Natural		SM	Natural SAND, SM: Silty, medium dense, grey orange brown, fine to coarse grained, moist.	MD	M	
			4							
							BH02 Terminate at 4.5m (End of borehole, target depth achieved)			

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

APPENDIX B
LABORATORY TEST RESULTS

CERTIFICATE OF ANALYSIS

Work Order	: **ES2509629**	Page	: 1 of 2
Client	: **CASH SALES SYDNEY**	Laboratory	: Environmental Division Sydney
Contact	: Umang Bhadani	Contact	: Customer Services ES
Address	:	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 31-Mar-2025 16:20
Order number	: ----	Date Analysis Commenced	: 08-Apr-2025
C-O-C number	: ----	Issue Date	: 10-Apr-2025 15:59
Sampler	: ----		
Site	: ----		
Quote number	: EN/444		
No. of samples received	: 5		
No. of samples analysed	: 5		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Layla Hafner	Acid Sulphate Soils - Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA003 (NATA Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01@0.5	BH01@1.0	BH01@2.0	BH02@0.5	BH02@1.5
			Sampling date / time	31-Mar-2025 00:00	31-Mar-2025 00:00	31-Mar-2025 00:00	31-Mar-2025 00:00	31-Mar-2025 00:00
Compound	CAS Number	LOR	Unit	ES2509629-001	ES2509629-002	ES2509629-003	ES2509629-004	ES2509629-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.6	5.2	7.7	8.3	11.1
EA003 :pH (field/fox)								
pH (F)	----	0.1	pH Unit	8.1	6.1	7.4	7.8	10.8
pH (Fox)	----	0.1	pH Unit	5.1	3.8	4.6	5.0	7.6
Reaction Rate	----	1	Reaction Unit	2	2	2	2	3
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	126	82	98	141	415

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry / Biology).

(SOIL) EA003 :pH (field/fox)