GEOTECHNICAL AND ACID SULFATE SOILS **REPORT**

310 Terrigal Drive, Terrigal NSW 2260

Loftus Lane Capital Pty Ltd – June 2023

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GEOTECHNICAL AND ACID SULFATE SOILS REPORT

310 Terrigal Drive,
Terrigal NSW 2260

PREPARED FOR

Loftus Lane Capital Pty Ltd
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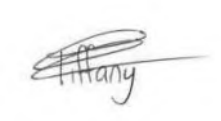

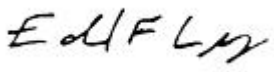

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1. INTRODUCTION

Geo-Logix has prepared this Geotechnical and Acid Sulfate Soils Investigation on behalf of LoftusLane Capital Partners (the applicant), in support of a Planning Proposal relating to land identified as 310 Terrigal Drive, Terrigal, which is legally described as Lot 27 in DP 1223375 (the site).

The Planning Proposal seeks to amend the Central Coast LEP 2022 by increasing the maximum permissible height of buildings to 32m, and the maximum floor space ratio to 1.4:1. The Planning Proposal will enable the site to be redeveloped from a vacant land parcel to a seven-storey residential flat building, with a café activating the corner of Charles Kay Drive and Terrigal Drive at the ground level. The concept drawings prepared by CKDS Architects demonstrate the potential for the site to accommodate 42 residential apartments and 75 car parking spaces across three basement levels (Attachment A).

1.1 Objectives and Scope of Work

The objective of the investigation was to provide an assessment of subsurface conditions for the proposed mixed use residential and retail facility development with three basement levels and underlying flood storage.

To satisfy the above objectives Geo-Logix completed the following scope of work:

- Visual appraisal of the site conditions and locality;
- Review of the geological maps for the area;
- Completion of four test bores, BH1 to BH4 using solid stem auger with V-bit and TC-bit attachment to a maximum depth of 20 metres below grade (mbg);
- Performance of Standard Penetrometer Tests (SPT) within each drilled bore at regular intervals to assess the relative density and / or consistency of the subsurface soils and to obtain representative soil samples;
- Logging of the borings in accordance with the Unified Soil Classification System (USCS);
- Collection of representative soil samples for selective geotechnical and Chromium Reducible Sulfur laboratory testing;
- The completed borings were backfilled with drill cuttings and compacted on completion; and
- Provision of this report detailing the results of the above investigation, recommendations for design, construction of the proposed extension and acid sulfate soils advice.

2. SITE INFORMATION

Site Information	Details
Address	310 Terrigal Drive, Terrigal NSW
Lot and Deposited Plan (DP)	Lot 27 DP1223375
Approximate Area	4,265 m2
Coordinates	Lat: 33° 26.379' S Long: 151° 25.701' E
Site Description	The site comprises a roughly triangle lot of open space and bushland area at the intersection of Terrigal and Charles Kay Drive. The site is bound by Terrigal Drive to the north and Charles Kay Drive to the west. The site shares its' southern boundary with Terrigal High School. At the time of the inspection, the site was vacant and vegetation with tall grass and mature trees. A creek was observed running in a from north to south along the eastern site boundary.
Topography and Elevation	The site has an elevation of 4 mAHD and generally slopes towards the on-site creek. Regional topographic slopes to the north-east towards Terrigal Lagoon.
Geology	The site consists of Quaternary age alluvium in a alluvial backswamp deposit formation. The dominant lithology is organic rich sediment, with organic rich mud, peat, silt and clay.
Regional Hydrogeology	Groundwater is expected to follow regional topography and flow northeast towards Terrigal lagoon. Terrigal lagoon is discharging to the Pacific Ocean at Terrigal Beach approximately 1.60 km southeast of the site.

3. METHOD OF INVESTIGATION

Geotechnical fieldworks were undertaken by Geo-Logix on 24 and 26 April 2023. The methodology is presented below:

- Prior to undertaking the borings, each location was scanned for underground services and utilities by an independent utility locator and cross-checked with the results of a 'Before You Dig' (BYD) search;
- Bores BH1 to BH4 were completed utilising a truck mounted drill rig equipped with solid stem augers with a "V" shaped hardened steel bit (V-bit) to V-bit refusal and SPTs. At BH2, the V-bit was switched to a TC-bit at 14.5 mbg until termination at 19 mbg.
- In all the borings, SPTs were completed at regular intervals to provide blow counts indicative of the soil/rock strength and provide representative samples of the subsurface;
- Performance of in situ pH and oxidised pH testing which indicate the presence of Acid Sulfate Soils at each metre in each boring;
- Encountered soils were logged in accordance with the Unified Soil Classification System (USCS). The boring logs, including SPT results are presented in Attachment B.

- Representative soil samples were submitted to Eurofins Environment Testing Australia Pty Ltd (Eurofins) and Macquarie Geotech for selective characterisation and chemical tests; and
- Submission of one sample from each boring exhibiting a drop in pH following oxidation to a NATA accredited laboratory for Chromium Reducible Sulfur Analysis; and
- At the completion of drilling, the test bores were reinstated with soil cuttings.

4. SITE GEOLOGY AND HYDROGEOLOGY

4.1 Surface and Subsurface Conditions

The following sections contain a summarised account of the site surface and subsurface. For detailed descriptions of individual locations please refer to the boring logs in Attachment B.

Soils

On-site soils were typically comprised of interbedded firm to stiff, brownish yellow / light red / dark grey Lean Clays (CL) and loose, very pale brown / greyish orange / pale red Sand (SP) with clay or loose medium dark grey clayey sand (SC).

Bedrock

Bedrock comprising light red / moderate reddish orange, weathered conglomerate or sandstone was encountered at approximately 13 mbg in BH02 in the north eastern portion of the site. Pink / moderate orange pink, low resistance weathered sandstone with medium resistant bands was encountered from 13 mbg in BH03 and 11.4 mbg in BH04.

Groundwater

During drilling, groundwater inflow was encountered at 1.5 to 2.5 mbg with stabilised groundwater recorded at 0.8 mbg after drilling.

5. ACID SULFATE SOIL FORMATION

Acid sulfate soils are those soils that naturally contain iron sulphides which, when exposed to air after being disturbed, can produce sulfuric acid due to oxidation of the sulphides. Their formation requires the presence of iron-rich sediments, sulfate (usually from sea water), removal of reaction products such as bicarbonate, the presence of sulfate-reducing bacteria and an abundant supply of organic matter. These conditions generally exist in mangroves, salt marshes, inter-tidal areas and on the beds of coastal rivers and lakes. In Australia they generally occur in soil horizons at a height of less than 5 m AHD.

The adverse environmental impacts of acid sulfate soil disturbance can be significant and include fish kills, fish disease, release of heavy metals from contaminated sediments, and human and ecological impacts.

Potential Acid Sulfate Soils (PASS) are acid sulfate soils which are unoxidised in their natural state. They possess the potential to generate acid upon lowering of the water table, excavation or other disturbance resulting in exposure to oxygen.

Actual Acid Sulfate Soils (AASS) are acid sulfate soils which are partially or wholly oxidised in their natural state. The pore water in these soils is acidic as a result of previous acid generation. The potential for additional acid generation may also exist.

6. ACID SULFATE SOIL RESULTS

ASS pH Screening

In each boring, samples of fill and natural soil from each metre were tested for natural pH and pH following oxidation with a peroxide solution to screen for Actual Acid Sulfate Soils (AASS) and Potential Acid Sulfate Soils (PASS). The reaction of the soil during oxidation was recorded using a Fizz Rating scale of 1.0 (no reaction to slight) to 4.0 (extreme reaction).

The existing pH of natural soil was typically slightly acidic to neutral, with a few profiles recording higher acidity values (pH 4.5 to 7.5). Oxidation tests with hydrogen peroxide across the entire soil profile displayed high reactions with highest reductions below 7 mbg between 1.06 and 3.0 in pHF to oxidised pH (Table 1).

Chromium Suite Analysis

Geo-Logix submitted four samples for chromium suite analysis. The laboratory results were compared against the acid sulfate soils action criteria defined in Table 4.4 of the NSW ASS Manual (ASSMAC, 1998). The action criteria for earthworks disturbing more than 1,000 tonnes of soil is ≥ 18 mol H+/tonne acidity.

Acid base accounting based on the results of chromium suite analysis is summarised in the following table:

Category	Location / Depth						Discussion
	BH4/ 0.4-0.5	BH3/ 3.9-4.0	BH4/ 5.0-5.1	BH1/ 7-7.1	BH2/ 7-7.1	BH2/ 14-14.1	
Existing Acidity (mol H^+/t)	**71**	16	**19**	**170**	**49**	6.7	Titratable Actual Acidity (TAA) exceeded the action criteria in four of the six soil samples tested, indicating the presence of significant existing acidity in the site soils.
Potential Acidity (eq. mol H^+/t)	6.8	3.3	< 3	**1,500**	**560**	7.2	Chromium reducible sulfur was detected at concentrations greater than the action criteria soil samples BH1/7-7.1 and BH2/7-7.1. Lower concentrations of sulfur were identified in three of the four remaining samples.
Acid Neutralising Capacity	n/a	n/a	n/a	n/a	n/a	n/a	No acid neutralising capacity was measured in the analysed samples.
Net Acidity (eq. mol H^+/t)	**78**	**19**	**19**	**1,700**	**610**	14	Net acidity exceeded the action criteria in all soil samples analysed, with the exception of bedrock sample BH2/14-14.1.
Liming Rate (kg $CaCO_3$/t)	5.8	1.5	1.5	130	45	1	

Exceedances of the action criteria are in **bold red**.

n/a = not applicable

ASS indicators exceeded the action criteria in all samples tested within the expected depth of excavation. Onsite soils are considered ASS and will require management during construction.

7. ACID SULFATE SOIL MANAGEMENT

All on-site soils deeper have been identified as ASS. Any disturbance of these soils is to be managed in accordance with the following procedures.

7.1 Temporary Stockpile Preparation

The stockpile area is to be prepared adjacent to the soil removal area prior to the commencement of soil removal activities. The stockpile area should be located on asphalt or concrete sealed hard stand if possible, and lined with 200 micron high density polyethylene (HDPE) sheeting. If it is impractical to locate stockpile on a hardstand surface then an area should be prepared by levelling and removal of any material that could lead to perforation of the HDPE liner.

The HDPE sheets are to be rolled out perpendicular to the slope, with a minimum of 300 mm overlap. The up-gradient layer is to overlap the down gradient layer. Each side of the overlap is to be sealed with a PVC tape. The HDPE is to be bunded by hay bales. The HDPE is to extend over the hay bale and be 'locked' into position by a second hay bale placed on the HDPE and positioned behind the first hay bale.

The stockpiled soil is to be covered with builders plastic once all excavation is complete to prevent additional leachate generation from rainfall percolating through stockpiled material. All stormwater entry points down gradient of the worksite are to be blocked off using sand bags or similar during excavation activities. Sand bags can be removed once the stockpile is covered with plastic.

7.2 Ex-Situ Lime Application

Lime is to be used to neutralise acid. Liming rates were provided by the laboratory for all samples analysed for Chromium Reducible Sulfur. Laboratory liming rates were in the range 1 – 130 kg lime/tonne for soils across the site.

Where ex-situ lime application is necessary to neutralise soils for on-site re-use or off-site disposal, Geo-Logix conservatively recomends that soils in the top 5 mbg be mixed with lime at a rate of 6 kg lime per tonne of soil and 130 kg lime per tonne of soil for spoil from below 5 mbg.

Agricultural lime with neutralising value of 95%-98% must be used. Builders lime, including hydrated lime, slaked lime or quicklime, is not appropriate for use.

Following lime application, the material should be subjected to verification testing for pH and acidity at a minimum rate of one sample per 250 m^3.

7.3 Stockpile Leachate Collection and Disposal

Any water/leachate draining from the stockpiled soils is to be collected in a sealed sump at the down-gradient end of the stockpile area. Any leachate is to be pumped from the sump into a holding tank. If otherwise suitable for onsite dispersal, the water should be sampled for pH and neutralised prior to dispersal.

7.4 Waste Classification and Off-site Disposal

Any excess soil to be disposed off-site must be classified in accordance with the NSW EPA (2014) Waste Classification Guidelines – Part 1 Classifying Waste.

A separate transport certificate must accompany each load of waste that is being transported. A waste transport certificate is a document that includes information about the waste, the consigner, the transporter and receiving facility.

7.5 Groundwater

Due to the presence of ASS, disturbance of groundwater levels should be avoided. Any necessary groundwater disturbance should be limited to the shortest possible duration. During design, care should be taken to ensure groundwater is not permanently lowered.

8. GEOTECHNICAL SOIL LABORATORY RESULTS

Representative samples of soil were collected during the fieldwork and submitted to Eurofins and Macquarie Geotechnical for laboratory testing. Tests included:

- Atterberg Limits and Linear Shrinkage tests to assess the plasticity and reactivity of specific soil samples to assist with classification and description;
- Standard Maximum Dry Density (MDD), Optimum Moisture Content (OMC) and California Bearing Ratio (CBR) testing to assist with pavement and slab design;
- Aggressivity testing (electrical conductivity, sulfate, chloride and pH) to assess the exposure classification of the soil with respect to buried structural concrete and/or exposed steel;
- Unconfined Compressive Strength (UCS) and Point Load Strength tests to assist with the determination of rock strength and rippability; and
- Chromium Reducible Sulfur Suite to assess if acid sulfate soils were present on-site.

The laboratory test results are presented in Attachment C. A summary of the results is provided in the following sections.

8.1 USCS Classification Testing

Soil samples were collected from locations BH2 and BH3 between 2.5 and 4.45 mbg and submitted for laboratory analysis to Macquarie for NATA accredited Atterberg Limits and Linear Shrinkage tests. The sample was selected to confirm the USCS field classification of fill and natural soils across the site. Linear Shrinkage testing was completed to facilitate calculation of the free surface movement of the onsite soils for site classification in accordance with AS2870-2011. A summary of the results is provided in the following table.

Location/Depth (m)	Sample Description	Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
BH2/2.5-2.95	Silty Clay	44	31	13.5
BH3/4.0-4.45	Silty Sand	30	20	9.5

-- not analysed

The potential for surface movement based on the reactivity of the soil to changes in moisture is discussed in Section 9.7.

8.2 Californian Bearing Ratio (CBR)

Bulk soil samples were collected from various locations and submitted for laboratory analysis to determine a CBR value for use in pavement design. These samples were submitted to Macquarie for NATA accredited testing of the CBR.

The CBR samples were remoulded in the laboratory and compacted to 100% standard maximum dry density (SMDD) at optimum moisture content (OMC). Prior to testing, the samples were soaked for four days under a surcharge load of 4.5 kg. The soaked CBR values are provided in the following table.

Sample ID	Sample Description	SMDD (t/m^3)	OMC (%)	CBR Value (%)	Swell After Soaking (%)
BH4/0.1-0.3	Silty Clay	1.38	28.6	10	0.5

Pavement design based on these CBR results is discussed in Section 9.9.

8.3 Exposure Classification Tests

Selected soil profile samples were submitted to Eurofins for NATA accredited testing of pH, sulfate, chloride and electrical conductivity to determine the exposure classification (or aggressiveness/ corrosiveness potential of the soil) with respect to buried steel and/or concrete. The samples were selected as representative of onsite soils in which foundations were expected.

To determine the aggressiveness of the soil and water environment on concrete or steel, the chemical test results are compared to Tables 6.1 and 6.3 from Section 6 of the Australian Standard AS2159 – 2009. This section provides assessment criteria to assess the 'exposure classification' for a concrete or steel pile. The Standard has two classes of soil conditions:

- Type A – high permeability soils below groundwater; and
- Type B – low permeability soils and all soils above groundwater.

Based on the chemical testing results, the Standard provides a range of 'exposure classifications' from non-aggressive to very severe. For the range of chemical conditions in the soil surrounding the structure, the condition leading to the most severe aggressive conditions is adopted. A summary of the soil results is provided in the following table.

Location/ Depth (m)	Soil Condition	Electrical Conductivity (EC) (dS/m)	Soil Texture Factor	Extract Electrical Conductivity (EC_e) (dS/m)	Electrical Resistivity (Ω·cm)	pH	Chloride (mg/kg)	Sulfate (mg/kg)
BH1/1.0-1.45	A	0.057	10	0.57	18,000	5.9	57	32
BH2/1.0-1.45	A	0.025	10	0.25	40,000	5.7	< 10	54
BH2/4.4-4.45	A	0.046	10	0.46	22,000	5.7	25	68
BH4/2.5-2.95	A	0.110	10	1.1	9,100	5.2	93	120
BH4/4.0-4.45	A	0.072	10	0.72	14,000	5.5	50	85
BH4/5.5-5.95	A	0.093	10	0.93	11,000	5.4	57	120
BH4/8.5-8.95	A	0.061	10	0.61	16,000	6.7	58	49
BH4/11.5-11.8	A	0.055	10	0.55	18,000	6.4	66	25

The potential aggressivity of an environment towards concrete and steel is dependent on the sulfate, chloride and pH levels of the soil. Soil aggressivity is discussed in Section 9.10. Site Salinity is discussed in Section 9.11.

9. DISCUSSION

9.1 Earthworks

The subject site should be prepared in accordance with AS 3798-2009 Section 6.1 and filled in accordance with AS 3798-2009 Section 6.2.

Initial Site Preparation

Initially surface features including pavements and building foundations should be stripped from the site, in an area extending at least 1.5 m laterally beyond any planned structures or improvements.

Utilities should be located and rerouted as necessary and any abandoned pipes or utility conduits should be removed or filled with grout. Utility trench excavations must be cut to competent bearing soils and backfilled with properly compacted structural fill.

Structural Filling

Where the above site preparation procedures create excavations below the proposed final grade, the excavations should be backfilled with properly compacted structural fill. Materials selected for use as structural fill should not contain organic matter, waste construction debris, or deleterious materials. Fill materials should be granular material or should be of low or medium plasticity. Existing onsite fill meeting the above criteria may be used as structural fill. Under no circumstances should topsoil or other organic-laden soils be placed as fill beneath or within 1.5 horizontal metres of buildings, pavements or other structural areas.

Once final grade is reached in cut areas, and prior to fill placement in areas of the site that will receive new fill, the subgrade should be evaluated by a geotechnical engineer or their representative. Following subgrade evaluation, the exposed subgrade should be test-rolled in accordance with AS 3798-2009. Any unstable areas failing the evaluation or test-roll should be excavated to the depth of competent bearing material and filled in accordance with the general site fill placement methodology outlined below.

Fill materials should be placed in individual lifts of 300 mm or less loose measurement and compacted using a sheep's foot roller for cohesive soils and a smooth drum roller for cohesionless soils. Fill should be compacted to a minimum of 98% of standard compaction with a moisture content within ±2% of the optimum moisture content.

Test rolling and fill placement is to be undertaken under Level 1 Supervision or Level 2 Inspection and Testing.

9.2 Excavations

It is expected that on-site soils and rock within the expected depth of excavation will generally be excavatable using large equipment (i.e., excavators greater than 25 tonne). Localised assistance by ripping or rock hammer may be required during excavation. Groundwater management, batter and shoring of excavations are discussed in the following sections.

9.3 Groundwater Inflow

During drilling, groundwater was encountered within the expected depth of excavation (at depths below 0.8 mbg). Due to the presence of ASS, groundwater disturbance must be minimised and dewatering of soils beyond the proposed basement excavation area is not recommended. To achieve this a secant pile cut-off wall anchored in the underlying bedrock is recommended.

Within area of the basement excavation inside the wall cut-off, dewatering may be accomplished by spear point or pump and sump methods. Dewatering below the depth of bulk excavation should be minimised and may result in additional need to neutralise dewatered soils.

9.4 Batter Slopes

Excavations must be designed and constructed in a stable manner. The sides of the excavation should be shored or battered so as to maintain stability of both the excavation sides and bottom. Assuming that excavations are undertaken prior to any other construction works, and provided all surcharge loads, including plant and stockpiled material are kept well clear of the top of the batters, minimum batter slopes are recommended as 2H:1V for temporary batters and 4H:1V for permanent batters.

Permanent batters should be protected from erosion by vegetation or other measures and designed with adequate surface and subsurface drainage. For batters extending below groundwater or taller than 2 m, localised assessment of batter slopes is recommended.

Stormwater runoff should be directed away from the tops of batters by use of berm drains. Where runoff must be directed down the face of a batter, the batter drains/chutes should be lined to prevent erosion. Properly installed silt fence should be used at the base of batter slopes to prevent offsite migration of sediment. Scouring of excavation faces due to runoff should be repaired prior to further works within the excavation(s). All permanent batters should be protected from erosion by vegetation or other measures and designed with adequate surface and subsurface drainage.

The contractor is solely responsible for temporary excavation design and should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench depth, exceed those specified in local, state, and national safety regulations.

9.5 Shoring

Due to the presence of shallow groundwater and ASS, a secant pier cut-off wall and tanked basement are recommended for the proposed development. Cast in place CFA pier are considered the most appropriate shoring method.

The following earth pressure coefficients are recommended for use in design of temporary and permanent retaining structures:

Retained Material	Bulk Density (kN/m^3)	Earth Pressure Coefficients		
		At rest (K_0)	Active (K_a)	Passive (K_p)
Onsite Clays and Sands	20	0.55	0.40	2.5
Weathered Sandstone/ Conglomerate (Class IV/V)	25	0.43	0.27	3.7

The 'at rest' earth pressure coefficient (K_0) is suitable for retaining structures where anchors or other methods restrain retaining wall movement or where significant movements cannot be tolerated (rigid wall). A uniform or trapezoidal earth pressure distribution should be adopted. It should be noted that shoring which is designed for this 'at rest' coefficient will still undergo some lateral movements.

The active earth pressure coefficient (K_a) is suitable for retaining structures allowing movement of the top such as cantilevered pile walls. For these structures the pressure acting on the wall can be estimated on the basis of a triangular earth pressure distribution.

The passive earth pressure coefficient (K_p) is suitable for the calculation of resisting forces at the toe of concrete, reinforced stone, or masonry walls.

Any surcharge affecting the walls (e.g. traffic, construction loads, adjacent footings, inclined backfill surface, etc.) should be allowed in the design using the appropriate earth pressure coefficient from above.

Design of all retaining structures should be undertaken in accordance with AS4678-2002. Furthermore, the design of any retaining structures should make allowance for all applicable surcharge loadings including construction activities around the perimeter of the excavation, traffic loadings and adjacent buildings. Consideration should be given to the possibility of a hydrostatic pressure due to build-up of water behind the wall (e.g. from broken services), unless permanent subsurface drainage can be provided.

9.6 Construction Induced Vibrations

Onsite soils are expected to be readily excavatable using excavators or backhoes; so long as percussive piling or excavation methods are not used, construction induced vibrations are not expected to be an issue.

If percussive piling (e.g. sheet piling) is used, consideration must be given to possible construction induced ground vibration. Construction induced ground vibration is unlikely to be an issue at the site unless heavy impact tools are required for excavation. The use of other techniques which do not involve impact (e.g. rock saws), although less productive, would reduce or possibly eliminate risks of damage due to vibrations.

If adopting a rock hammer or similar, on-site guidance by a vibration specialist is recommended during the early part of excavation. This should include vibration characterisation trials that are used to define vibration levels for the selected equipment.

Peak Particle Velocity (PPV) is usually the adopted measure of ground vibration and the safe limits depend on the sensitivity of the adjoining structures and services. There are a number of Australian and overseas publications that provide vibration velocity guideline levels (or safe limits) including:

- Australian Standard AS2187.2-2006 Explosives - Storage and use - Use of explosives - Appendix J: Ground Vibrations and Airblast Overpressure;
- DIN 4150 – Part 3 – 1999. Effects if Vibration on Structures;
- Department of Environment and Conservation NSW, 2006. Assessing Vibration: a technical guideline;
- British Standard BS 7385-1:1990. Evaluation and measurement for vibration in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings;
- British Standard BS 7385-2:1993. Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.

The most appropriate guidelines levels for the proposed excavation work are provided in AS2187.2-2006, which refers to guideline values from BS7385-2 for the prevention of minor or cosmetic damage occurring in structures from ground vibration. Additionally, the guideline levels provided in DIN 4150 Part 3 is considered an appropriate source for guideline levels.

Ideally, safe limits should be determined by a specialist vibration consultant. However, as a preliminary guide, and considering the above guidelines and the type of adjoining structures present, Geo-Logix recommend a maximum PPV of 10 mm/sec (measured at the foundations of adjoining structures) to prevent cosmetic and structural damage.

Geo-Logix notes human discomfort levels caused by vibration are typically less than the levels that are likely to cause cosmetic or structural damage to structures. Therefore, neighbours may lodge complaints before any cosmetic or structural damage occurs.

Regardless of excavation, retention or foundation methods, Geo-Logix recommends dilapidation surveys be carried out on neighbouring buildings prior to construction to confirm that the construction works are not causing damage. These surveys should be agreed to, and the report signed, by the owners of the adjacent building prior to work commencing.

9.7 Site Classification

Based on Linear Shrinkage testing results, for structures with foundations in the onsite natural soils, the appropriate site classification is considered to be equivalent to Class ‘M’ with a characteristic free surface movement (y_s) of 20–40 mm with changes in moisture (AS2870-2011).

Where foundations on rock are proposed little or no ground movement from changes in moisture is expected.

Geo-Logix notes that this site classification has not included the effects of trees, poor site drainage, leaking plumbing, and exceptionally wet or dry moisture conditions.

9.8 `Foundations

Geo-Logix recommends that footings be founded on a consistent medium to minimise any potential differential settlements. However, depending on the building loads and whether the structures are designed

to be relatively flexible, this may not be significant. Existing on-site fill is not generally considered to be a suitable founding medium.

Provided new structural fill is placed in a controlled manner as advised in Section 6.1, native on-site soils and structural fill are expected to be capable of supporting shallow footings for minor structures. Assuming an allowable settlement of 25 mm shallow footings in soil may be designed based on an allowable bearing capacity of 100 kPa.

Geo-Logix recommend that foundation subgrade surfaces be observed and tested by a geotechnical engineer using Dynamic Cone Penetrometer (DCP) testing equipment or other satisfactory methods prior to steel or concrete placement. Any unsatisfactory soil detected during this evaluation should be undercut as directed by the geotechnical engineer. Footing excavations should be protected from surface water run-off; if water is allowed to accumulate within a footing excavation and soften the bearing soils, the deficient soils should be removed from the excavation prior to concrete placement.

Allowable bearing pressure and adhesion for deep foundations including bored piers and basements founded on rock are summarised in the following table.

Bearing Stratum	Allowable Bearing Pressure (MPa)	Allowable Adhesion (kPa)*	Young's Modulus, Es (MPa)	Estimated Settlement
Class IV-V Sandstone/Conglomerate	1,000	50	100	1% of Footing Width or Pier Base

*For pier foundations only, not applicable for footings. Assumes a clean socket of roughness R2 or better.

The bearing stratum should be verified prior to the placement of rebar or concrete. Pier borings should be filled on the same day as drilling. Pier borings should be dewatered immediately prior to placement of concrete. If required dewatering for pier borings may be accomplished by sump pump.

All footing systems should be designed and constructed in accordance with the recommendations contained in AS 2870-2011 and/or AS 2159-2009 by a suitably qualified and experienced structural engineer.

9.9 Ground Slabs and Pavements

Slab and pavement designs are based on the California Bearing Ratio (CBR) and modulus of the subgrade materials encountered after any excavation or re-grading has taken place. The principal aim of the subgrade preparation is to provide a uniform foundation over the entire slab/pavement formation which will not give rise to unevenness in the slab/pavement surface under the design loads. The final subgrade, following the earthworks recommended in Section 9.1, may comprise natural soil or well compacted structural fill or weathered shale provided the material performs satisfactorily under test-rolling as detailed in AS3798-2007. Other than current pavement subgrades, existing on-site fill is not considered suitable for use as pavement subgrade unless excavated and reinstated as new structural fill.

Based on Laboratory results and Geo-Logix's experience with similar soil and provided the final subgrade performs under test-rolling and is compacted to at least 98% standard compaction, design of pavements and slabs-on-grade placed on onsite residual soils may be based on a CBR of 8%.

In order to provide uniform support beneath any proposed floor slab-on-grade, Geo-Logix recommends that floor slabs be underlain by a minimum of 100 mm of free-draining (a maximum particle size of 19 mm with less than 5 percent material passing the 75 µm sieve), well graded gravel or crushed rock base course.

Exterior slabs and pavements should be isolated from the building. These slabs should be reinforced to function as independent units. Movement of these slabs should not be transmitted to the building foundation or superstructure.

9.10 Aggressivity/Exposure Classification

Based on the preliminary exposure classification test results, and in accordance with AS3600-2009 and AS2159-2009, steel and concrete structures in contact with natural soils should be designed based on no less than moderately aggressive, B1, exposure. For steel and concrete structures in contact with natural soils below 5 mbg, design should be based on no very aggressive, C2, exposure.

9.11 Salinity Risk

Soil salinity risk is based on extract electrical conductivity (EC_e). Based on laboratory testing of the selected samples, on-site soils do not appear to be saline (Department of Land and Water Conservation NSW, 2002).

9.12 Earthquake Design

Structural design for earthquake loads should be carried out in accordance with the relevant provisions in AS1170.4–2007. Based on the subsurface profile encountered at the base elevation of the proposed excavation, and with reference to Tables 3.2 and 4.1 of AS1170.4, the site subsoil class is considered to be C_e (shallow soil site) with a hazard factor (Z) of 0.09.

10. LIMITATIONS

This report should be read in full, and no executive summary, conclusion or other section of the report may be used or relied on in isolation or taken as representative of the report as a whole. No responsibility is accepted by Geo-Logix, and any duty of care that may arise but for this statement is excluded, in relation to any use of any part of this report other than on this basis.

This report has been prepared for the sole benefit of and use by the Client. No other person may rely on the report for any purpose whatsoever except with Geo-Logix' express written consent. Any duty of care to third parties that would or may arise in respect of persons other than the Client, but for this statement, is excluded.

Geo-Logix owns the copyright in this report. No copies of this report are to be made or distributed by any person without express written consent to do so from Geo-Logix. If the Client provides a copy of this report to a third party, without Geo-Logix's consent, the Client indemnifies Geo-Logix against all loss, including without limitation consequential loss, damage and/or liability, howsoever arising, in connection with any use or reliance by a Third Party.

This report is based on the available project information and the subsurface information obtained by Geo-Logix. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, Geo-Logix should be notified immediately to determine if there are consequences to the recommendations provided in this report. If Geo-Logix is not retained to perform these functions, Geo-Logix cannot be responsible for the impact of those conditions on the performance of the project.

Unless otherwise expressly stated, Geo-Logix has assumed that the information and data contained in previous reports carried out by others and reviewed in preparation of this report are completely accurate and has not sought independently to verify the accuracy of the information or data.

Where laboratory tests have been carried out by others on Geo-Logix' behalf, the tests are reproduced in this report on the assumption that the tests are accurate. Geo-Logix has not sought independently to verify the accuracy of those tests and assumes no responsibility in respect of them.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area at the time of this report. No other warranties are implied or expressed.

This report has been prepared for the specific application to the proposed development as described in the report. After the plans and specifications for the project are more complete the geotechnical engineer should be provided with the opportunity to review the final design plans and specifications to assess whether our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations.

11. REFERENCES

Australian Standard (2007) AS1170.4–2007 Structural design actions – Earthquake actions in Australia, Standards Australia.

Australian Standard (2007) AS3798–2007 Guidelines on earthworks for commercial and residential developments, Standards Australia.

Australian Standard (2009) *AS2159–2009 Piling Design and Installation,* Standards Australia.

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Department of Land and Water Conservation NSW (2002) *Site Investigations for Urban Salinity*.

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FIGURES

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SITE LOCATION

Geotechnical and ASS Investigation
310 Terrigal Drive, Terrigal NSW 2260

Project No. 2301022

Figure 1

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SITE MAP

Geotechnical and ASS Investigation
310 Terrigal Dr, Terrigal NSW 2260

Project No. 2301022

Figure 2

TABLES

Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH1/0.5	BH1/1.0	BH1/2.0	BH1/3.0	BH1/4.0
	Units	Action Criteria			Depth (m)	0.5	1.0	2.0	3.0	4.0
		by Soil Type			Date	26/04/2023	26/04/2023	26/04/2023	26/04/2023	26/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		6.0	6.0	5.0	6.0	7.5
pH_{FOX} (oxidised)	pH Units	-	-	-		5	6.0	4.0	4.5	7.0
ΔpH	pH Units	-	-	-		1.0	0.0	1.0	1.5	0.5
Reaction Rating*	unitless	-	-	-		4.0	4.0	4.0	3.0	1.0
pH_{KCl}	pH Units	-	-	-		-	-	-	-	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		-	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		-	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		-	-	-	-	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		-	-	-	-	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		-	-	-	-	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		-	-	-	-	-
ANC Fineness Factor	unitless	-	-	-		-	-	-	-	-
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		-	-	-	-	-
Net Acidity	% S	0.03	0.06	0.1		-	-	-	-	-
Net Acidity	eq. mol. H^+/t	18	36	62		-	-	-	-	-
Liming Rate	kg $CaCO_3$/t	-	-	-		-	-	-	-	-

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
- = action criteria not available
< # or ND = analyte(s) not detected in excess of laboratory reporting limit
-- = sample not analysed
Bold/red indicates exceedance of action criteria

Geo-Logix

Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH1/5.0	BH1/6.0	BH1/7.0	BH1/7-7.1	BH1/8.0
	Units	Action Criteria			Depth (m)	5.0	6.0	7.0	7-7.1	8.0
		by Soil Type			Date	26/04/2023	26/04/2023	26/04/2023	26/04/2023	26/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		5.0	5.0	5.0	5.7	5.0
pH_{FOX} (oxidised)	pH Units	-	-	-		4.5	4.5	3.0	2.1	3.0
ΔpH	pH Units	-	-	-		0.5	0.5	2.0	3.6	2.0
Reaction Rating*	unitless	-	-	-		4.0	4.0	4.0	4.0	4.0
pH_{KCl}	pH Units	-	-	-		-	-	-	3.9	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		-	-	-	170	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		-	-	-	2.4	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		-	-	-	1500	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		-	-	-	0.25	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		-	-	-	0.25	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		-	-	-	< 0.005	-
ANC Fineness Factor	unitless	-	-	-		-	-	-	1.5	-
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		-	-	-	N/A	-
Net Acidity	% S	0.03	0.06	0.1		-	-	-	**2.7**	-
Net Acidity	eq. mol. H^+/t	18	36	62		-	-	-	**1700**	-
Liming Rate	kg $CaCO_3$/t	-	-	-		-	-	-	130	-

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
- = action criteria not available
< # or ND = analyte(s) not detected in excess of laboratory reporting limit
-- = sample not analysed
Bold/red indicates exceedance of action criteria

Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH1/9.0	BH1/12	BH2/0.5	BH2/1.0	BH2/2.0
	Units	Action Criteria			Depth (m)	9.0	12	0.5	1.0	2.0
		by Soil Type			Date	26/04/2023	26/04/2023	26/04/2023	26/04/2023	26/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		4.5	5.0	7.5	7.5	5.0
pH_{FOX} (oxidised)	pH Units	-	-	-		3.5	4.0	5.0	5.0	4.5
ΔpH	pH Units	-	-	-		1.0	1.0	2.5	2.5	0.5
Reaction Rating*	unitless	-	-	-		4.0	4.0	4.0	4.0	4.0
pH_{KCl}	pH Units	-	-	-		-	-	-	-	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		-	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		-	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		-	-	-	-	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		-	-	-	-	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		-	-	-	-	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		-	-	-	-	-
ANC Fineness Factor	unitless	-	-	-		-	-	-	-	-
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		-	-	-	-	-
Net Acidity	% S	0.03	0.06	0.1		-	-	-	-	-
Net Acidity	eq. mol. H^+/t	18	36	62		-	-	-	-	-
Liming Rate	kg $CaCO_3$/t	-	-	-		-	-	-	-	-

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
- = action criteria not available
< # or ND = analyte(s) not detected in excess of laboratory reporting limit
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Bold/red indicates exceedance of action criteria

Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH2/3.0	BH2/4.0	BH3/5.0	BH2/6.0	BH2/7.0
	Units	Action Criteria			Depth (m)	3.0	4.0	5.0	6.0	7.0
		by Soil Type			Date	26/04/2023	26/04/2023	26/04/2023	26/04/2023	26/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		5.5	6.0	5.0	5.0	5.0
pH_{FOX} (oxidised)	pH Units	-	-	-		4.5	4.0	4.5	4.5	3.0
ΔpH	pH Units	-	-	-		1	2	0.5	0.5	2
Reaction Rating*	unitless	-	-	-		4.0	4.0	4.0	4.0	4.0
pH_{KCl}	pH Units	-	-	-		-	-	-	-	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		-	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		-	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		-	-	-	-	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		-	-	-	-	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		-	-	-	-	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		-	-	-	-	-
ANC Fineness Factor	unitless	-	-	-		-	-	-	-	-
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		-	-	-	-	-
Net Acidity	% S	0.03	0.06	0.1		-	-	-	-	-
Net Acidity	eq. mol. H^+/t	18	36	62		-	-	-	-	-
Liming Rate	kg $CaCO_3$/t	-	-	-		-	-	-	-	-

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
- = action criteria not available
< # or ND = analyte(s) not detected in excess of laboratory reporting limit
-- = sample not analysed
Bold/red indicates exceedance of action criteria

Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH2/7-7.1	BH2/8.0	BH2/9.0	BH2/9.0	BH2/12.0
	Units	Action Criteria			Depth (m)	7-7.1	8.0	9.0	9.0	12.0
		by Soil Type			Date	26/04/2023	26/04/2023	26/04/2023	26/04/2023	26/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		5.7	5.0	5.0	5.5	5.5
pH_{FOX} (oxidised)	pH Units	-	-	-		2.1	3.0	3.5	3.5	3.5
ΔpH	pH Units	-	-	-		3.6	2	1.5	2	2
Reaction Rating*	unitless	-	-	-		4.0	4.0	4.0	4.0	4.0
pH_{KCl}	pH Units	-	-	-		4.5	-	-	-	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		49	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		0.89	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		560	-	-	-	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		N/A	-	-	-	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		N/A	-	-	-	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		N/A	-	-	-	-
ANC Fineness Factor	unitless	-	-	-		1.5	-	-	-	-
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		N/A	-	-	-	-
Net Acidity	% S	0.03	0.06	0.1		0.97	-	-	-	-
Net Acidity	eq. mol. H^+/t	18	36	62		**610**	-	-	-	-
Liming Rate	kg $CaCO_3$/t	-	-	-		45	-	-	-	-

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
- = action criteria not available
< # or ND = analyte(s) not detected in excess of laboratory reporting limit
-- = sample not analysed
Bold/red indicates exceedance of action criteria

Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH2/14.0	BH2/14-14.1	BH3/1.0	BH3/2.0	BH3/3.0
	Units	Action Criteria			Depth (m)	14.0	14-14.1	1.0	2.0	3.0
		by Soil Type			Date	26/04/2023	26/04/2023	24/04/2023	24/04/2023	24/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Hard Rock	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		5.0	6.2	5.0	5.0	5.5
pH_{FOX} (oxidised)	pH Units	-	-	-		5.0	4.8	5.0	4.5	4.5
ΔpH	pH Units	-	-	-		0	1.4	0	0.5	1
Reaction Rating*	unitless	-	-	-		4.0	3.0	0.0	4.0	4.0
pH_{KCl}	pH Units	-	-	-		-	5.5	-	-	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		-	6.7	-	-	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		-	0.012	-	-	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		-	7.2	-	-	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		-	N/A	-	-	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		-	N/A	-	-	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		-	N/A	-	-	-
ANC Fineness Factor	unitless	-	-	-		-	1.5	-	-	-
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		-	N/A	-	-	-
Net Acidity	% S	0.03	0.06	0.1		-	0.02	-	-	-
Net Acidity	eq. mol. H^+/t	18	36	62		-	14	-	-	-
Liming Rate	kg $CaCO_3$/t	-	-	-		-	1	-	-	-

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
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Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH3/3.9-4.0	BH3/4.0	BH3/5.0	BH3/6.0	BH3/7.0
	Units	Action Criteria			Depth (m)	3.9-4.0	4.0	5.0	6.0	7.0
		by Soil Type			Date	24/04/2023	24/04/2023	24/04/2023	24/04/2023	24/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		6.2	5.5	5.0	5.0	6.5
pH_{FOX} (oxidised)	pH Units	-	-	-		4.2	4.5	5.0	4.5	4.5
ΔpH	pH Units	-	-	-		2	1	0	0.5	2
Reaction Rating*	unitless	-	-	-		4.0	4.0	2.0	4.0	4.0
pH_{KCl}	pH Units	-	-	-		4.9	-	-	-	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		16	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		0.005	-	-	-	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		3.3	-	-	-	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		N/A	-	-	-	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		N/A	-	-	-	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		N/A	-	-	-	-
ANC Fineness Factor	unitless	-	-	-		1.5	-	-	-	-
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		N/A	-	-	-	-
Net Acidity	% S	0.03	0.06	0.1		**0.03**	-	-	-	-
Net Acidity	eq. mol. H^+/t	18	36	62		**19**	-	-	-	-
Liming Rate	kg $CaCO_3$/t	-	-	-		1.5	-	-	-	-

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
- = action criteria not available
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Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH3/8.0	BH3/10.0	BH3/12.0	BH4/0.4-0.5	BH4/1.0
	Units	Action Criteria			Depth (m)	8.0	10.0	12.0	0.4-0.5	1.0
		by Soil Type			Date	24/04/2023	24/04/2023	24/04/2023	24/04/2023	24/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		7.0	6.0	5.0	5.7	6.0
pH_{FOX} (oxidised)	pH Units	-	-	-		4.0	3.5	4.5	3.8	4.5
ΔpH	pH Units	-	-	-		3	2.5	0.5	1.9	1.5
Reaction Rating*	unitless	-	-	-		4.0	4.0	4.0	4.0	4.0
pH_{KCl}	pH Units	-	-	-		-	-	-	4.6	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		-	-	-	71	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		-	-	-	0.011	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		-	-	-	6.8	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		-	-	-	N/A	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		-	-	-	N/A	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		-	-	-	N/A	-
ANC Fineness Factor	unitless	-	-	-		-	-	-	1.5	-
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		-	-	-	N/A	-
Net Acidity	% S	0.03	0.06	0.1		-	-	-	**0.12**	-
Net Acidity	eq. mol. H^+/t	18	36	62		-	-	-	**78**	-
Liming Rate	kg $CaCO_3$/t	-	-	-		-	-	-	5.8	-

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
- = action criteria not available
< # or ND = analyte(s) not detected in excess of laboratory reporting limit
-- = sample not analysed
Bold/red indicates exceedance of action criteria

Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH4/2.0	BH4/3.0	BH4/4.0	BH4/5.0	BH4/5.0-5.1
	Units	Action Criteria			Depth (m)	2.0	3.0	4.0	5.0	5.0-5.1
		by Soil Type			Date	24/04/2023	24/04/2023	24/04/2023	24/04/2023	24/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		6.0	4.5	5.0	6.0	5.5
pH_{FOX} (oxidised)	pH Units	-	-	-		4.5	4.5	4.5	4.5	3.9
ΔpH	pH Units	-	-	-		1.5	0	0.5	1.5	1.6
Reaction Rating*	unitless	-	-	-		2.0	4.0	4.0	4.0	3.0
pH_{KCl}	pH Units	-	-	-		-	-	-	-	4.8
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		-	-	-	-	19
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		-	-	-	-	< 0.005
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		-	-	-	-	< 3
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		-	-	-	-	N/A
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		-	-	-	-	N/A
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		-	-	-	-	N/A
ANC Fineness Factor	unitless	-	-	-		-	-	-	-	1.5
ANC_{BT} - Acid Neutralising Capacity	%$CaCO_3$	-	-	-		-	-	-	-	N/A
Net Acidity	% S	0.03	0.06	0.1		-	-	-	-	**0.03**
Net Acidity	eq. mol. H^+/t	18	36	62		-	-	-	-	**19**
Liming Rate	kg $CaCO_3$/t	-	-	-		-	-	-	-	1.5

Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
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-- = sample not analysed
Bold/red indicates exceedance of action criteria

Table 1: Summary of Soil Analytical Data - Acid Sulfate Soils

Acid Sulfate Soil and Geotechnical Investigation

Project No.: 2301022

310 Terrigal Drive,
Terrigal NSW 2260

					Sample ID	BH4/7.0	BH4/8.0	BH4/10.0	BH4/11.0
	Units	Action Criteria			Depth (m)	7.0	8.0	10.0	11.0
		by Soil Type			Date	24/04/2023	24/04/2023	24/04/2023	24/04/2023
		Coarse	Medium	Fine	Soil Type	Coarse	Coarse	Coarse	Coarse
pH_F (natural)	pH Units	-	-	-		5.6	5.5	6.0	5.5
pH_{FOX} (oxidised)	pH Units	-	-	-		4.5	4.0	4.0	4.5
ΔpH	pH Units	-	-	-		1.06	1.5	2	1
Reaction Rating*	unitless	-	-	-		4.0	4.0	4.0	4.0
pH_{KCl}	pH Units	-	-	-		-	-	-	-
TAA - Titratable Actual Acidity	mol. H^+/t	-	-	-		-	-	-	-
S_{CR} - Chromium Reducible Sulfur	% S	-	-	-		-	-	-	-
S_{CR} - Chromium Reducible Sulfur	eq. mol. H^+/t	-	-	-		-	-	-	-
S_{KCl} - KCl Extractable Sulphur	% S	-	-	-		-	-	-	-
S_{HCl} - HCl Extractable Sulphur	% S	-	-	-		-	-	-	-
S_{NAS} - Net Acid Soluable Sulphur	% S	-	-	-		-	-	-	-
ANC Fineness Factor	unitless	-	-	-		-	-	-	-
ANC_{BT} - Acid Neutralising Capacity	$\%CaCO_3$	-	-	-		-	-	-	-
Net Acidity	% S	0.03	0.06	0.1		-	-	-	-
Net Acidity	eq. mol. H^+/t	18	36	62		-	-	-	-
Liming Rate	kg $CaCO_3$/t	-	-	-		-	-	-	-

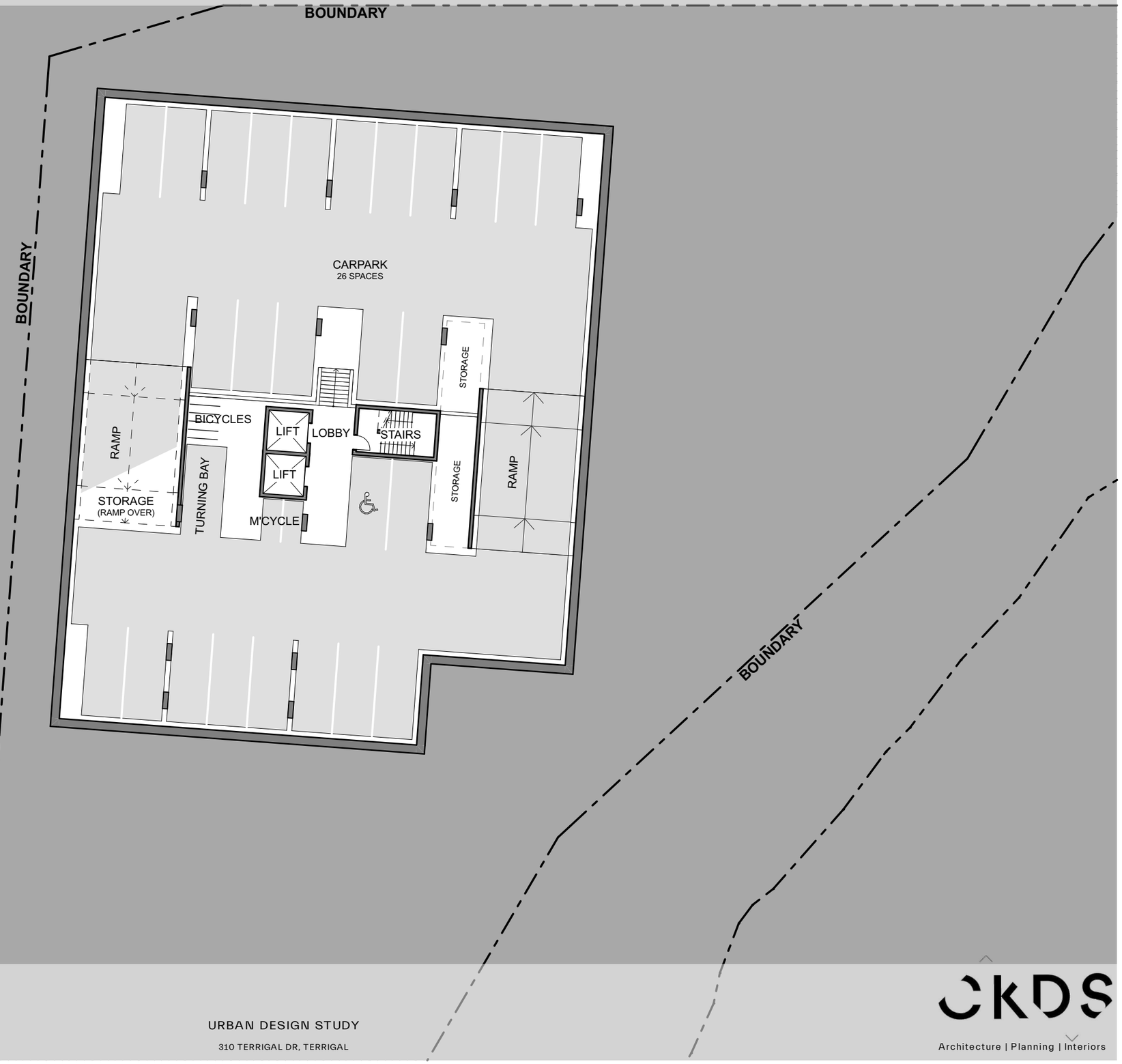
Notes:

Action Criteria = ASSMAC (1998) Acid Sulfate Soils Assessment Guidelines, Table 4.4.
*Field Screen uses the following reaction rating to classify the rate the samples reacted to the peroxide:
0.0 No reaction 1.0 - No reaction to slight; 2.0 - Moderate reaction;
3.0 - Strong reaction with persistent froth; and 4.0 - Extreme reaction.
- = action criteria not available
< # or ND = analyte(s) not detected in excess of laboratory reporting limit
-- = sample not analysed
Bold/red indicates exceedance of action criteria

ATTACHMENT A

Architecturals: Basement 03

1:250 @ A3



Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

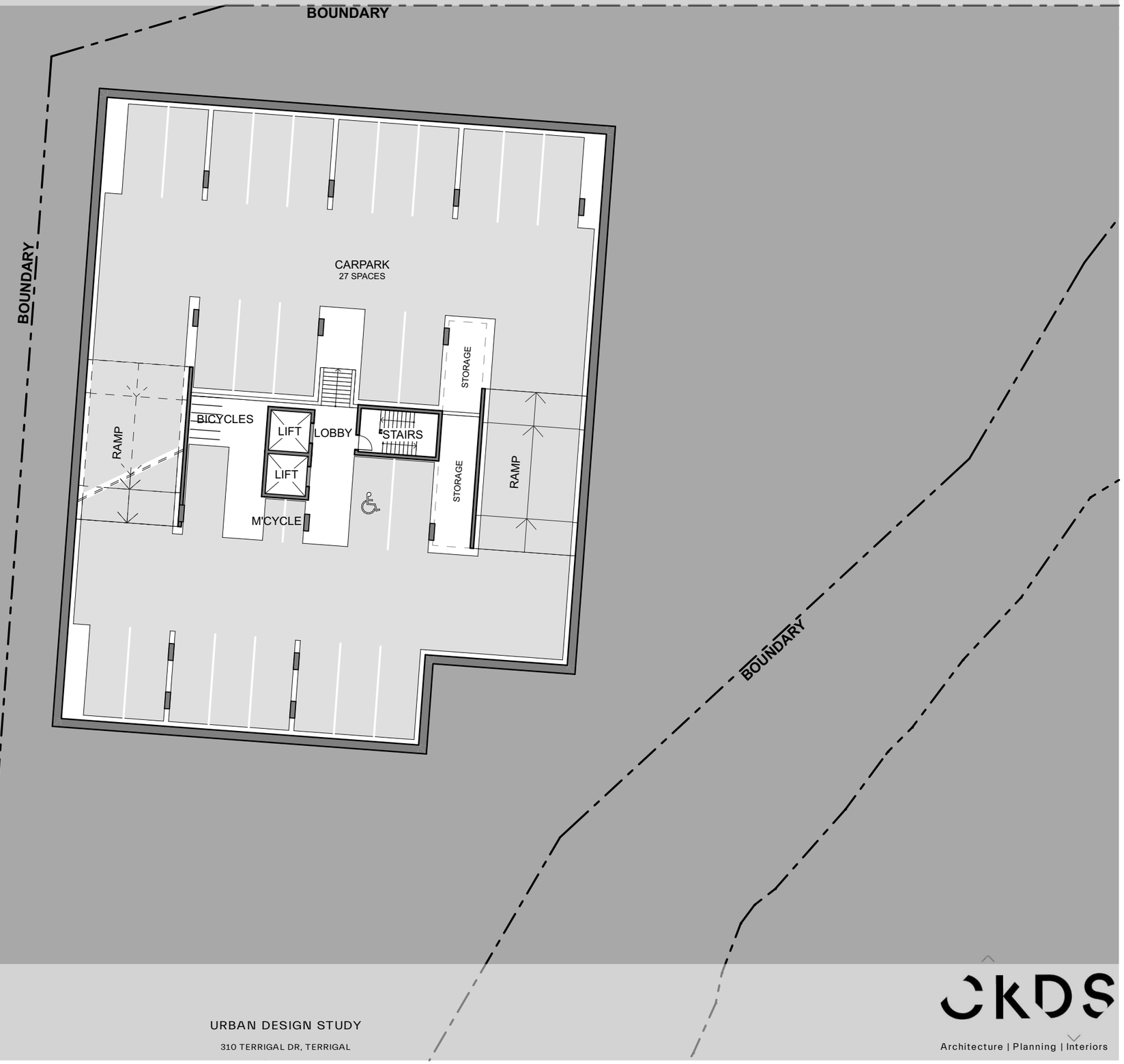
URBAN DESIGN STUDY

310 TERRIGAL DR, TERRIGAL

Architecture | Planning | Interiors

Architecturals: Basement 02

1:250 @ A3



Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

URBAN DESIGN STUDY

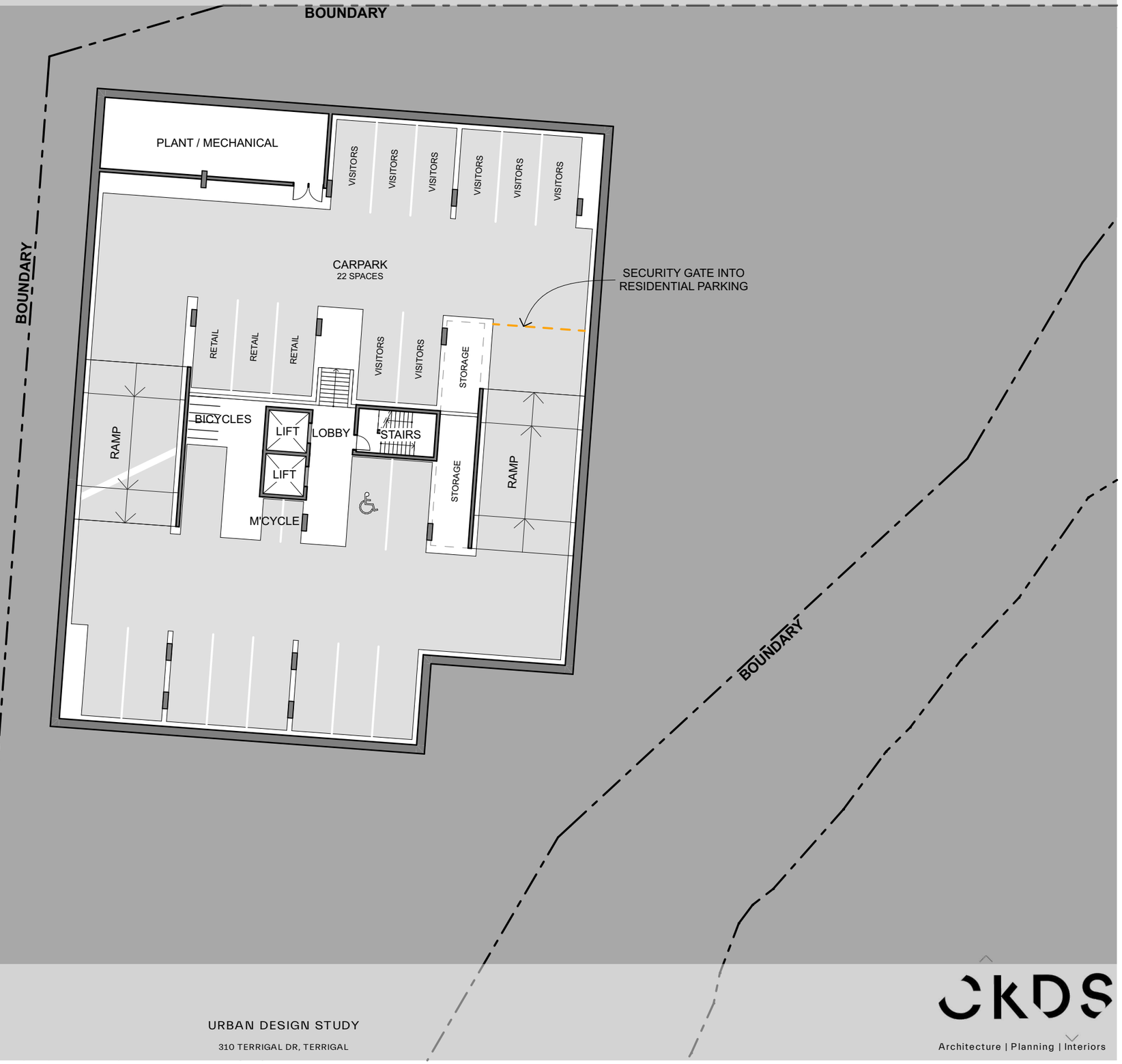
310 TERRIGAL DR, TERRIGAL

CKDS

Architecture | Planning | Interiors

Architecturals: Basement 01

1:250 @ A3



URBAN DESIGN STUDY

310 TERRIGAL DR, TERRIGAL

Architecturals: Ground Floor

1:250 @ A3

Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

URBAN DESIGN STUDY

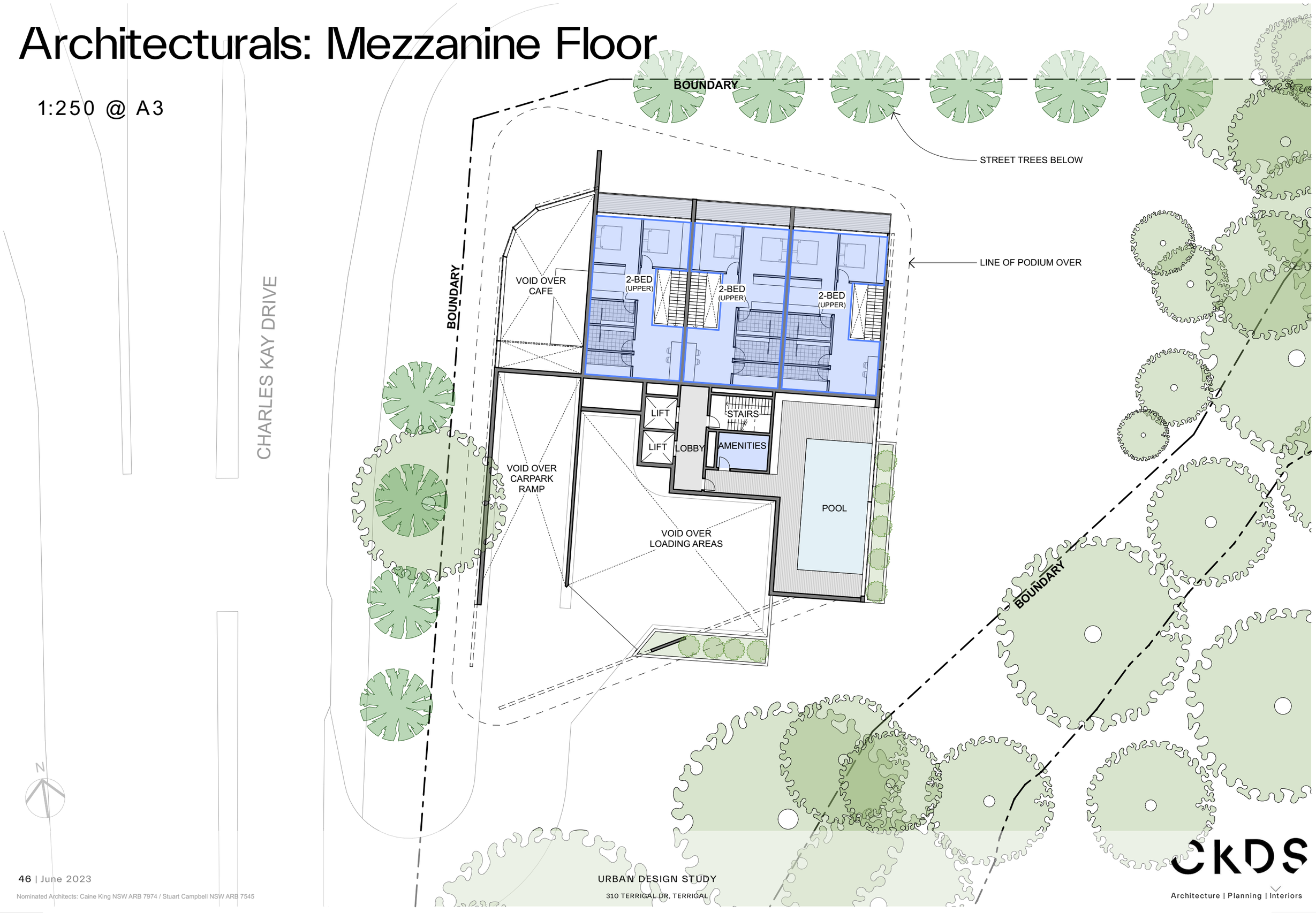
310 TERRIGAL DR, TERRIGAL

CKDS

Architecture | Planning | Interiors

Architecturals: Mezzanine Floor

1:250 @ A3



Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

URBAN DESIGN STUDY

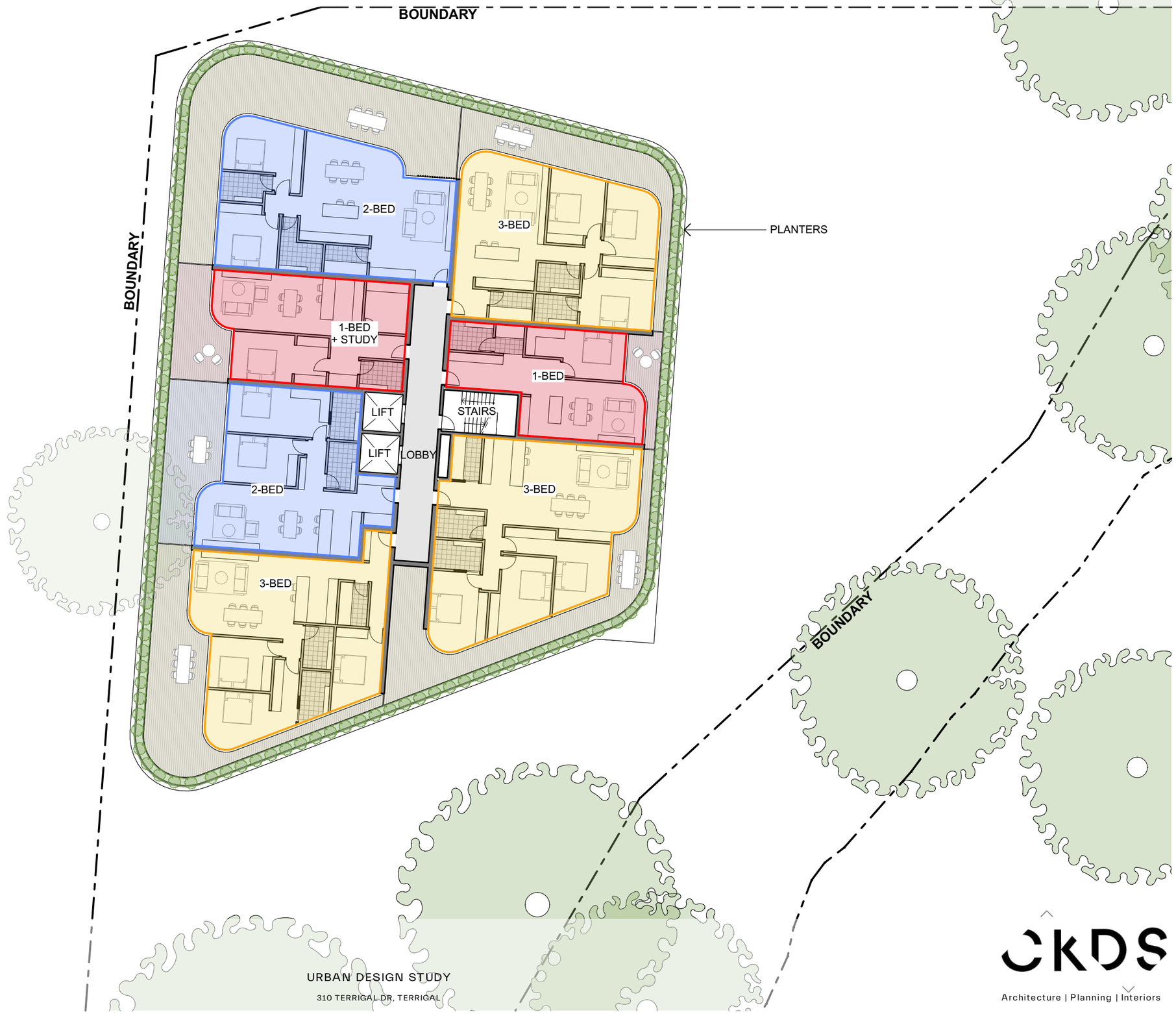
310 TERRIGAL DR, TERRIGAL

CKDS

Architecture | Planning | Interiors

Architecturals: First Floor

1:250 @ A3



N

URBAN DESIGN STUDY

310 TERRIGAL DR, TERRIGAL

Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

CKDS

Architecture | Planning | Interiors

Architecturals: Typical Floor x 4

1:250 @ A3

N

URBAN DESIGN STUDY

310 TERRIGAL DR, TERRIGAL

Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

CKDS

Architecture | Planning | Interiors

Architecturals: Top Floor

1:250 @ A3

N

URBAN DESIGN STUDY

310 TERRIGAL DR, TERRIGAL

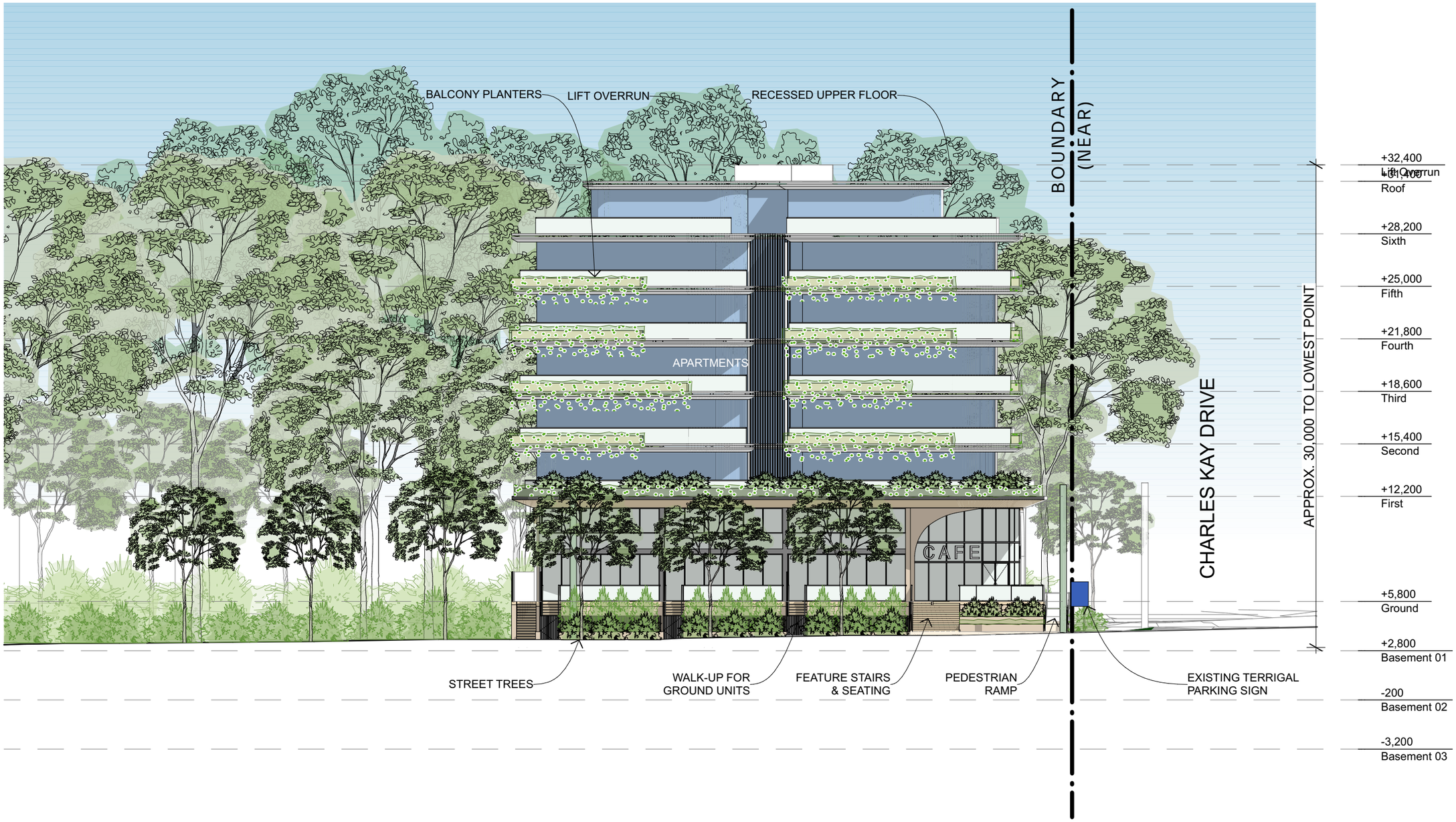
CKDS

Architecture | Planning | Interiors

Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

Architecturals: Elevation - North

1:250 @ A3



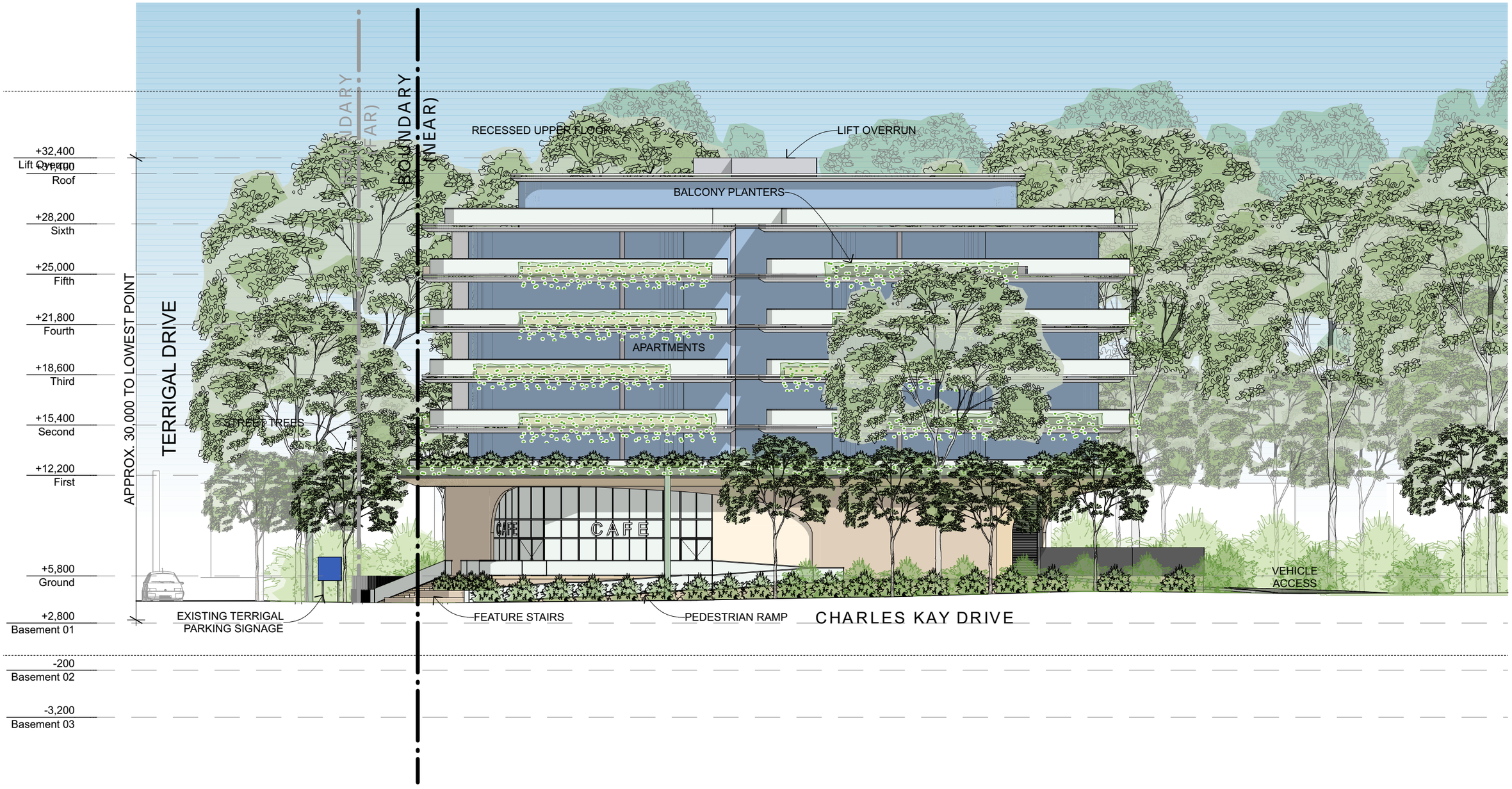
Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

CKDS

Architecture | Planning | Interiors

Architecturals: Elevation - West

1:250 @ A3



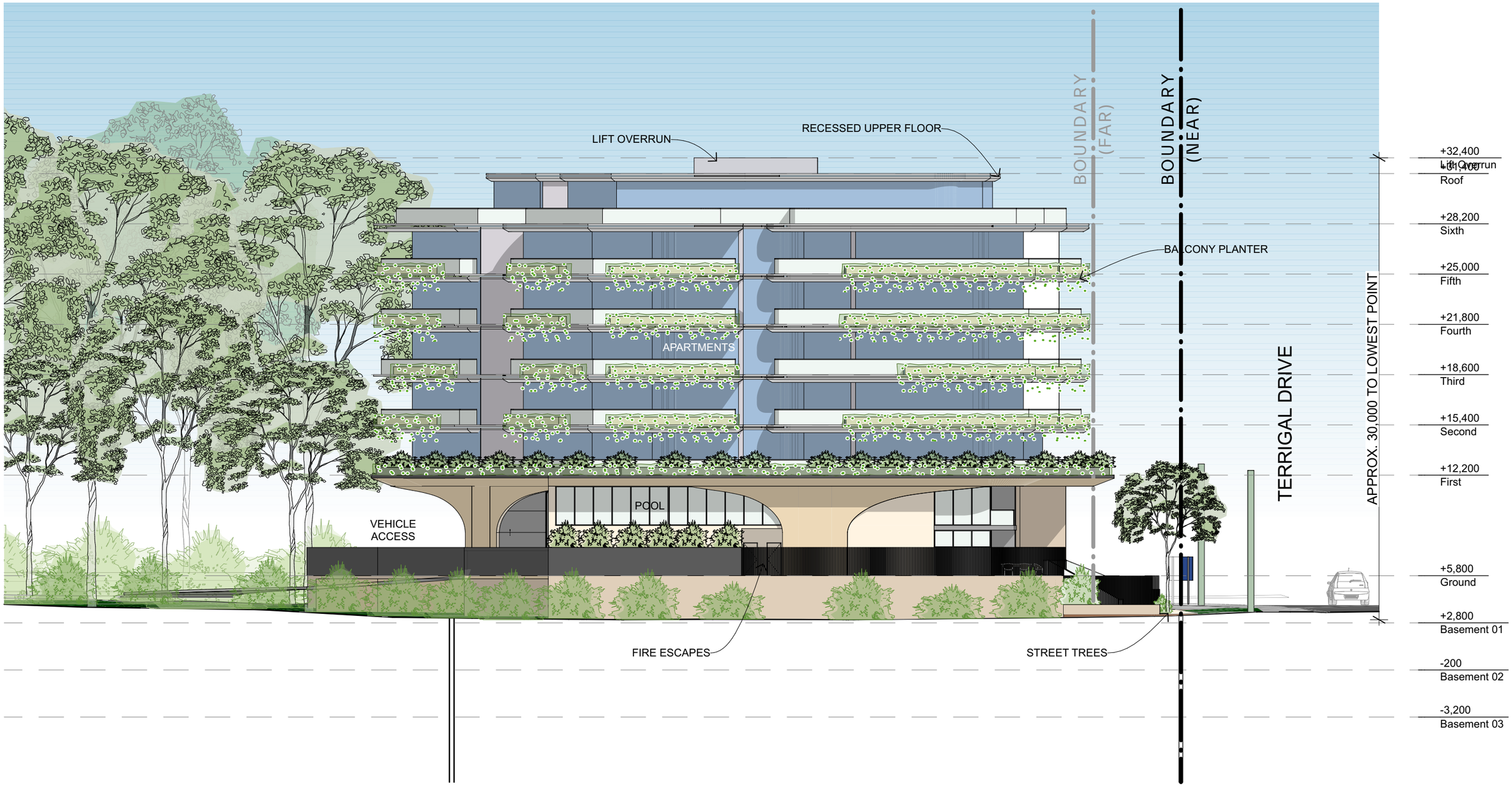
Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

CKDS

Architecture | Planning | Interiors

Architecturals: Elevation - East

1:250 @ A3



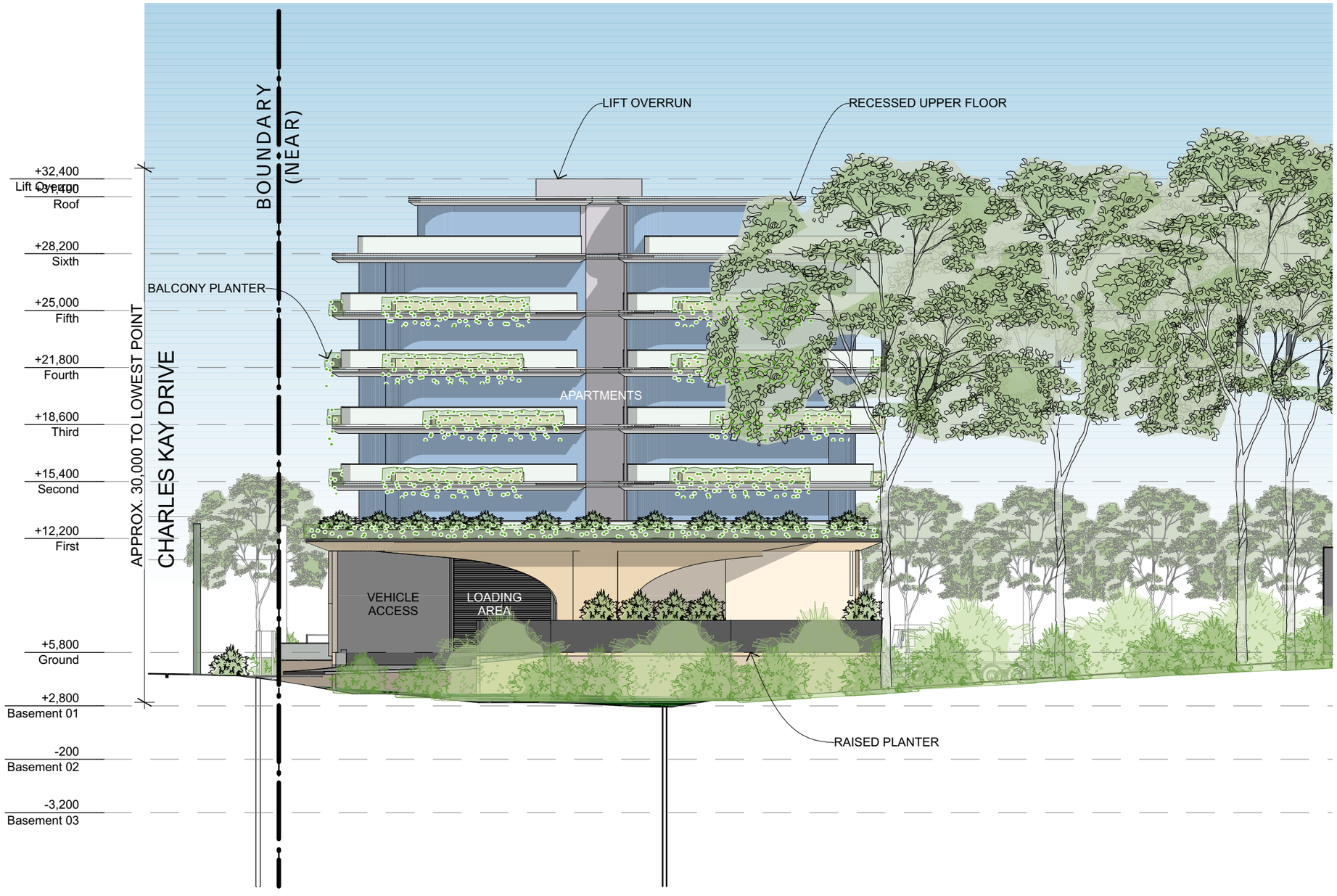
Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

CKDS

Architecture | Planning | Interiors

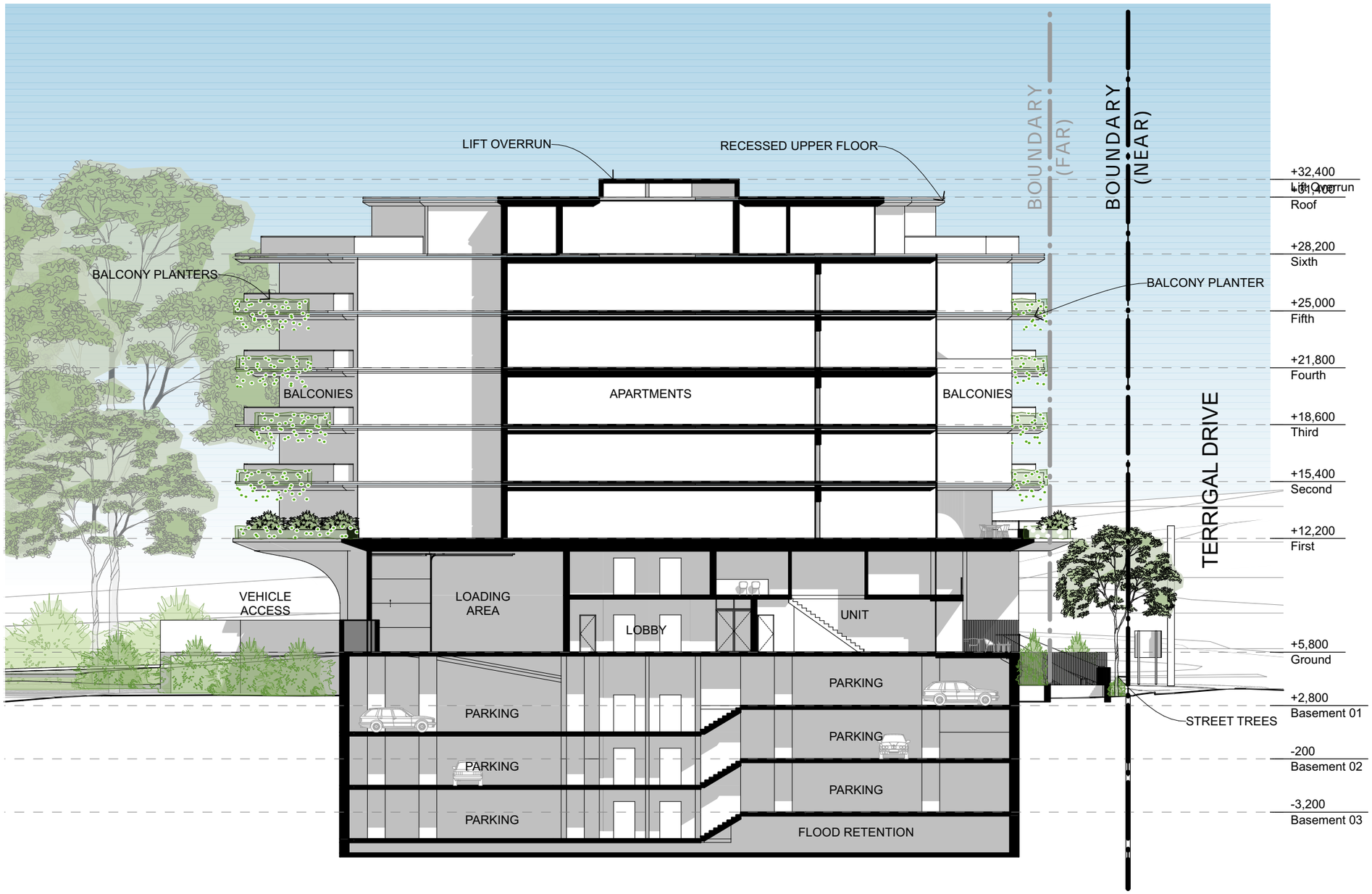
Architecturals: Elevation - South

1:250 @ A3



Architecturals: Section

1:250 @ A3



Nominated Architects: Caine King NSW ARB 7974 / Stuart Campbell NSW ARB 7545

CKDS
Architecture | Planning | Interiors

ATTACHMENT B

BOREHOLE LOG: BH01

Geo-Logix
environment · geotech

Geo-Logix Pty Ltd
Building Q2, Level 3
Unit 2309 / 4 Daydream Street
Warriewood NSW 2102
www.geo-logix.com.au

Project Number:	**2301022**
Hole Depth:	**13.32 m**
Date Started:	**26/04/2023**
Date Completed:	**26/04/2023**

Project Name: **Acid Sulfate Soil & Geotechnical Investigation**
Location / Site: **310 Terrigal Drive, Terrigal NSW**
Client: **Loftus Lane Capital**
Contractor: **Fico Group Pty Limited**
Method: **Solid Flight Auger (Truck mounted)**

Method	Water Level	Depth (mBGL)	RL (mAHD)	Sample Type	HC Odour	Sample ID	pH_F	pH_{FOX}	Reaction	Material Type	USCS Symbol	Graphic Log	Material Description	Moisture	SPT
SFA (V-bit)		0.10								Natural	CL		**TOPSOIL**.	damp	
		0.50		D	Z	BH01/0.3-0.5	6	5	4				**CLAY**- dark reddish brown / greyish brown (5YR 3/2), 90% clay, 10% sand, medium plasticity, firm.	wet	
		1		D	Z	BH01/0.9-1.0	6	6	4		CL		**CLAY**- brownish yellow / dark yellowish orange (10YR 6/6), 90% clay, 10% sand, medium plasticity, firm.		
				R	Z	BH01/1.0-1.45									1,2,3 N=5
		2		D	Z	BH01/1.8-2.0	5	4	4						
	▽			R	Z	BH01/2.5-2.45									2,2,3 N=5
		2.80													
		3					6	4.5	3		SP		**SAND with Clay**- very pale brown / greyish orange (10YR 7/4), 10% clay, 90% sand, loose.	wet	
		3.20													
											CL		**CLAY**- light red / moderate reddish orange (10R 6/6), 90% clay, 10% sand, medium plasticity, firm.	wet	
		3.80													
		4					7.5	7	1		SP		**SAND with Clay**- pale red (10R 6/2), 10% clay, 90% sand, loose.	wet	
		4.20		R	Z	BH01/4.0-4.45									1,3,4 N=7
											CL		**CLAY**- dark grey (N3), 90% clay, 10% sand, medium plasticity, stiff.	wet	
		5		D	Z	BH01/5.0-5.1	5	4.5	4						
				R	Z	BH01/5.5-5.95									3,4,4 N=8
		6					5	4.5	4						
		7		D	Z	BH01/7.0-7.1	5	3	4						
		8		D	Z	BH01/8.0-8.1	5	3	4						
		8.90		R	Z	BH01/8.5-8.95									1,WOH,WOH
		9					4.5	3.5	4		SC		**Clayey SAND**- medium dark grey (N4), 40% clay, 60% sand, loose.	wet	
		10													

Abbreviations

Hydrocarbon Odour
H High
M Medium
L Low
Z Zero

Sample Type
D Disturbed
U Undisturbed
B Bulk
R Representative
C Continuous
J Jar
Asb Asbestos

Strength Testing
SPT Standard Penetration Test
DCP Dynamic Cone Penetrometer
PP Pocket Penetrometer

Water Levels
▽ Encountered Groundwater
▼ Stabilised Groundwater

Abandonment Method: Backfill with soil and compact.
Additional Comments: SPT hammer type: Donut hammer.

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Ted Lilly / Reyhaneh Kalami** Date: **26/04/2023**
Checked By: **Ted Lilly** Date: **10/05/2023**

BOREHOLE LOG: BH01

Geo-Logix Pty Ltd
Building Q2, Level 3
Unit 2309 / 4 Daydream Street
Warriewood NSW 2102
www.geo-logix.com.au

Project Number:	**2301022**
Hole Depth:	**13.32 m**
Date Started:	**26/04/2023**
Date Completed:	**26/04/2023**

Project Name: **Acid Sulfate Soil & Geotechnical Investigation**
Location / Site: **310 Terrigal Drive, Terrigal NSW**
Client: **Loftus Lane Capital**
Contractor: **Fico Group Pty Limited**
Method: **Solid Flight Auger (Truck mounted)**

Method	Water Level	Depth (mBGL)	RL (mAHD)	Sample Type	HC Odour	Sample ID	pH_F	pH_{FOX}	Reaction	Material Type	USCS Symbol	Graphic Log	Material Description	Moisture	SPT
SFA (V-bit)		11		R	Z	BH01/11.5-11.95	5	4	4	Natural	SC		**Clayey SAND**- medium dark grey (N4), 40% clay, 60% sand, loose.*(continued)*	wet	3,4,3 N=7
		12													
		13		R	Z	BH01/13.3-13.32							**Terminated at 13.315 m** V-bit refusal at 13.3m. SPT refusal at 13.315m.		25/15
		14													
		15													
		16													
		17													
		18													
		19													
		20													
		21													

Abbreviations

Hydrocarbon Odour
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Sample Type
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Water Levels
Encountered Groundwater
Stabilised Groundwater

Abandonment Method: Backfill with soil and compact.
Additional Comments: SPT hammer type: Donut hammer.

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Ted Lilly / Reyhaneh Kalami** Date: **26/04/2023**
Checked By: **Ted Lilly** Date: **10/05/2023**

BOREHOLE LOG: BH02

Geo-Logix Pty Ltd
Building Q2, Level 3
Unit 2309 / 4 Daydream Street
Warriewood NSW 2102
www.geo-logix.com.au

Project Number:	**2301022**
Hole Depth:	**19.00 m**
Date Started:	**26/04/2023**
Date Completed:	**26/04/2023**

Project Name: **Acid Sulfate Soil & Geotechnical Investigation**
Location / Site: **310 Terrigal Drive, Terrigal NSW**
Client: **Loftus Lane Capital**
Contractor: **Fico Group Pty Limited**
Method: **Solid Flight Auger (Truck mounted)**

Method	Water Level	Depth (mBGL)	RL (mAHD)	Sample Type	HC Odour	Sample ID	pH_F	pH_{FOX}	Reaction	Material Type	USCS Symbol	Graphic Log	Material Description	Moisture	SPT
SFA (V-bit)		0.10								Natural					
		0.50		D	Z	BH02/0.3-0.5	7.5	5	4		CL		**TOPSOIL**.	moist	
													Sandy CLAY- dark reddish brown / greyish brown (5YR 3/2), 65% clay, 35% sand, medium plasticity, firm.	moist	
		1		D	Z	BH02/0.8-1.0	7.5	5	4		CL		**CLAY**- dark reddish brown / greyish brown (5YR 3/2), 90% clay, 10% sand, medium plasticity, soft.		
	▽	1.50		R	Z	BH02/1.0-1.45									1,1,1 N=3
		2		D	Z	BH02/1.9-2.0	5	4.5	4		SC		**Clayey SAND**- medium light grey (N6), 40% clay, 60% sand, loose.	wet	
		2.30													
				R	Z	BH02/2.5-2.75							**CLAY with Sand**- moderate red (5R 4/6), 80% clay, 20% sand, medium plasticity, stiff.	wet	2,5,6 N=11
		3		R	Z	BH02/2.8-2.95	5.5	4.5	4						
		4		D	Z	BH02/3.9-4.0	6	4	4				Light grey (N7) at 3.7m.		4,2,3 N=5
				R	Z	BH02/4.4-4.45					CL				
		5		D	Z	BH02/4.9-5.0	5	4.5	4						
				R	Z	BH02/5.5-5.8									2,2,3 N=5
		6					5	4.5	4						
		7.00		D	Z	BH02/7.0-7.1	5	3	4		SC		**Clayey SAND**- medium dark grey (N4), 40% clay, 60% sand, loose.	wet	
		8.00		D	Z	BH02/8.0-8.1	5	3	4		SC		**Clayey SAND**- medium dark grey (N4), 15% clay, 85% sand, loose.	wet	
				R	Z	BH02/8.5-8.95									4,7,3 N=10
		9					5	3.5	4						
		10													
		10.50													

Abbreviations

Hydrocarbon Odour
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Sample Type
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Strength Testing
SPT Standard Penetration Test
DCP Dynamic Cone Penetrometer
PP Pocket Penetrometer

Water Levels
▽ Encountered Groundwater
▼ Stabilised Groundwater

Abandonment Method: Backfill with soil and compact.
Additional Comments: SPT hammer type: Donut hammer.

Log Drawn By:	Laurie White	Logged By:	**Ted Lilly**
Contact:	laurie.white@reumad.com.au	Checked By:	**Ted Lilly**
		Date:	**26/04/2023**
		Date:	**10/05/2023**

BOREHOLE LOG: BH02

Geo-Logix
environment · geotech

Geo-Logix Pty Ltd
Building Q2, Level 3
Unit 2309 / 4 Daydream Street
Warriewood NSW 2102
www.geo-logix.com.au

Project Number:	**2301022**
Hole Depth:	**19.00 m**
Date Started:	**26/04/2023**
Date Completed:	**26/04/2023**

Project Name: **Acid Sulfate Soil & Geotechnical Investigation**
Location / Site: **310 Terrigal Drive, Terrigal NSW**
Client: **Loftus Lane Capital**
Contractor: **Fico Group Pty Limited**
Method: **Solid Flight Auger (Truck mounted)**

Method	Water Level	Depth (mBGL)	RL (mAHD)	Sample Type	HC Odour	Sample ID	pH_F	pH_{FOX}	Reaction	Material Type	USCS Symbol	Graphic Log	Material Description	Moisture	SPT
SFA (V-bit)		11		R	Z	BH02/11.5-11.95	5.5	3.5	4	Natural	SC		**Clayey SAND with Gravel**- very light grey (N8), 30% clay, 60% sand, 10% gravel, medium dense.	wet	7,7,8 N=15
		12													
		13.00													
		14					5	5	4		SC		**Clayey SAND / Extremely Weathered Conglomerate**- light red / moderate reddish orange (10R 6/6), 30% clay, 70% sand, low resistance.		
		14.50		D	Z	BH02/14.5							**Weathered Conglomerate**- light red / moderate reddish orange (10R 6/6), high resistance, switched to TC-bit at 14.5m.		5/0,double bounce
SFA (TC-bit)		***15.20***											**Weathered Conglomerate**- light red / moderate reddish orange (10R 6/6), low to medium resistance.		
		16													
		17													
		18													
		19													
		20											**Terminated at 19.000 m**		
		21													

Abbreviations

Hydrocarbon Odour
H High
M Medium
L Low
Z Zero

Sample Type
D Disturbed
U Undisturbed
B Bulk
R Representative
C Continuous
J Jar
Asb Asbestos

Strength Testing
SPT Standard Penetration Test
DCP Dynamic Cone Penetrometer
PP Pocket Penetrometer

Water Levels
Encountered Groundwater
Stabilised Groundwater

Abandonment Method: Backfill with soil and compact.
Additional Comments: SPT hammer type: Donut hammer.

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Ted Lilly** Date: **26/04/2023**
Checked By: **Ted Lilly** Date: **10/05/2023**

BOREHOLE LOG: BH03

Geo-Logix Pty Ltd
Building Q2, Level 3
Unit 2309 / 4 Daydream Street
Warriewood NSW 2102
www.geo-logix.com.au

Project Number:	**2301022**
Hole Depth:	**15.00 m**
Date Started:	**24/04/2023**
Date Completed:	**24/04/2023**

Project Name: **Acid Sulfate Soil & Geotechnical Investigation**
Location / Site: **310 Terrigal Drive, Terrigal NSW**
Client: **Loftus Lane Capital**
Contractor: **Fico Group Pty Limited**
Method: **Solid Flight Auger (Truck mounted)**

Method	Water Level	Depth (mBGL)	RL (mAHD)	Sample Type	HC Odour	Sample ID	pH_F	pH_{FOX}	Reaction	Material Type	USCS Symbol	Graphic Log	Material Description	Moisture	SPT
SFA (V-bit)		0.20								Natural			**TOPSOIL**- dusky brown (5YR 2/2).		
	▼	1		R	Z	BH03/1.0-1.45	5	5	0		CL		**CLAY**- dark reddish brown / moderate brown (5YR 3/4), 95% clay, 5% sand, medium plasticity, firm.	moist	3,3,4 N=7
		1.70													
		2		D	Z	BH03/2.0-2.1	5	4.5	4		CL		**CLAY**- 75% clay, 15% sand, medium plasticity, firm.	wet	
		2.20													
	▽	3		R	Z	BH03/2.5-2.95	5.5	4.5	4		SP		**SAND with clay**- medium light grey (N6), 10% clay, 90% sand, loose.	wet	3,4,5 N=9
		3.70													
		4		R	Z	BH03/4.0-4.45	5.5	4.5	4		SC		**Clayey SAND**- grey / light brownish grey (5YR 6/1), 40% clay, 50% sand, loose.	wet	3,3,5 N=8
		5		D	Z	BH03/5.0-5.1	5	5	2				Sulfur odour at 5m.		
		5.50													
		6		R	Z	BH03/5.5-5.95	5	4.5	4		CL		**CLAY with Sand**- medium light grey (N6), 70% clay, 30% sand, medium plasticity, stiff.	wet	5,4,5 N=9
		6.50													
		7		R	Z	BH03/7.0-7.45	6.5	4.5	4		SC		**Clayey SAND**- brownish yellow / dark yellowish orange (10YR 6/6), 20% clay, 80% sand, medium dense.	wet	5,10,18 N=28
		7.80													
		8		D	Z	BH03/8.0-8.1	7	4	4		SC		**Clayey SAND**- light grey / yellowish grey (5Y 7/2), 20% clay, 80% sand, loose.	wet	
		9		R	Z	BH03/8.5-8.95									2,1,2 N=3
		10		D	Z	BH03/10.0-10.1	6	3.5	4						8,10,14 N=24
		10.40		R	Z	BH03/10.0-10.45									

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Strength Testing
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DCP Dynamic Cone Penetrometer
PP Pocket Penetrometer

Water Levels
▽ Encountered Groundwater
▼ Stabilised Groundwater

Abandonment Method: Backfill with soil and compact.
Additional Comments: SPT hammer type: Donut hammer.

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Christian Menini** Date: **24/04/2023**
Checked By: **Ted Lilly** Date: **10/05/2023**

BOREHOLE LOG: BH03

Geo-Logix Pty Ltd
Building Q2, Level 3
Unit 2309 / 4 Daydream Street
Warriewood NSW 2102
www.geo-logix.com.au

Project Number:	**2301022**
Hole Depth:	**15.00 m**
Date Started:	**24/04/2023**
Date Completed:	**24/04/2023**

Project Name: **Acid Sulfate Soil & Geotechnical Investigation**
Location / Site: **310 Terrigal Drive, Terrigal NSW**
Client: **Loftus Lane Capital**
Contractor: **Fico Group Pty Limited**
Method: **Solid Flight Auger (Truck mounted)**

Method	Water Level	Depth (mBGL)	RL (mAHD)	Sample Type	HC Odour	Sample ID	pH_F	pH_{FOX}	Reaction	Material Type	USCS Symbol	Graphic Log	Material Description	Moisture	SPT
SFA (V-bit)		11.00								Natural	SC		**Clayey SAND**- medium light grey (N6), 20% clay, 70% sand, 10% gravel, loose.*(continued)*	wet	
				D	Z	BH03/11.2-11.3					SC		**Clayey SAND**- brownish yellow / dark yellowish orange (10YR 6/6), 30% clay, 70% sand, very dense.	wet	
		12		R	Z	BH03/11.5-11.95	5	4.5	4		SC				9,22, 30/110
		13.00											**Weathered SANDSTONE**- pink / moderate orange pink (5YR 8/4), low resistance with medium resistance bands.		
		14													
		15		R	Z	BH03/14.5-14.95									25/90
		16											**Terminated at 15.000 m**		
		17													
		18													
		19													
		20													
		21													

Abbreviations

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SPT Standard Penetration Test
DCP Dynamic Cone Penetrometer
PP Pocket Penetrometer

Water Levels
Encountered Groundwater
Stabilised Groundwater

Abandonment Method: Backfill with soil and compact.
Additional Comments: SPT hammer type: Donut hammer.

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Christian Menini** Date: **24/04/2023**
Checked By: **Ted Lilly** Date: **10/05/2023**

BOREHOLE LOG: BH04

Geo-Logix Pty Ltd
Building Q2, Level 3
Unit 2309 / 4 Daydream Street
Warriewood NSW 2102
www.geo-logix.com.au

Project Number:	**2301022**
Hole Depth:	**20.00 m**
Date Started:	**24/04/2023**
Date Completed:	**24/04/2023**

Project Name: **Acid Sulfate Soil & Geotechnical Investigation**
Location / Site: **310 Terrigal Drive, Terrigal NSW**
Client: **Loftus Lane Capital**
Contractor: **Fico Group Pty Limited**
Method: **Solid Flight Auger (Truck mounted)**

Method	Water Level	Depth (mBGL)	RL (mAHD)	Sample Type	HC Odour	Sample ID	pH_F	pH_{FOX}	Reaction	Material Type	USCS Symbol	Graphic Log	Material Description	Moisture	SPT
SFA (V-bit)		0.10								Natural			**TOPSOIL**- dusky brown (5YR 2/2).	moist	
				D	Z	BH04/0.4-0.5					CL		**CLAY with Silt & Sand**- dusky brown (5YR 2/2), 50% clay, 30% silt, 20% sand, medium plasticity.		
	▼	1.00					6	4.5	4						
				R	Z	BH04/1.0-1.45							**CLAY**- yellowish red / light brown (5YR 5/6), 90% clay, 10% sand, medium plasticity, firm.	wet	2,3,4 N=7
		2		D	Z	BH04/2.0-2.2	6	4.5	2						
				R	Z	BH04/2.5-2.95					CL				5,6,7 N=13
	▽	3					4.5	4.5	4						
		4		D	Z	BH04/3.9-4.0	5	4.5	4						
				R	Z	BH04/4.0-4.45									3,4,5 N=9
		4.50													
		5		D	Z	BH04/5.0-5.1	6	4.5	4				**CLAY**- red / moderate reddish brown (10R 4/6), 70% clay, 30% sand, medium plasticity, stiff.	wet	
				R	Z	BH04/5.5-5.95									3,4,4 N=8
		6									CL				
		7		D	Z	BH04/7.0-7.2	5.5	4.5	4						
		8					5.5	4	4						
		8.50		D	Z	BH04/8.3-8.5									
				R	Z	BH04/8.5-8.95							**CLAY**- medium dark grey (N4), 60% clay, 40% sand, medium plasticity, soft.	wet	1,1,2 N=3
		9									CL				
		10		D	Z	BH04/10.0-10.1	6	4	4						

Abbreviations

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Strength Testing
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DCP Dynamic Cone Penetrometer
PP Pocket Penetrometer

Water Levels
▽ Encountered Groundwater
▼ Stabilised Groundwater

Abandonment Method: Backfill with soil and compact.
Additional Comments: SPT hammer type: Donut hammer.

Log Drawn By:	Laurie White	Logged By:	**Christian Menini**
Contact:	laurie.white@reumad.com.au	Checked By:	**Ted Lilly**
		Date:	**24/04/2023**
		Date:	**10/05/2023**

BOREHOLE LOG: BH04

Geo-Logix Pty Ltd
Building Q2, Level 3
Unit 2309 / 4 Daydream Street
Warriewood NSW 2102
www.geo-logix.com.au

Project Number:	**2301022**
Hole Depth:	**20.00 m**
Date Started:	**24/04/2023**
Date Completed:	**24/04/2023**

Project Name: **Acid Sulfate Soil & Geotechnical Investigation**
Location / Site: **310 Terrigal Drive, Terrigal NSW**
Client: **Loftus Lane Capital**
Contractor: **Fico Group Pty Limited**
Method: **Solid Flight Auger (Truck mounted)**

Method	Water Level	Depth (mBGL)	RL (mAHD)	Sample Type	HC Odour	Sample ID	pH_F	pH_{FOX}	Reaction	Material Type	USCS Symbol	Graphic Log	Material Description	Moisture	SPT
SFA (V-bit)		11		D	Z	BH04/11.0-11.14	5.5	4.5	4	Natural	CL		**CLAY**- medium dark grey (N4), 60% clay, 40% sand, medium plasticity, soft.*(continued)*	wet	
		11.40													
		12		R	Z	BH04/11.5-11.8							**Extremely Weathered SANDSTONE**- medium light grey (N6), low resistance.	wet	7,21,stopped due to collapsing sand condition, no refusal
		13													
		13.30													
SFA (TC-bit)		14											**Weathered SANDSTONE**- medium light grey (N6), low resistance, V-bit refusal at 13.3m, switch to TC-bit.	damp	
		15													
		16													
		17													
		18													
		19													
		20													
		21											**Terminated at 20.000 m**		

Abbreviations

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Water Levels
Encountered Groundwater
Stabilised Groundwater

Abandonment Method: Backfill with soil and compact.
Additional Comments: SPT hammer type: Donut hammer.

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Christian Menini** Date: **24/04/2023**
Checked By: **Ted Lilly** Date: **10/05/2023**

ATTACHMENT C

Geo-Logix P/L
Bld Q2 Level 3, 2309/4 Daydream St
Warriewood
NSW 2102

Attention: **Ted Lilly**

Report **985366-S**
Project name TERRIGAL
Project ID 2301022
Received Date Apr 28, 2023

Client Sample ID			**BH1/1-1.45**	**BH2/1-1.4.5**	**BH2/4-4.45**	**BH4/2.5-2.95**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S23-My0002534**	**S23-My0002535**	**S23-My0002536**	**S23-My0002537**
Date Sampled			**Apr 26, 2023**	**Apr 26, 2023**	**Apr 26, 2023**	**Apr 26, 2023**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	67	< 10	25	93
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	57	25	46	110
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	5.9	5.7	5.7	5.2
Resistivity*	0.5	ohm.m	180	400	220	93
Sulphate (as SO4)	10	mg/kg	32	54	68	120
Sample Properties						
% Moisture	1	%	25	28	18	22

Client Sample ID			**BH4/4-4.45**	**BH4/5.5-5.95**	**BH4/8.5-8.95**	**BH4/11.5-11.8**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S23-My0002538**	**S23-My0002539**	**S23-My0002540**	**S23-My0002541**
Date Sampled			**Apr 24, 2023**	**Apr 24, 2023**	**Apr 24, 2023**	**Apr 24, 2023**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	50	57	58	66
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	72	93	61	55
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	5.5	5.4	6.7	6.4
Resistivity*	0.5	ohm.m	140	110	160	180
Sulphate (as SO4)	10	mg/kg	85	120	49	25
Sample Properties						
% Moisture	1	%	17	17	16	15

Client Sample ID			BH1/7-7.1	BH2/7-7.1	BH2/14-14.1	BH3/3.9-4.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			S23-My0002542	S23-My0002543	S23-My0002544	S23-My0002545
Date Sampled			Apr 26, 2023	Apr 26, 2023	Apr 26, 2023	Apr 24, 2023
Test/Reference	LOR	Unit				
Sample Properties						
% Moisture	1	%	25	21	25	25
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.3	5.7	6.2	6.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	2.1	2.1	4.8	4.2
Reaction Ratings*[S05]	0	-	4.0	4.0	3.0	4.0
Actual Acidity (NLM-3.2)						
pH-KCL (NLM-3.1)	0.1	pH Units	3.9	4.5	5.5	4.9
Titratable Actual Acidity (NLM-3.2)	2	mol H+/t	170	49	6.7	16
Titratable Actual Acidity (NLM-3.2)	0.003	% pyrite S	0.27	0.079	0.011	0.026
Potential Acidity - Chromium Reducible Sulfur						
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)[S04]	0.005	% S	2.4	0.89	0.012	0.005
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	3	mol H+/t	1500	560	7.2	3.3
Extractable Sulfur						
Sulfur - KCl Extractable	0.005	% S	0.25	N/A	N/A	N/A
HCl Extractable Sulfur	0.005	% S	0.25	N/A	N/A	N/A
Retained Acidity (S-NAS)						
Net Acid soluble sulfur (SNAS) NLM-4.1	0.005	% S	< 0.005	N/A	N/A	N/A
Net Acid soluble sulfur (s-SNAS) NLM-4.1[S02]	0.005	% S	< 0.005	N/A	N/A	N/A
Net Acid soluble sulfur (a-SNAS) NLM-4.1	2	mol H+/t	< 2	N/A	N/A	N/A
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0	2.0	2.0
Acid Neutralising Capacity (ANCbt)						
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	0.01	% CaCO3	N/A	N/A	N/A	N/A
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)[S03]	0.02	% S	N/A	N/A	N/A	N/A
Acid Neutralising Capacity - (a-ANCbt) (NLM-5.2)	2	mol H+/t	N/A	N/A	N/A	N/A
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Including ANC)						
CRS Suite - Net Acidity - NASSG (Including ANC)	0.02	% S	2.7	0.97	0.02	0.03
CRS Suite - Net Acidity - NASSG (Including ANC)	10	mol H+/t	1700	610	14	19
CRS Suite - Liming Rate - NASSG (Including ANC)[S01]	1	kg CaCO3/t	130	45	1.0	1.5
Extraneous Material						
<2mm Fraction	0.005	g	450	160	340	310
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1

Client Sample ID			BH4/0.4-0.5	BH4/5.0-5.1
Sample Matrix			Soil	Soil
Eurofins Sample No.			S23-My0002546	S23-My0002547
Date Sampled			Apr 24, 2023	Apr 24, 2023
Test/Reference	LOR	Unit		
Sample Properties				
% Moisture	1	%	23	33
Acid Sulfate Soils Field pH Test				
pH-F (Field pH test)*	0.1	pH Units	5.7	5.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.8	3.9
Reaction Ratings*[S05]	0	-	4.0	3.0

Client Sample ID			BH4/0.4-0.5	BH4/5.0-5.1
Sample Matrix			Soil	Soil
Eurofins Sample No.			S23-My0002546	S23-My0002547
Date Sampled			Apr 24, 2023	Apr 24, 2023
Test/Reference	LOR	Unit		
Actual Acidity (NLM-3.2)				
pH-KCL (NLM-3.1)	0.1	pH Units	4.6	4.8
Titratable Actual Acidity (NLM-3.2)	2	mol H+/t	71	19
Titratable Actual Acidity (NLM-3.2)	0.003	% pyrite S	0.11	0.031
Potential Acidity - Chromium Reducible Sulfur				
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)[S04]	0.005	% S	0.011	< 0.005
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	3	mol H+/t	6.8	< 3
Extractable Sulfur				
Sulfur - KCl Extractable	0.005	% S	N/A	N/A
HCl Extractable Sulfur	0.005	% S	N/A	N/A
Retained Acidity (S-NAS)				
Net Acid soluble sulfur (SNAS) NLM-4.1	0.005	% S	N/A	N/A
Net Acid soluble sulfur (s-SNAS) NLM-4.1[S02]	0.005	% S	N/A	N/A
Net Acid soluble sulfur (a-SNAS) NLM-4.1	2	mol H+/t	N/A	N/A
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0
Acid Neutralising Capacity (ANCbt)				
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	0.01	% CaCO3	N/A	N/A
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)[S03]	0.02	% S	N/A	N/A
Acid Neutralising Capacity - (a-ANCbt) (NLM-5.2)	2	mol H+/t	N/A	N/A
ANC Fineness Factor		factor	1.5	1.5
Net Acidity (Including ANC)				
CRS Suite - Net Acidity - NASSG (Including ANC)	0.02	% S	0.12	0.03
CRS Suite - Net Acidity - NASSG (Including ANC)	10	mol H+/t	78	19
CRS Suite - Liming Rate - NASSG (Including ANC)[S01]	1	kg CaCO3/t	5.8	1.5
Extraneous Material				
<2mm Fraction	0.005	g	110	420
>2mm Fraction	0.005	g	< 0.005	< 0.005
Analysed Material	0.1	%	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chloride	Sydney	May 02, 2023	28 Days
- Method: LTM-INO-4270 Anions by Ion Chromatography			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Sydney	May 02, 2023	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25 °C as rec.)	Sydney	May 02, 2023	7 Days
- Method: LTM-GEN-7090 pH by ISE			
Sulphate (as SO4)	Sydney	May 02, 2023	28 Days
- Method: In-house method LTM-INO-4270 Sulphate by Ion Chromatograph			
% Moisture	Brisbane	May 01, 2023	14 Days
- Method: LTM-GEN-7080 Moisture			
Acid Sulfate Soils Field pH Test	Brisbane	May 04, 2023	7 Days
- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests			
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	May 04, 2023	6 Week
- Method: LTM-GEN-7070 Chromium Reducible Sulfur Suite			
Extraneous Material	Brisbane	May 04, 2023	6 Week
- Method: LTM-GEN-7050/7070			

eurofins

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NATA# 1261
Site# 25079 & 25289

Eurofins ARL Pty Ltd
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Tel: +61 8 6253 4444
NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

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Company Name: Geo-Logix P/L
Address: Bld Q2 Level 3, 2309/4 Daydream St
Warriewood
NSW 2102

Project Name: TERRIGAL
Project ID: 2301022

Order No.: P05912TL
Report #: 985366
Phone: 02 9979 1722
Fax: 02 9979 1222

Received: Apr 28, 2023 6:24 PM
Due: May 5, 2023
Priority: 5 Day
Contact Name: Ted Lilly

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						HOLD	Acid Sulfate Soils Field pH Test	Aggressivity Soil Set	Chromium Reducible Sulfur Suite	Moisture Set	Moisture Set
Sydney Laboratory - NATA # 1261 Site # 18217						X		X		X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							X		X	X	X
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	BH1/1-1.45	Apr 26, 2023		Soil	S23-My0002534			X			X
2	BH2/1-1.4.5	Apr 26, 2023		Soil	S23-My0002535			X			X
3	BH2/4-4.45	Apr 26, 2023		Soil	S23-My0002536			X			X
4	BH4/2.5-2.95	Apr 26, 2023		Soil	S23-My0002537			X			X
5	BH4/4-4.45	Apr 24, 2023		Soil	S23-My0002538			X			X
6	BH4/5.5-5.95	Apr 24, 2023		Soil	S23-My0002539			X			X
7	BH4/8.5-8.95	Apr 24, 2023		Soil	S23-My0002540			X			X
8	BH4/11.5-11.8	Apr 24, 2023		Soil	S23-My0002541			X			X
9	BH1/7-7.1	Apr 26, 2023		Soil	S23-My0002542		X		X	X	
10	BH2/7-7.1	Apr 26, 2023		Soil	S23-My0002543		X		X	X	
11	BH2/14-14.1	Apr 26, 2023		Soil	S23-My0002544		X		X	X	
12	BH3/3.9-4.0	Apr 24, 2023		Soil	S23-My0002545		X		X	X	

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Sydney Laboratory - NATA # 1261 Site # 18217						X		X		X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							X		X	X	X
13	BH4/0.4-0.5	Apr 24, 2023		Soil	S23-My0002546		X		X	X	
14	BH4/5.0-5.1	Apr 24, 2023		Soil	S23-My0002547		X		X	X	
15	BH1/5.5-5.95	Apr 26, 2023		Soil	S23-My0002548	X					
16	BH1/0.3-0.5	Apr 26, 2023		Soil	S23-My0002549	X					
17	BH1/0.9-1.0	Apr 26, 2023		Soil	S23-My0002550	X					
18	BH1/1.9-2.0	Apr 26, 2023		Soil	S23-My0002551	X					
19	BH1/2.5-2.95	Apr 26, 2023		Soil	S23-My0002552	X					
20	BH1/4-4.45	Apr 26, 2023		Soil	S23-My0002553	X					
21	BH1/5-5.1	Apr 26, 2023		Soil	S23-My0002554	X					
22	BH1/8-8.1	Apr 26, 2023		Soil	S23-My0002555	X					
23	BH1/8.5-8.95	Apr 26, 2023		Soil	S23-My0002556	X					
24	BH1/11.5-11.95	Apr 26, 2023		Soil	S23-My0002557	X					
25	BH2/0.3-0.5	Apr 26, 2023		Soil	S23-My0002558	X					
26	BH2/0.8-1.0	Apr 26, 2023		Soil	S23-My0002559	X					

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Sydney Laboratory - NATA # 1261 Site # 18217						X		X		X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							X		X	X	X
27	BH2/1.9-2.0	Apr 26, 2023		Soil	S23-My0002560	X					
28	BH2/2.8-2.95	Apr 26, 2023		Soil	S23-My0002561	X					
29	BH2/3.9-4	Apr 26, 2023		Soil	S23-My0002562	X					
30	BH2/4.9-5	Apr 26, 2023		Soil	S23-My0002563	X					
31	BH2/5.5-5.95	Apr 26, 2023		Soil	S23-My0002564	X					
32	BH2/8-8.1	Apr 26, 2023		Soil	S23-My0002565	X					
33	BH2/8.5-8.95	Apr 26, 2023		Soil	S23-My0002566	X					
34	BH2/11.5-11.95	Apr 26, 2023		Soil	S23-My0002567	X					
35	BH3/1-1.45	Apr 26, 2023		Soil	S23-My0002568	X					
36	BH3/2-2.1	Apr 24, 2023		Soil	S23-My0002569	X					
37	BH3/2.5-2.95	Apr 24, 2023		Soil	S23-My0002570	X					
38	BH3/5.0-5.1	Apr 24, 2023		Soil	S23-My0002571	X					
39	BH3/5.5-5.95	Apr 24, 2023		Soil	S23-My0002572	X					
40	BH3/7-7.95	Apr 24, 2023		Soil	S23-My0002573	X					

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Sydney Laboratory - NATA # 1261 Site # 18217						X		X		X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							X		X	X	X
41	BH3/8-8.1	Apr 24, 2023		Soil	S23-My0002574	X					
42	BH3/8.5-8.95	Apr 24, 2023		Soil	S23-My0002575	X					
43	BH3/10-10.1	Apr 24, 2023		Soil	S23-My0002576	X					
44	BH3/11.5-11.95	Apr 24, 2023		Soil	S23-My0002577	X					
45	BH4/1-1.45	Apr 24, 2023		Soil	S23-My0002578	X					
46	BH4/2.0-2.2	Apr 24, 2023		Soil	S23-My0002579	X					
47	BH4/3.9-4.0	Apr 24, 2023		Soil	S23-My0002580	X					
48	BH4/7.0-7.2	Apr 24, 2023		Soil	S23-My0002581	X					
49	BH4/8.3-8.5	Apr 24, 2023		Soil	S23-My0002582	X					
50	BH4/10-10.1	Apr 24, 2023		Soil	S23-My0002583	X					
51	BH4/11.0-11.1	Apr 24, 2023		Soil	S23-My0002584	X					
Test Counts						37	6	8	6	14	14

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres
CFU: Colony forming unit

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/kg	< 10			10	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	uS/cm	< 10			10	Pass	
Sulphate (as SO4)	mg/kg	< 10			10	Pass	
LCS - % Recovery							
Chloride	%	97			70-130	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	%	97			70-130	Pass	
Resistivity*	%	97			70-130	Pass	
Sulphate (as SO4)	%	103			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
Chloride	S23-My0002541	CP	%	96			70-130	Pass	
Sulphate (as SO4)	S23-My0002541	CP	%	95			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1	Result 2	RPD	Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	S23-My0001224	NCP	uS/cm	72	67	6.8	30%	Pass	
pH (1:5 Aqueous extract at 25 °C as rec.)	S23-Ap0061627	NCP	pH Units	8.8	8.9	<1	30%	Pass	
Resistivity*	S23-My0001224	NCP	ohm.m	140	150	6.8	30%	Pass	
Duplicate									
Sample Properties				Result 1	Result 2	RPD			
% Moisture	S23-My0002280	NCP	%	17	17	1.7	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S23-My0002493	NCP	pH Units	4.8	4.7	pass	20%	Pass	
Duplicate									
Actual Acidity (NLM-3.2)				Result 1	Result 2	RPD			
pH-KCL (NLM-3.1)	S23-My0002546	CP	pH Units	4.6	4.7	<1	20%	Pass	
Titratable Actual Acidity (NLM-3.2)	S23-My0002546	CP	mol H+/t	71	70	<1	20%	Pass	
Titratable Actual Acidity (NLM-3.2)	S23-My0002546	CP	% pyrite S	0.11	0.11	<1	30%	Pass	
Duplicate									
Potential Acidity - Chromium Reducible Sulfur				Result 1	Result 2	RPD			
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)	S23-My0002546	CP	% S	0.011	0.012	N/A	20%	Pass	
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	S23-My0002546	CP	mol H+/t	6.8	7.7	12	30%	Pass	
Duplicate									
Extractable Sulfur				Result 1	Result 2	RPD			
Sulfur - KCl Extractable	S23-My0002546	CP	% S	N/A	N/A	N/A	30%	Pass	
HCl Extractable Sulfur	S23-My0002546	CP	% S	N/A	N/A	N/A	20%	Pass	
Duplicate									
Retained Acidity (S-NAS)				Result 1	Result 2	RPD			
Net Acid soluble sulfur (SNAS) NLM-4.1	S23-My0002546	CP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur (s-SNAS) NLM-4.1	S23-My0002546	CP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur (a-SNAS) NLM-4.1	S23-My0002546	CP	mol H+/t	N/A	N/A	N/A	30%	Pass	

Duplicate									
Acid Neutralising Capacity (ANCbt)				Result 1	Result 2	RPD			
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	S23-My0002546	CP	% CaCO3	N/A	N/A	N/A	20%	Pass	
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)	S23-My0002546	CP	% S	N/A	N/A	N/A	30%	Pass	
ANC Fineness Factor	S23-My0002546	CP	factor	1.5	1.5	<1	30%	Pass	
Duplicate									
Net Acidity (Including ANC)				Result 1	Result 2	RPD			
CRS Suite - Net Acidity - NASSG (Including ANC)	S23-My0002546	CP	% S	0.12	0.13	<1	30%	Pass	
CRS Suite - Net Acidity - NASSG (Including ANC)	S23-My0002546	CP	mol H+/t	78	78	<1	30%	Pass	
CRS Suite - Liming Rate - NASSG (Including ANC)	S23-My0002546	CP	kg CaCO3/t	5.8	5.9	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised by:

Ursula Long	Analytical Services Manager
Dilani Samarakoon	Senior Analyst-Inorganic
Roopesh Rangarajan	Senior Analyst-Inorganic
Jonathon Angell	Senior Analyst-Sample Properties
Jonathon Angell	Senior Analyst-SPOCAS

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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35 O'Rorke Road	43 Detroit Drive
Penrose,	Rolleston,
Auckland 1061	Christchurch 7675
Tel: +64 9 526 45 51	Tel: 0800 856 450
IANZ# 1327	IANZ# 1290

Sample Receipt Advice

Company name:	Geo-Logix P/L
Contact name:	Ted Lilly
Project name:	TERRIGAL
Project ID:	2301022
Turnaround time:	5 Day
Date/Time received	Apr 28, 2023 6:24 PM
Eurofins reference	985366

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	Sample Temperature of chilled sample on the batch as recorded by Eurofins Sample Receipt : 2.1 degrees Celsius.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✓	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✓	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
✓	Sample containers for volatile analysis received with zero headspace.
X	Split sample sent to requested external lab.
X	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

Received assbg labeled with BH1/1.8-2.0. logged as per COC.
Samples received by the laboratory after 5.30pm are deemed to have been received the following working day.

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Asim Khan on phone : or by email: AsimKhan@eurofins.com

Results will be delivered electronically via email to Ted Lilly - tlilly@geo-logix.com.au.

Note: A copy of these results will also be delivered to the general Geo-Logix P/L email address.

Geo-Logix Pty Ltd
Building Q2, Level 3
2309/4 Daydream St
Warriewood, NSW 2102

ABN: 86 116 892 936

P: (02) 9979 1722
F: (02) 9979 1222

CHAIN OF CUSTODY

Project Manager: T Lilly
Contact email: tlilly@geo-logix.com.au
Project Name: Terrigal
Project Number: 2301022 Date Submitted: 28/4

Page 1 of 3
Purchase Order No: PO5912TL
Quote Reference:
Send Invoice to: accounts@geo-logix.com.au
TAT required: std

ANALYSIS REQUIRED

Lab ID	Sample ID	Date	Matrix: soil	Matrix: water	Matrix: air	Matrix: paint, filters	Matrix: other	Comments	COMPOSITE	TRH - C6 - C10	TRH - C10 - C40	VOCs	BTEXN	PAHs	PCBs	OCPs	OPPs	Phenols	Metals - M8	Metals - Lead	Metals - Specify **	TCLP	Asbestos (ID only)	Asbestos (WA DOH)	Foreign Materials	Conductivity (EC)	pH	CRS ASS suite		Hold	SUITE
	BH1/1-1.45	28/4/23	X					Jar																							L2
	BH1/1-1.45	26/4/23	↓					↓																							L2
	BH2/4-4.45	26/4/23	↓					↓																							↓
	BH4/2.5-2.95	24/4/23	↓					↓																							↓
	BH4/4-4.45	24/4/23	↓					↓																							↓
	BH4/5.5-5.95	↓	↓					↓																							↓
	BH4/8.5-8.95	↓	↓					↓																							↓
	BH4/11.5-11.8		↓					↓																							
	BH1/5.5-5.95	26/4/23	X					↑																						X	
	BH1/0.3-0.5	26/4/23	X					Ziploc Bag																						X	
	BH1/0.9-1.0	↓	↓					↓																						X	
	BH1/1.9-2.0	↓	↓					↓																						X	
	BH1/2.5-2.95	↓	↓					↓																						X	
	BH1/4-4.45	↓	↓					↓																						X	
	BH1/5-5.1	↓	↓					↓																						X	
	BH1/7-7.1	↓	↓					↓																			X				
	BH1/8-8.1	↓	↓					↓																						X	
	BH1/8.5-8.95	↓	↓																											X	

Eurofins MGT Suite Codes

Code	Suite
B1	TRH/BTEXN
B1A	TRH/MAH
B2	TRH/BTEXN/Pb
B2A	TRH/MAH/Pb
B3	PAH/Phenols
B4	TRH/BTEXN/PAH
B4A	TRH/BTEXN/PAH/Phenols
B5	TRH/BTEXN/M7
B6	TRH/BTEXN/M8
B7	TRH/BTEXN/PAH/M8
B7A	TRH/BTEXN/PAH/Phenols/M8
B8	TRH/VOC/PAH/M8
B9	TRH/BTEXN/PAH/OCP/M8
B10	TRH/BTEXN/PAH/OCP/OPP/M8
B11	Na/K/Ca/Mg/Cl/SO_4/CO_3/HCO_3/NH_3/N
B11A	B11/Alkalinity
B11B	B11/EC/TDS
B12	TRH/BTEXN/Oxygenates/Ethanol
B12A	TRH/BTEXN/Oxygenates
B13	OCP/PCB
B14	OCP/OPP
B15	OCP/OPP/PCB
B16	TDS/SO_4/CH_4/Alk/BOD/COD/HPC/CU
B17	SO_4/NO_3/Fe++/HPC/CUB
B18	Cl-/SO_4/pH
B19	N/P/K
B20	CEC/%ESP/Ca/Ma/Na/K

Metals**(circle) As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Cr^{6+}, Cr^{3+}, Fe^{2+}, Fe^{3+}, Be, B, Al, V, Mn, Fe, Co, Se, Sr, Sn, Mo, Ag, Ba, Tl, Bi, Sb

Chain of Custody

Relinquished by: E Lilly Date/Time: 28/5 Signature: [signature] Received by: Laura [illegible] Date/Time: 28.4.23 17.24 Signature: [signature]

985366

chill 2.1°C

Versi
Issued: Jun
Review: Januar

CHAIN OF CUSTODY

Geo-Logix Pty Ltd
Building Q2, Level 3
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Warriewood, NSW 2102

ABN: 86 116 892 936

P: (02) 9979 1722
F: (02) 9979 1222

Project Manager: T. Lilly
Contact email: T.lilly@geologix.com.au
Project Name: Terisol
Project Number: 2301022 Date Submitted: 28/4

Page 2 of 3
Purchase Order No: P05912
Quote Reference:
Send Invoice to: accounts@geo-logix.com.au
TAT required: Std

ANALYSIS REQUIRED

Lab ID	Sample ID	Date	Matrix: soil	water	air	paint, filters	other	Comments	COMPOSITE	TRH - C6 - C10	TRH - C10 - C40	VOCs	BTEXN	PAHs	PCBs	OCPs	OPPs	Phenols	Metals - M8	Metals - Lead	Metals - Specify **	TCLP	Asbestos (ID only)	Asbestos (WA DOH)	Foreign Materials	Conductivity (EC)	pH	CRS 455.24		Hold	SUITE
	BH1/11.5-11.95	26/4	X																										X		
	BH2/0.3-0.5																												X		
	BH2/0.8-1.0																												X		
	BH2/1.9-2.0																												X		
	BH2/2.3-2.45																												X		
	BH2/3.9-4																												X		
	BH2/4.9-5																												X		
	BH2/5.5-5.95																												X		
	BH2/7-7.1																											X			
	BH2/8-8.1																												X		
	BH2/8.5-8.95																												X		
	BH2/11.5-11.95																												X		
	BH2/14-14.1																											X			
	BH3/1-1.45																												X		
	BH3/2-2.1	24/4																											X		
	BH3/2.5-2.95																												X		
	BH3/3.9-4.0																											X			
	BH3/5.0-5.1		↓																										X		

Metals**(circle) As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Cr^{6+}, Cr^{3+}, Fe^{2+}, Fe^{3+}, Be, B, Al, V, Mn, Fe, Co, Se, Sr, Sn, Mo, Ag, Ba, Tl, Bi, Sb

Eurofins MGT Suite Codes

B1	TRH/BTEXN
B1A	TRH/MAH
B2	TRH/BTEXN/Pb
B2A	TRH/MAH/Pb
B3	PAH/Phenols
B4	TRH/BTEXN/PAH
B4A	TRH/BTEXN/PAH/Phenols
B5	TRH/BTEXN/M7
B6	TRH/BTEXN/M8
B7	TRH/BTEXN/PAH/M8
B7A	TRH/BTEXN/PAH/Phenols/M8
B8	TRH/VOC/PAH/M8
B9	TRH/BTEXN/PAH/OCP/M8
B10	TRH/BTEXN/PAH/OCP/OPP/M8
B11	Na/K/Ca/Mg/Cl/SO_4/CO_3/HCO_3/NH_3/NC
B11A	B11/Alkalinity
B11B	B11/EC/TDS
B12	TRH/BTEXN/Oxygenates/Ethanol
B12A	TRH/BTEXN/Oxygenates
B13	OCP/PCB
B14	OCP/OPP
B15	OCP/OPP/PCB
B16	TDS/SO_4/CH_4/Alk/BOD/COD/HPC/CUE
B17	SO_4/NO_3/Fe++/HPC/CUB
B18	Cl-/SO_4/pH
B19	N/P/K
B20	CEC/%ESP/Ca/Ma/Na/K

Chain of Custody

Relinquished by: Ed Lilly Date/Time: 28/4 Signature: Ed L
Received by: Date/Time: Signature:

Versio
Issued: June
Review: January

Geo-Logix Pty Ltd
Building Q2, Level 3
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Warriewood, NSW 2102

ABN: 86 116 892 936

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CHAIN OF CUSTODY

Project Manager: T Gillis
Contact email: TJ.11.@geo-logix.com.au
Project Name: Terrigal
Project Number: 230122 Date Submitted: 28/4

Page 3 of 3
Purchase Order No: P05912
Quote Reference:
Send Invoice to: accounts@geo-logix.com.au
TAT required: Std

ANALYSIS REQUIRED

Lab ID	Sample ID	Date	Matrix: soil	water	air	paint, filters	other	Comments	COMPOSITE	TRH - C6 - C10	TRH - C10 - C40	VOCs	BTEXN	PAHs	PCBs	OCPs	OPPs	Phenols	Metals - M8	Metals - Lead	Metals - Specify **	TCLP	Asbestos (ID only)	Asbestos (WA DOH)	Foreign Materials	Conductivity (EC)	pH	CRS As Suite		Hold	SUITE
	BH3/5.5-5.95	24/4	X																										X	
	BH3/7-7.45																												X	
	BH3/8-8.1																												X	
	BH3/8.5-8.95																												X	
	BH3/10-10.1																												X	
	BH3/11.5-11.95																												X	
	BH4/0.4-0.5																												X	
	BH4/1-1.45																											X		
	BH4/2.0-2.2																												X	
	BH4/3.9-4.0																												X	
	BH4/5.0-5.1																												X	
	BH4/7.0-7.2																										X			
	BH4/8.3-8.5																												X	
	BH4/10-10.1																												X	
	BH4/11.0-11.1																												X	

Metals(circle)** As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Cr^{6+}, Cr^{3+}, Fe^{2+}, Fe^{3+}, Be, B, Al, V, Mn, Fe, Co, Se, Sr, Sn, Mo, Ag, Ba, Tl, Bi, Sb

Eurofins MGT Suite Codes

B1	TRH/BTEXN
B1A	TRH/MAH
B2	TRH/BTEXN/Pb
B2A	TRH/MAH/Pb
B3	PAH/Phenols
B4	TRH/BTEXN/PAH
B4A	TRH/BTEXN/PAH/Phenols
B5	TRH/BTEXN/M7
B6	TRH/BTEXN/M8
B7	TRH/BTEXN/PAH/M8
B7A	TRH/BTEXN/PAH/Phenols/M8
B8	TRH/VOC/PAH/M8
B9	TRH/BTEXN/PAH/OCP/M8
B10	TRH/BTEXN/PAH/OCP/OPP/M8
B11	Na/K/Ca/Mg/Cl/SO_4/CO_3/HCO_3/NH_3/NO_3
B11A	B11/Alkalinity
B11B	B11/EC/TDS
B12	TRH/BTEXN/Oxygenates/Ethanol
B12A	TRH/BTEXN/Oxygenates
B13	OCP/PCB
B14	OCP/OPP
B15	OCP/OPP/PCB
B16	TDS/SO_4/CH_4/Alk/BOD/COD/HPC/CUB
B17	SO_4/NO_3/Fe++/HPC/CUB
B18	Cl-/SO_4/pH
B19	N/P/K
B20	CEC/%ESP/Ca/Ma/Na/K

Chain of Custody

Relinquished by: Date/Time: 28/4 Signature: Received by: Date/Time: Signature:

SOIL CLASSIFICATION REPORT

Client	Geo-Logix Pty Ltd	**Source**	BH2 2.50-2.95m
Address	Building Q2, Level 3, 2309/4 Daydream St, Warriewood, NSW 2102	**Sample Description**	Silty CLAY
Project	Terrigal (2301022)	**Report No.**	S85839-PI
Job No.	S23168-1	**Lab No.**	S85839

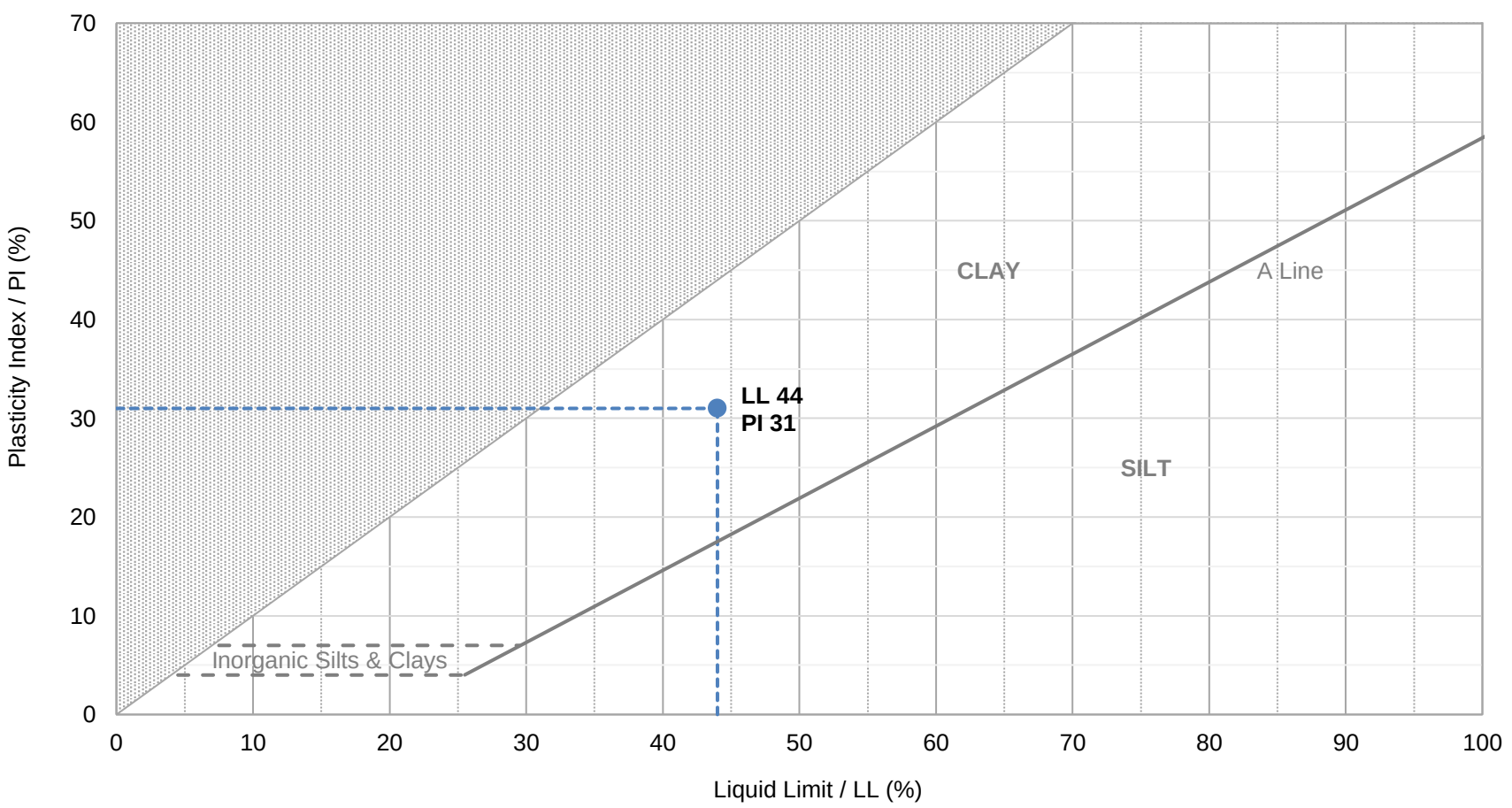
Test Procedure

- ☐ AS1289 3.1.1 Liquid Limit - Four point Casagrande method
- ☑ AS1289 3.1.2 Liquid Limit - One point Casagrande method
- ☑ AS1289 3.2.1 Plastic Limit - Standard method
- ☑ AS1289 3.3.1 Calculation of the Plasticity Index
- ☑ AS1289 3.4.1 Linear Shrinkage - Standard method

Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	26/04/2023
Preparation	Prepared in accordance with the test method	**Date Tested**	19/05/2023

Plasticity Chart for Classification of Fine-Grained Soils

AS 1726:2017 Clause 6.1.6 (Figure 5)



Preparation		**Results**	
Method of Preparation	**Dry Sieved**	Liquid Limit / LL (%)	**44**
History of the Sample	**Oven Dried**	Plastic Limit (%)	**13**
		Plasticity Index / PI (%)	**31**
		Linear Shrinkage (%)	**13.5**
		Condition upon Drying	**Linear**

Notes

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. This document shall not be reproduced, except in full. Results relate only to the samples tested.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

23/05/2023

Date:

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

SOIL CLASSIFICATION REPORT

Client	Geo-Logix Pty Ltd	**Source**	BH3 4.00-4.45m
Address	Building Q2, Level 3, 2309/4 Daydream St, Warriewood, NSW 2102	**Sample Description**	Silty SAND
Project	Terrigal (2301022)	**Report No.**	S85840-PI
Job No.	S23168-1	**Lab No.**	S85840

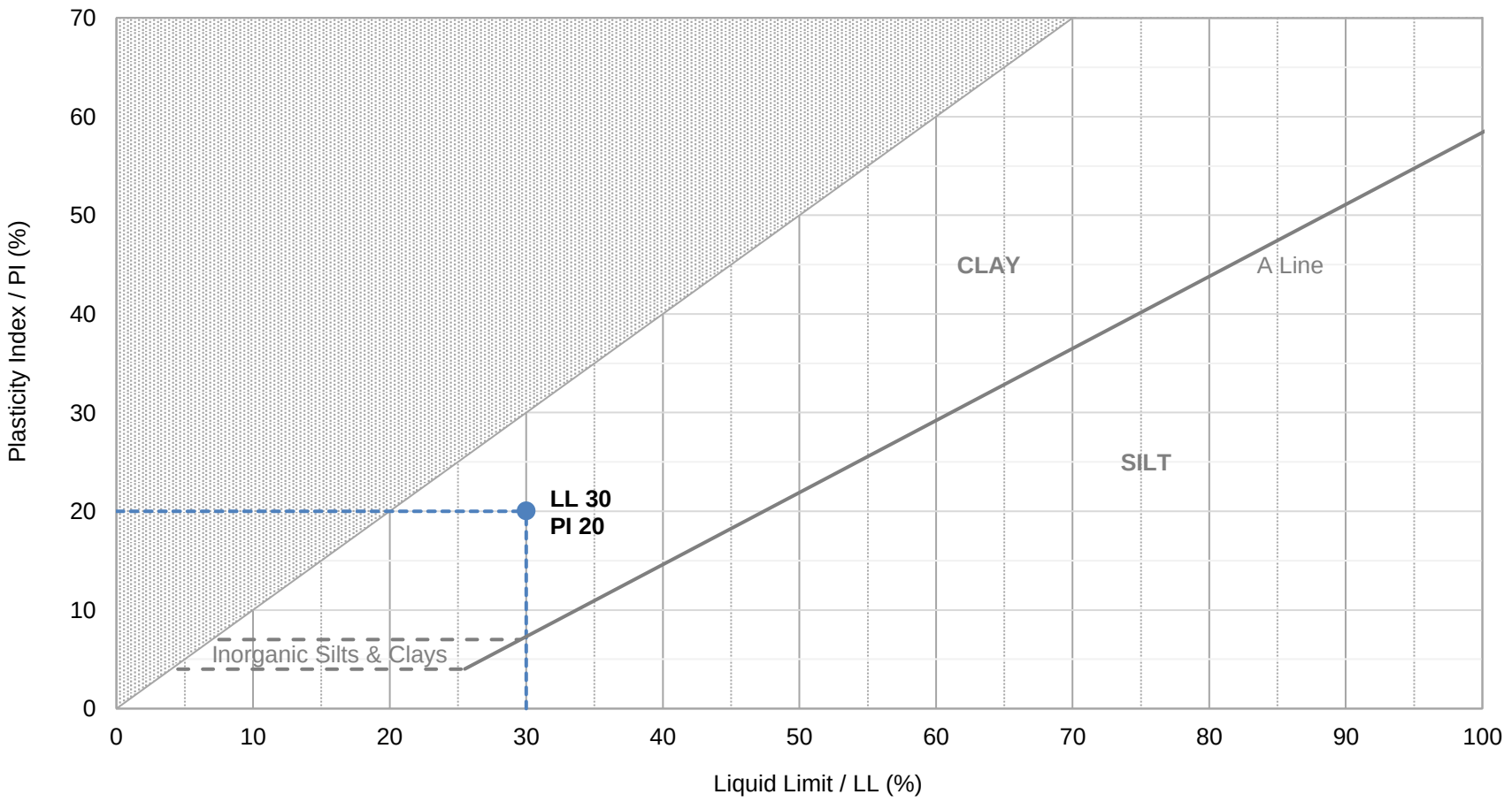
Test Procedure

☐	AS1289 3.1.1	Liquid Limit - Four point Casagrande method
☑	AS1289 3.1.2	Liquid Limit - One point Casagrande method
☑	AS1289 3.2.1	Plastic Limit - Standard method
☑	AS1289 3.3.1	Calculation of the Plasticity Index
☑	AS1289 3.4.1	Linear Shrinkage - Standard method

Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	24/04/2023
Preparation	Prepared in accordance with the test method	**Date Tested**	18/05/2023

Plasticity Chart for Classification of Fine-Grained Soils

AS 1726:2017 Clause 6.1.6 (Figure 5)



Preparation

Method of Preparation	**Dry Sieved**
History of the Sample	**Oven Dried**

Results

Liquid Limit / LL (%)	**30**
Plastic Limit (%)	**10**
Plasticity Index / PI (%)	**20**
Linear Shrinkage (%)	**9.5**
Condition upon Drying	**Linear**

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Jacob Lloyd

25/05/2023

Date:

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

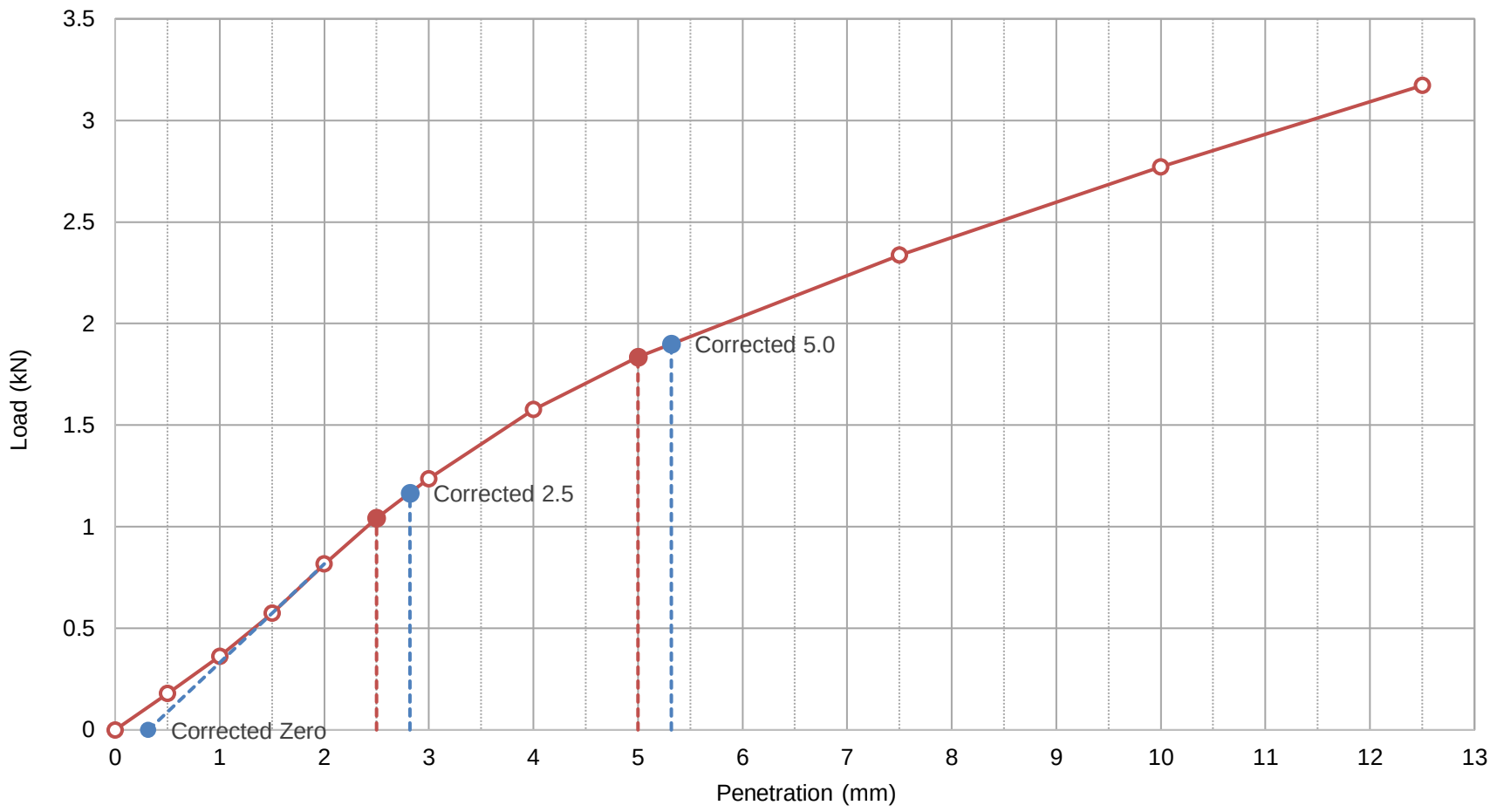
CALIFORNIA BEARING RATIO REPORT

Client	Geo-Logix Pty Ltd	**Source**	BH4 0.10-0.30m
Address	Building Q2, Level 3, 2309/4 Daydream St, Warriewood, NSW 2102	**Sample Description**	Silty CLAY
Project	Terrigal (2301022)	**Report No.**	S85841-CBR
Job No.	S23168-1	**Sample No.**	S85841

Test Procedure	☑ AS 1289.6.1.1	☐ RMS T117	California Bearing Ratio
	☑ AS 1289.5.1.1	☐ RMS T111	Dry Density / Moisture Content Relationship - Standard Compaction
	☐ AS 1289.5.2.1	☐ RMS T112	Dry Density / Moisture Content Relationship - Modified Compaction
	☑ AS 1289.2.1.1	☐ RMS T120	Moisture Content - Oven Drying Method (Standard Method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 26/04/2023

Preparation Prepared in accordance with the test method **Date Tested** 11/05/2023



Preparation & Specification	
Retained on 19.0mm Sieve (%)	0
Method of Establishing Plasticity Level	Technician Assessment
Sample Curing Time (hrs)	71 hrs
Compaction Hammer Used	Standard
Surcharge Mass Applied (kg)	4.5
Period of Soaking (Days)	4
Maximum Dry Density - MDD (t/m³)	1.38
Optimum Moisture Content - OMC (%)	28.6

Density & Moisture	Achieved	Target
Lab Moisture Ratio - LMR (%)	101.5	100.0
Lab Density Ratio - LDR (%)	100.5	100.0
Dry Density - At Compaction (t/m³)	1.38	1.38
Dry Density - After Soaking (t/m³)	1.38	
Specimen Swell (%)	0.5	
Moisture Content - At Compaction (%)	29.1	
Moisture Content - Top 30mm (%)	31.1	
Moisture Content - Remainder (%)	30.7	

Material CBR Value (%): 10 at a penetration of 5.0 mm

Notes

Accredited for compliance with ISO/IEC 17025 - Testing.

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Results relate only to the samples tested.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

22/05/2023

Jacob Lloyd Date:

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

Client	Geo-Logix Pty Ltd	**Source**	BH4 0.10-0.30m
Address	Building Q2, Level 3, 2309/4 Daydream St, Warriewood, NSW 2102	**Sample Description**	Silty CLAY
Project	Terrigal (2301022)	**Report No**	S85841-MDD
Job No	S23168-1	**Sample No**	S85841

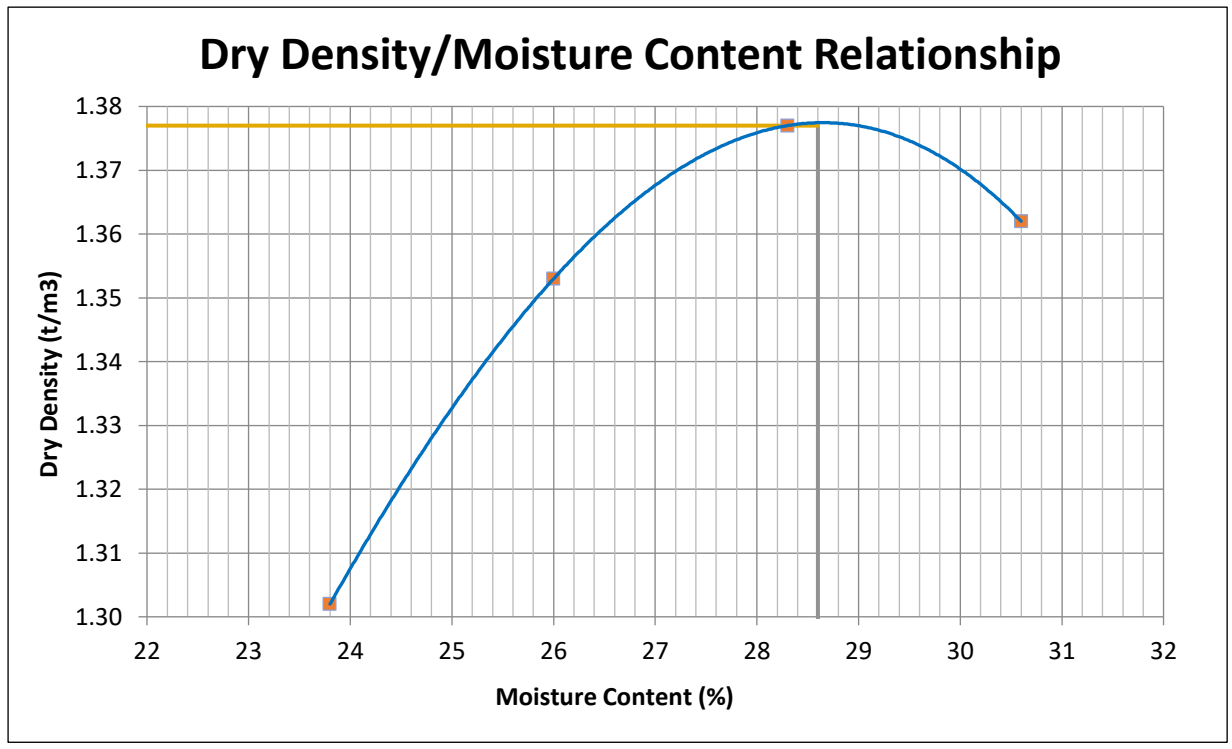
Test Procedure

☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction

☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 26/04/2023

Preparation Prepared in accordance with the test method **Date Tested** 11/05/2023



Maximum Dry Density (t/m^3)	1.377
Optimum Moisture Content (%)	28.6
Oversize Retained on 19mm sieve (%)	0.0
Oversize Retained on 37.5mm sieve (%)	0.0
Curing Time	48 hrs
Liquid Limit Determination	Technician Assessment

Notes

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.

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This document shall not be reproduced, except in full.
Results relate only to the samples tested.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Jacob Lloyd

22/05/2023

Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

GEO-LOGIX PTY LTD
ABN 86 116 892 936

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Web www.geo-logix.com.au