Intrax LAND

Preliminary Geotechnical Investigation Report

40 The Retreat

Bradfield NSW 2556

Submitted To

Sathio Group

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Table of Contents

Table of Figures and Tables

List of Appendices

Appendix A

Site Plan

Appendix B

Borehole Log(s) and Explanatory Notes

Appendix C

Site Photography

Appendix D

Laboratory Test Reports

1 Introduction

Sathio Group has engaged Intrax Consulting Engineers Pty Ltd (Intrax) to conduct geotechnical, groundwater and environmental assessments for a proposed multi-storey development at 40 The Retreat, Bradfield NSW 2556. The proposed development is classified as a NSW State Significant Development (SSD). The investigation data and assessments presented by Intrax and our subcontractors for 40 The Retreat, Bradfield are to support SSD lodgement.

The scope of work and terms and conditions of our engagement are set out in the Intrax-Client service agreement reference number 96044070.1 executed on 31 October 2023. Approval to proceed was given by Peter Mullen on 31 October 2023.

1.1 Development Description

This State Significant Development Application seeks consent for the detailed design and delivery (including construction and use) of a new mixed use residential development, to be developed in two (2) stages. Specifically, development consent is sought for:

Stage 1

- Overall site clearing and preparation works, including demolition of all existing development on the Site;
- The redevelopment of the northern portion of the Site, comprising:
    - Temporary Site access to the northern portion of the Site from The Retreat;
    - Temporary bin enclosure adjacent the temporary access;
    - Excavation works and construction of a shared two (2) storey basement to a maximum depth of RL 60.60, with capacity for 309 vehicle car spaces;
    - Construction of three (3) individual mixed use buildings, comprising:
        - Maximum building heights between 30.4m and 39.8m;
        - A total Gross Floor Area (GFA) of 26, 204sqm, comprising 25,744 sqm of residential GFA, 248 sqm of non-residential GFA and 212 sqm of retail GFA, distributed across the three buildings;
        - 254 residential units, distributed across the three buildings.
    - Associated landscaping, communal open space and embellishment works; and
    - Delivery and augmentation of services.

Stage 2

- The redevelopment of the southern portion of the Site, comprising:
    - Removal of the Stage 1 temporary access from The Retreat;
    - Connection and access of the Stage 1 basement to the western boundary (to become a future Collector Road);
    - Excavation works and construction of a shared three (3) storey basement to a depth of RL 56.35, with capacity for 326 vehicle car spaces;
    - Site and basement access from the western boundary (to become a future Collector Road);
    - Construction of three (3) individual mixed use buildings, comprising:
    - Maximum building heights between 23.8m and 39.9m;
    - A total Gross Floor Area (GFA) of 29,126 sqm, comprising 28,540 sqm of residential GFA, 212 sqm of retail GFA and 374 sqm of non-residential GFA, distributed across the three buildings;
    - 279 residential units, distributed across the three buildings.
- Associated landscaping, communal open space and embellishment works; and
- Delivery and augmentation of services.

A detailed description of the proposed development is detailed in Section 3.0 of the Environmental Impact Statement prepared by Ethos Urban.

1.2 Basement layout

A draft preliminary basement layout sketch was provided to Intrax to provide a general development layout (Figure 1-1).

Figure 1-1: Draft concept basement floor plan (DKO Architecture, 13317, 25/10/2023)

The proposed foundation types, layouts or design loads have not been provided to Intrax for assessment in this report, Intrax have assumed typical pile load for buildings of this nature. Additional assessment and modifications to reported parameters may be required following confirmation of structural design loads and performance requirements.

1.3 Objectives and Scope

The objective of the investigation was to document ground and groundwater conditions (separate report by ECS) to assess the geotechnical conditions at the project site for the intended development. The geotechnical assessment is prepared for SSD preparation and lodgement and is not suitable for construction. Additional investigations are likely to be required prior to detailed design or construction once the final project scope and loading have been confirmed.

The scope of work included:

- Preparation of health, safety and environmental documents
- Mobilisation of drilling crews onsite
- Drilling of six boreholes to a target depths of 10 to 15 m below ground level (mbgl)
- Dynamic cone penetrometer testing (DCP)
- Installation of three groundwater monitoring wells and data loggers
- Laboratory testing of selected samples
- Analysis and review of field geotechnical test information and the preparation of this report.

The objectives of this report are to:

- Present the findings of the geotechnical site investigation.
- Develop a geotechnical ground and groundwater model of the site.
- Present geotechnical material parameters based on the available information.
- Classify the site reactivity in accordance with AS2870-2011
- Classify the site subsoil category in accordance with AS1170.4-2007 for earthquake design.
- Provide preliminary recommendations for:

- Suitable foundation systems.
- Shallow foundation design parameters and bearing capacities.
- Piling recommendations and discussion.
- Excavation and retention
- Drainage
- Earthworks and material reuse
- Slope Stability
- Acid Sulfate Risk
- Flood and erosion

- Provide commentary on construction considerations.
- Highlight likely additional geotechnical investigations at later stages of development.

1.4 Acknowledgement of Country

Our investigation is being carried out on the lands of the Dharug people and we wish to acknowledge them as Traditional Owners. Intrax would also like to pay our respects to their Elders, past and present, and Aboriginal Elders of other communities.

1.5 Secretary's Environmental Assessment Requirements

In accordance with section 4.39 of the *Environmental Planning & Assessment Act 1979* (EP&A Act), Secretary's Environmental Assessment Requirements (SEARs) for SSD 49645977 were issued on 18 November 2022. This report has been prepared to respond to the relevant issued SEARs, as set out in the table below.

Table 1-1: SEAR

SEAR	Response / Location in Report
12. Ground and Water Conditions - Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site, including soil erosion, salinity and acid sulfate soils.	3.3 Subsurface Conditions 5.5 Excavation and Retention 5.7 Other Geotechnical Matters

1.6 Summary of Mitigation Measures

Table 1-2: Mitigation Measures

Mitigation Measures	
Erosion and Sediment Control	Sediment management plans shall be prepared for construction Tanked basement
Acid Sulfate Soils / Salinity	Acid sulfate and salinity testing prior to detailed design. Low risk.
Excavation Stability	Monitoring program during construction with appropriate alarm triggers
Vibration	Monitoring program during construction with appropriate alarm triggers

2 Completed Investigations

2.1 Desktop assessment

A review of geological maps from the Geological Survey of New South Wales, aerial photography and a search of Intrax' internal project records were used to assess the anticipated site conditions prior to attending site and to aid in identification of the geological origin.

2.2 Field Investigations

The fieldwork was conducted between 22 November and 15 December 2023, generally in accordance with the proposed scope of work. Prior to commencement of intrusive investigations, the borehole locations were pegged out by an Intrax surveyor.

BH02 and BH03 were drilled using a trailer mounted Drillman GT-30 drill rig operated by Intrax, and BH01, BH04, BH05 and BH06 were drilled using a track mounted Christie Engineering CE180 operated by BG Drilling. All boreholes were progressed using 100 mm solid flight auger drilling methods through soil and NMLC rotary diamond coring with water flush through rock. BH05 was drilled to a target depth of 15 mbgl with remaining boreholes drilled to target depth of approximately 10 mbgl. Standard Penetration Tests (SPT) were conducted at 1.5 m increments within the soil profile, noting that shallow soil profile restricted SPTs to BH03. Dynamic Cone Penetrometer (DCP) tests were completed adjacent to boreholes.

Groundwater monitoring well were installed within BH01, BH03 and BH06 as summarised in Table 2-1, with details in borehole logs.

Table 2-1: Well details

Hole ID	Total Depth	Screened Depth	Backfill	Capping	Notes
BH01	10.05 mbgl (59.51 mAHD)	5.05 to 10.05 mbgl (64.51 to 59.51 mAHD)	2 mm filter sand in screen Bentonite to surface	Cast iron gatic	Data logger installed 11/1/2024
BH02	8.0 mbgl (56.11 mAHD)	5.0 to 8.0 mbgl (59.11 to 56.11 mAHD)			
BH03	10.0 mbgl (59.33 mAHD)	5.0 to 10.0 mbgl (64.33 to 59.33 mAHD)			

Selected soil samples were retrieved from the substrata for laboratory testing. Borehole locations without wells were backfilled using generated spoil. Drilling mud and excess spoil were discharged at surface or down boreholes.

All materials were described in accordance with the visual and tactile method presented within AS1726 (2017): Geotechnical Site Investigation.

The test locations are shown on the site plan provided in Appendix A. Logs from the boreholes and an explanatory sheet outlining the terms and symbols used on the logs is presented in Appendix B.

2.2.1 Test Locations

Borehole locations were picked up by an Intrax Surveyor using GPS RTK surveying equipment accurate to +/- 20mm. The coordinates are recorded to GDA20 and Australian Height Datum.

Table 2-2: Test locations

Hole ID	Depth (mbgl)	Easting (m)	Northing (m)	Surface Elevation (mAHD)	Notes
BH01	10.16	291318.23	6244492.06	69.56	Monitoring well
BH02	10.35	291309.08	6244430.25	67.18	
BH03	10.2	291304.61	6244344.37	64.11	Monitoring well
BH04	10.0	291394.34	6244336.56	66.94	
BH05	15.0	291403.65	6244425.86	69.25	
BH06	9.82	291372.05	6244500.35	69.33	Monitoring well

2.3 Laboratory Testing

Disturbed soil samples collected during borehole drilling were transported to the Intrax Scoresby laboratory for testing. Testing completed is summarised in Table 2-3.

Table 2-3: Completed lab testing

Laboratory Test	Quantity
Moisture Content	6
Atterberg Limits & Linear Shrinkage	6
Particle Size Distribution (PSD)	6
Soil Aggressivity (sulfate, chloride, pH, EC)	6
Point Load Strength Index (PLSI)	39

The results of laboratory testing are summarised in Section 3 and test reports provided in Appendix C.

3 Site Conditions

3.1 Site Description

The site is located at 40 The Retreat, Bradfield NSW 2556, allotment DP 803167 (-33.920405, 150.742272).

The project site is located in Bradfield, Western Sydney, within the development area of the Western Sydney Airport. The Western Sydney Aerotropolis Precinct Plan designates the site for mixed use residential within the Aerotropolis Core Precinct Area, as shown in Figure 3-1, with the site located in proximity to the Aerotropolis Metro Station.

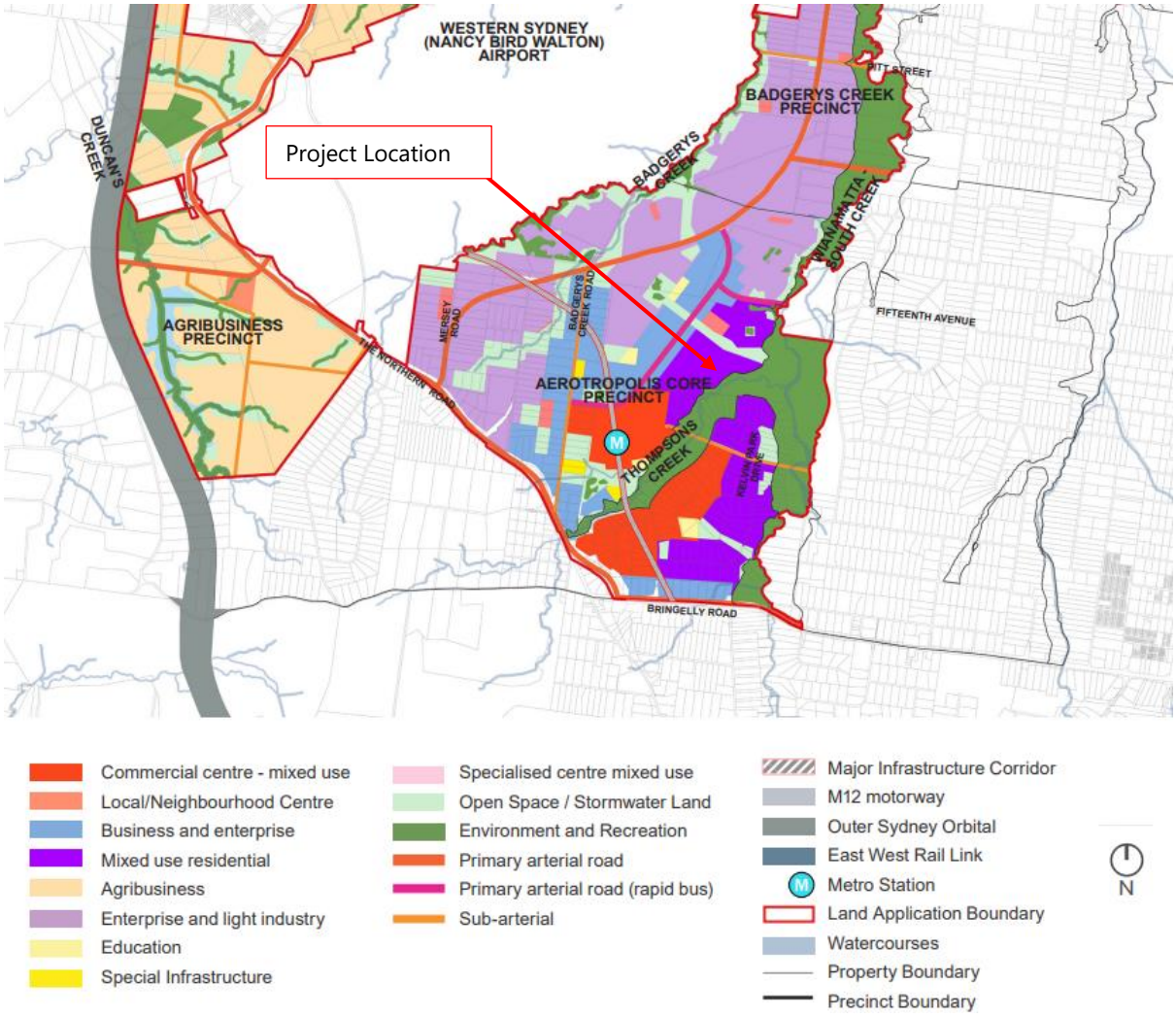

Figure 3-1: Land use and structure plan (Western Sydney Aerotropolis Precinct Plan, March 2022, NSW Government – Planning and Environment)

The site is located at the end of The Retreat is an irregular shaped allotment covering approximately 20800 m^2. The landform is generally level with minor slope falling from a high point of RL 60 mAHD in the north-eastern section of the site to a low point of 63.5 mAHD in the south-western corner of the site.

At the time of investigation, the site and surrounding area comprised a combination of grazing land and low density residential land. The southern portion of the site contained a centrally located single storey residential dwelling surrounded by maintained lawns. The northern portion contained a collection of cars or car parts, scattered sheds, olive barrels and an olive pit; with unmanaged grass.

A review of historical aerial imagery indicates that existing structures were built between 1994 and 2005, with earlier imagery indicating the land farming likely used as farming land. No obvious signs of significant earthworks or construction are noted other than the current development.

Pertinent site features are visible in in current aerial imagery (Figure 3-2) and site plans in Appendix A. Site conditions on the date of inspection are visible in the attached photographs in Appendix C.

Figure 3-2: Aerial image of site – 25 January 2024 (Nearmap.com)

3.2 Regional Geology

The surface geology underlying the site has been mapped by the New South Wales. The digital seamless geological map for the area indicates that the surface geology is Triassic aged Bringelly Shale. The Bringelly Shale is a member of the Wianamatta Group, typically comprising shale claystone, sandstone, laminate and less commonly coal. The dominate shale unit comprises grey claystone to dark carbonaceous claystone, with next most common unit comprising light grey medium to fine grained sandstone. It is anticipated that the geological unit shall comprise a residual clay unit overlying a weathered shale profile, which typically improves with depth. An extract of the local geological map is provided below.

Figure 3-3: Extract of local geology, Geological Survey of New South Wales (MinView, minview.geoscience.nsw.gove.au)

3.3 Subsurface Conditions

The geotechnical units encountered within the boreholes consisted of the following generalised materials.

Table 3-1: Geological units

Unit	Description, material, relative consistency. Extent of occurrence
Fill	Fill - Silty Sand (SM); brown, fine to medium grained, medium dense and moist. Inferred topsoil or reworked surface layer. Encountered in all boreholes except BH06 to a depth of 0.1 m.
Residual Soil (RS)	Clay (CH); high plasticity with variable minor sand content and lesser gravel. Generally encountered as orange-brown and grey, tending to dark grey in BH03 where the residual profile was significantly deeper. Insitu DCP and SPT results indicate the material ranges from stiff to hard, with DCP blow counts ranging from 3 to 20 per 100 mm of penetration, with an average of 11.5. SPT N values (BH03 only) increased from 10 at 1.5 mbgl to Refusal at 4.5 mbgl or deeper. Moisture content was encountered as near to or below the plasticity limit. Residual soil of the Bringelly Shale Formation. Encountered in all boreholes directly below topsoil/fill to a depth between 0.8 m and 4.5 (RL68.76 to 59.61 mAHD), with typical layer thickness of 0.7 m to 1.2 m.
EW Bringelly Shale (EW BS)	Extremely weathered siltstone or sandstone, recorded as clay, high plasticity, orange, brown and grey; with variable sand content and minor gravel. Logged as hard with moisture below the plasticity limit. Material is similar to behavioural characteristics to residual soil, generally with lower moisture and expected higher strength. Bringelly Shale Formation. A single DCP and SPT were conducted in EW BS, the DCP recorded 15 blows for 100 mm penetration and SPT encountered effective refusal to the tests.

	Encountered within most boreholes between the residual soil and competent bedrock. The base of the EW BS ranged from 1.3 m to 5.8 mbgl (RL 68.03 to 58.31 mAHD).
Bringelly Shale (BS)	The Bringelly Shale bedrock was encountered as Siltstone or Sandstone, light brown-grey or orange / red tending to dark grey or grey as the rock became less weathered. The material is generally thinly bedded, at dips between 0 and 40 degrees. Point load strength testing indicates the rock ranges from low to high strength, generally low to moderate strength. The mass is moderately fractured in highly to moderated weathered sections and slightly to moderately fractured in moderately to slightly weathered sections. Defects generally consist of extremely weathered bedding partings, planar joints or curved joints and minor crushed seams or fractured zones. The overall rock mass is comprised of interbedded regions of highly to slightly weathered rock, generally less weathered with depth, progressing from highly to moderately weathered rock mass (HW-MW BS) to a moderately to slightly weathered rock mass (MW-SW BS) between 4.95 and 9.26 mbgl (RL63.69 to 56.26 mAHD). All boreholes terminated in moderately weathered or better BS at depths between 9.82 and 15.0 mbgl (RL53.91 to 59.51 mAHD)

Table 3-2 below presents a summary of the subsurface profiles encountered within investigation boreholes. Detailed records of ground profiles encountered at each test location are provided in the borehole logs in Appendix B.

Table 3-2: Subsurface summary

Unit	Depth, mbgl (Elevation, mAHD)					
	BH01	BH02	BH03	BH04	BH05	BH06
Fill	0 - 0.1 (69.56 - 69.46)	0 - 0.1 (67.18 - 67.08)	0 - 0.1 (64.11 - 64.01)	0 - 0.1 (66.94 - 66.84)	0 - 0.1 (69.25 - 69.15)	-
RS	0.1 - 0.8 (69.46 - 68.76) 1.5 - 3.04 (68.06 - 66.52)	0.1 - 1.1 (67.08 - 66.08)	0.1 - 4.5 (64.01 - 59.61)	0.1 - 1 (66.84 - 65.94)	0.1 - 0.8 (69.15 - 68.45)	0 - 1.2 (69.33 - 68.13)
EW BS	0.8 - 1.5 (68.76 - 68.06)	1.1 - 1.5 (66.08 - 65.68)	4.5 - 5.8 (59.61 - 58.31)	1 - 1.75 (65.94 - 65.19)	0.8 - 1.55 (68.45 - 67.7)	1.2 - 1.3 (68.13 - 68.03)
HW-MW BS	3.04 - 5.87 (66.52 - 63.69)	1.5 - 5.9 (65.68 - 61.28)	5.8 - 7.85 (58.31 - 56.26)	1.75 - 4.95 (65.19 - 61.99)	1.55 - 9.26 (67.7 - 59.99)	1.3 - 7.37 (68.03 - 61.96)
MW-SW BS	5.87 - 10.16 (63.69 - 59.4)	5.9 - 10.35 (61.28 - 56.83)	7.85 - 10.2 (56.26 - 53.91)	4.95 - 10 (61.99 - 56.94)	9.26 - 15 (59.99 - 54.25)	7.37 - 9.82 (61.96 - 59.51)

Given the nature of ground, materials it should be anticipated that the maximum or minimum limits of profile layers across site have been encountered within the limited borehole locations. Variation in the above ground profile will exist throughout the site.

Ground conditions encountered within the completed boreholes are interpreted to be generally consistent with the mapped surface geology and published information.

3.3.1 Ground Water

Groundwater was not encountered during borehole drilling within open auger drilling, at the commencement of rotatory flush coring water was added to the borehole to facilitate diamond coring therefore observations on groundwater were not possible.

Groundwater monitoring wells were installed within BH01, BH03 and BH06, groundwater measurements from wells are summarised below.

Table 3-3: Groundwater monitoring well summary

Hole ID	Groundwater Level * 11 Jan 2024		Groundwater Level * 25 Jan 2024	
	Depth (mbgl)	Elevation (mAHD)	Depth (mbgl)	Elevation (mAHD)
BH01	6.5	63.06	7.5	62.06
BH03	2.9	61.21	3.0	61.11
BH06	6.7	62.63	6.8	62.53

**Manual reading*

Substrata conditions encountered are such that infiltration and occurrence of perched water at the interface between different material layers may occur. The implications of perched groundwater or the potential for perched water infiltration into open excavations should be considered during design and construction.

Additional groundwater data and analysis is provided in a separate accompanying report to this geotechnical assessment. At the date of this report issue the groundwater assessment was not available for review.

3.4 In-situ Test Results

Dynamic Cone Penetrometer (DCP) tests were conducted from surface level, adjacent to BH01 to BH05. DCP test results are summarised in the table below which shows blows per 100 mm of penetration. Results indicate that the natural soils onsite are generally hard within the upper metre of surface, BH02 results corresponds to a very stiff consistency material.

Table 3-4: DCP – Blows per 100 mm of penetration

Depth (m)	BH01	BH02	BH03	BH04	BH05
0 to 0.1	5	3	7	3	1
0.1 to 02	11	6	12	10	9
0.2 to 0.3	10	6	12	15	8
0.3 to 0.4	13	7	13	12	15
0.4 to 0.5	12	9	12	14	15
0.5 to 0.6	13	9	10	15	20
0.6 to 0.7	16	9	12	16	
0.7 to 0.8	12	9/50mm	12		
0.8 to 0.9	15				

Legend	
	Fill
	Residual Clay
	EX Siltstone

Standard Penetration Tests (SPT) were conducted at regular intervals in the soil profile, given the shallow rock head SPTs were only conducted within BH03 which had a significantly deeper soil profile. A plot of SPT results with depth is provided in figure below. The SPT results for BH03 demonstrate the material increases in

consistency from stiff at 1.5 m to very stiff at 3.0 m and hard or greater in the 4.5m and 5.5 m tests. Details of the DCP test results and SPT results are provided on the borehole logs in Appendix B.

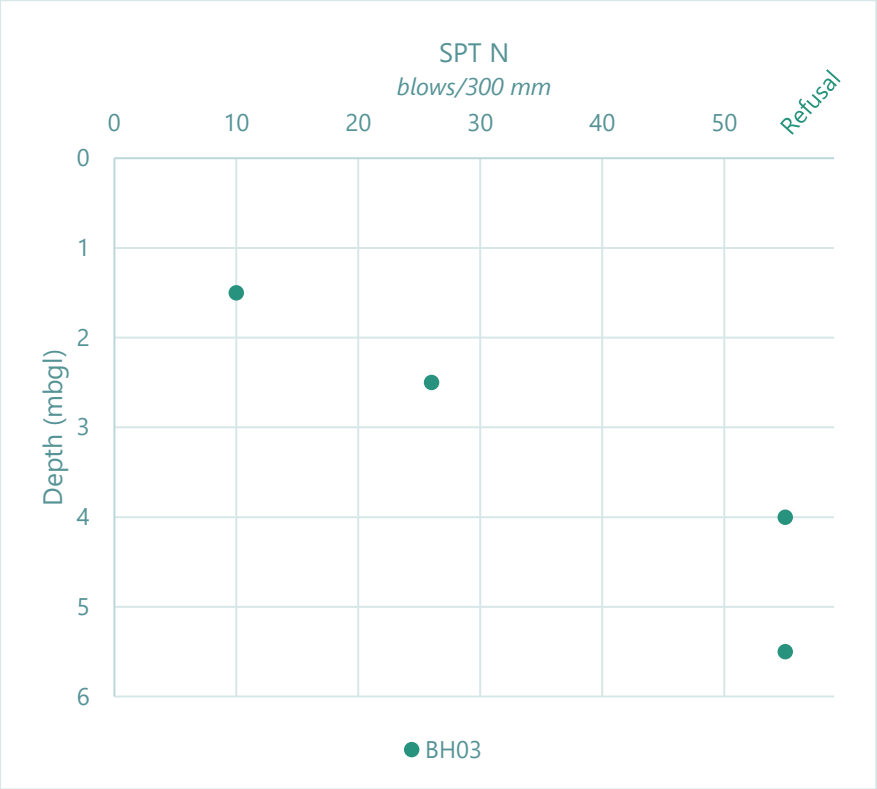

Figure 3-4: SPT N – depth profile plot

3.5 Laboratory Test Results

A summary of laboratory test results is provided in tables below, full laboratory test reports are attached in Appendix C.

3.5.1 Soil Classification Tests

Soil samples were obtained for classification testing, comprising moisture content, Atterberg limits, linear shrinkage, and particle size distribution. Test results are summarised in the table below. These results indicate that all residual soils are high plasticity clays with variable sand content and generally minor gravel content. The residual soils are of moderate reactivity to changes in moisture content, and insitu moisture content was below or near the plastic limit.

Table 3-5: Classification test results (moisture content, Atterberg Limits, Linear Shrinkage & Particle Size Distribution)

Sample Location	Sample Depth (m)	Unit	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Fines (%)	Sand (%)	Gravel (%)
BH01	0.4-1.0m	RS, Clay	14.0	55	17	38	12.5	85	9	6
BH02	0.4-1.0m	RS, Clay	13.8	66	19	47	14.5	71	17	12

BH03	1.0-1.5m	RS, Clay	15.0	60	16	44	14.0	77	21	2
BH04	0.2-1.0m	RS, Clay	15.8	54	16	38	12.5	71	28	1
BH05	0.1-0.7m	RS, Clay	13.1	52	17	35	11.0	72	12	16
BH06	0.1-0.7m	RS, Clay	15.0	60	16	44	14.0	75	23	2

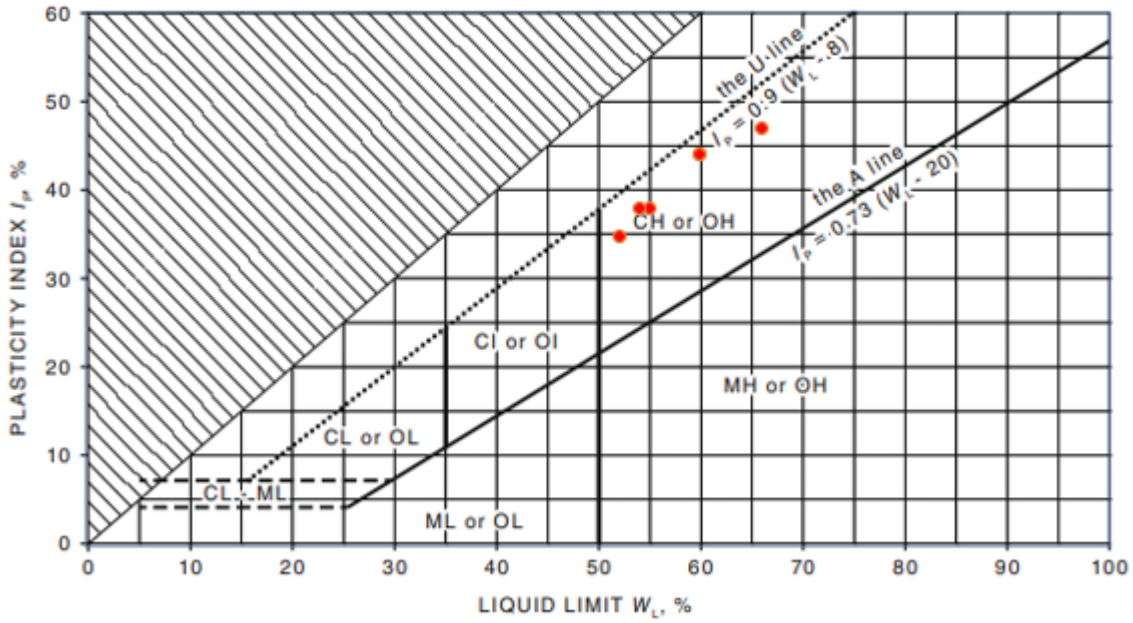

Figure 3-5: Casagrande chart plot of test results

3.5.2 Soil Aggressivity

Soil aggressivity test results for soil samples from RS profile are presented below.

Table 6: Soil aggressivity test results

Sample Location	Sample Depth (m)	Sample Description	Sulfate	Chloride	pH	Conductivity EC (1:5)	Moisture	Resistivity
			mg/kg	mg/kg		(µS/cm)	%	Ohm cm
BH01	0.4-1.0	RS, Clay	120	50	5.9	112	11.4	8930
BH02	0.4-1.0	RS, Clay	40	10	5.2	35	13.2	28600
BH03	1.0-1.5	RS, Clay	320	450	5.6	422	12.4	2370
BH04	0.2-1.0	RS, Clay	40	<10	5.6	32	13.3	31200
BH05	0.1-0.7	RS, Clay	90	40	5.4	89	10.9	11200
BH06	0.1-0.7	RS, Clay	40	20	5.2	63	12.5	15900

3.5.3 Rock Testing

The completed Point Load Strength Index (PLSI) testing results for the siltstone is presented in Figure 3-6.

These results indicate that there is minor correlation between weathering grades and rock strength, however that the rock strength broadly increases with depth accounting for variability within the rock mass. No uniaxial

compressive strength testing was completed to establish a site specific relationship with point load index; however, based on previous testing data in the Sydney basin on other projects Intrax have assumed a relationship of UCS = 16 x Is(50) for classification of rock strength in accordance with AS1726-2017.

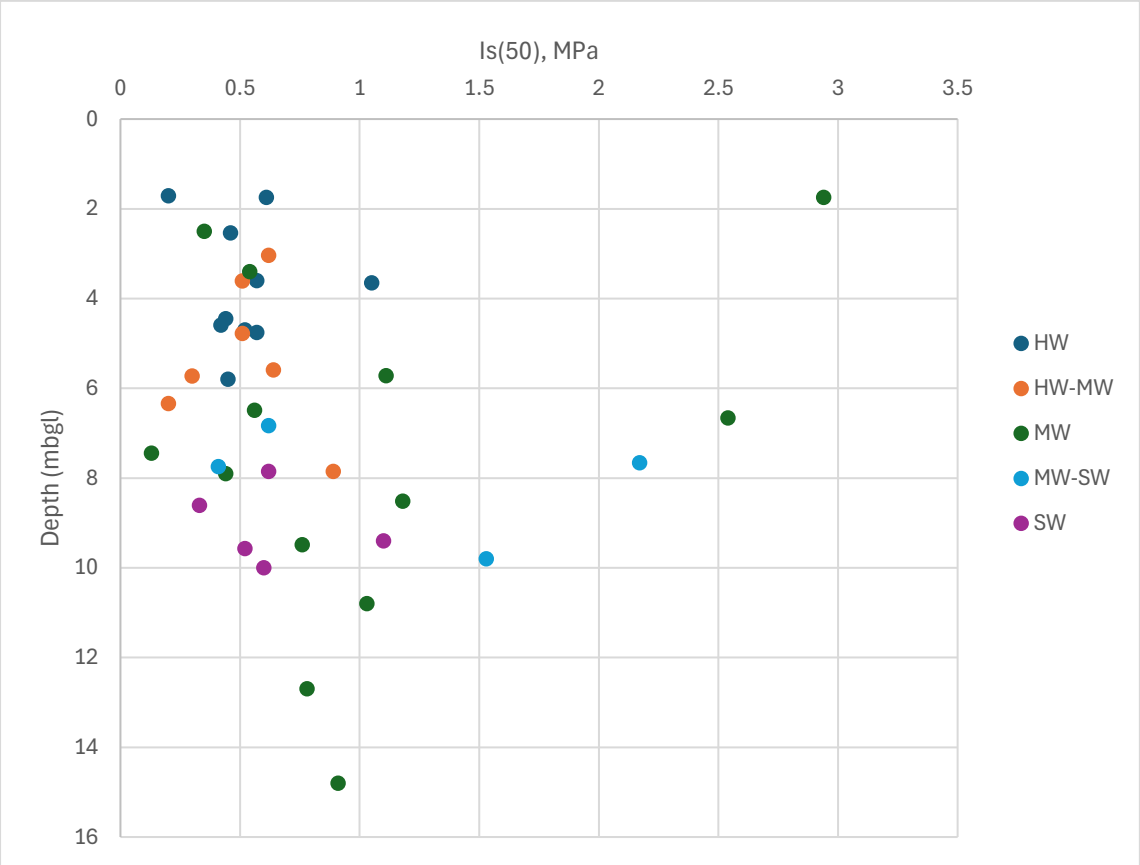

Figure 3-6: Point Load Strength Index plot

4 Preliminary Ground Model

A preliminary ground model has been developed based on the available information compiled within this geotechnical investigation. The ground model is a generalised and simplified representation of the site conditions. The accuracy of the presented ground model is limited to the extent and detail of ground data available. Intrax considers this ground model to be suitable for concept design of the proposed development outlined within Section 1. This ground model should be revisited and modified as necessary where additional geotechnical data becomes available and the development progresses to later stages of design.

The preliminary ground model is interpreted to comprise:

- A thin fill or topsoil layer, approximately 0.1 m thick, across the site consisting of fine to medium grained silty sand. This material is expected to be stripped during site works and may be suitable for reuse in garden beds or other non-structural planted areas of the development.
- Residual soil (RS) of the Bringelly Shale formation, high plasticity clay, with minor sand content and trace gravel. Stiff to hard with moisture content near or below the plastic limit. Residual soils were generally encountered to depth of 0.8 m to 1.2 m, with except of BH03 where it was recorded to a depth of 4.5 mbgl and BH01 where a residual soil was encountered above and below a thin layer of EX-HW Siltstone to a depth of 3.04 mbgl. Local variation in the residual soil depth is likely to follow weathered profile of the underlying rock mass around defects.
- Extremely Weathered Bringelly Shale (EW BS) material was encountered in most boreholes below residual soil, extremely weathered material was generally lower in moisture content, contained some relic rock structure and was higher strength then residual soil. EW siltstone and sandstone were encountered and logged as clay or sandy clay, hard and dry of the plastic limit. The EW layer encountered was 0.1 to 1.3 m thick below the residual soil. Minor beds of EW material were encountered within the rock mass or inferred to be present in areas of core loss.
- Highly to Moderately Weathered Bringelly Shale (HW-MW BS), encountered as siltstone or sandstone to lesser extent, light orange, red or grey; thinly bedded at 0 to 40 degree angle. Generally low to moderate strength, moderately fractured with planar extremely weathered bedding partings, or curved and planar joints; minor crushed seams or fractured zones. Encountered as interbedded highly and moderately weathered material in each borehole to depths of 4.95 m to 9.26 mbgl below EW material.
- Moderately to Slightly Weathered Bringelly Shale (MW-SW BS), encountered as siltstone with minor sandstone, light grey tending to dark grey; thinly bedded at 0 to 40 degree angles. Low to high strength, slightly to moderately fractured generally with planar extremely weathered bedding partings, or curved and planar joints; minor crushed seams or fractured zones. Encountered at the base of each borehole below a depth of 4.95 m to 9.29 mbgl to the termination depths of 9.82 m to 15 mbgl.

Preliminary geotechnical material parameters for the ground model are presented in Table 4-1.

Table 4-1: Preliminary geotechnical material parameters

Unit	Y	Su	c′	φ′	ν	E′	UCS
	kN/m^3	kPa	kPa	Degree		MPa	MPa
Fill	17	-	-	28	0.35	5	-
RS	20	200	10	28	0.3	40	-
EW BS	20	300	15	28	0.3	60	-
HW-MW BS	23	-	50	30	0.3	200	5
MW-SW BS	24	-	100	30	0.3	300	8

Notes: g: bulk unit weight, Su: undrained shear strength, c′: drained cohesion; ϕ': drained friction angle, E′: drained elastic modulus, v: drained Poisson's ratio, UCS: Uniaxial compressive strength, mbgl: metres below ground level

Mohr-Coulomb design parameters and modulus values presented in the weathered rock units are provided for the rock mass.

Material properties are based on the findings of the intrusive investigations, typical material properties, previous experience, and available published information. Where site specific test data is available it is used to determine material properties. In the absence of test results, typical material properties, previous experience and available published information are adopted.

5 Preliminary Recommendations

5.1 Key Geotechnical Considerations

Key geotechnical considerations for the proposed development relate to the grounds ability to withstand the pressures applied from a 40-storey building and retention behaviours for basement construction.

This preliminary geotechnical investigation has identified that the site is underlain by a relatively shallow siltstone or sandstone rock profile. Rock strength and weathering improve with depth, transitioning from residual clay soils near surface, through EW BS (clay) and into the HW-MW BS then into less weathered MW-SW BS below approximately 7 m. The rock mass is generally moderately fractured reducing when MW-SW BS is encountered. A deeper section of residual clay was encountered in BH03 and beds of inferred EW BS or residual soil were encountered within the upper portions of BS in BH01 and BH03; demonstrating a variable rock interface.

Soil and rock material encountered within the investigation presents a relatively steady ground profile across the site, and the area geology is less susceptible to large scale variations over a project area of this size; however, the soil profile limits and rock mass properties are likely to vary beyond the extents of this investigation.

Broadly speaking the ground conditions encountered are suitable for the proposed development, as the ground profile would permit typical construction practices for foundations and basement constructions of building of this nature.

The encountered MW-SW BS will provide a suitable founding medium for piled foundations. The depth of investigation is limited for piles taking large end bearing loads, and deeper investigations should be undertaken where large pile loads are required or when piles are founded significantly below basement depth. A minimum of 5 m of ground data should be obtained below the required pile founding depth.

Retaining wall design and basement excavation should be possible through typical top-down support methods, with batters possible for open cuts on shallower basement depths. Groundwater levels and hydrogeological processes are important for basement construction and covered in more detail within the ECS groundwater assessment report.

5.2 Earthquake Subsoil Classification – AS1170

Based on the evidence obtained during this geotechnical investigation, and in accordance with AS1170.4 (2007) Structural design actions Part 4: Earthquake actions in Australia, we recommend that structures be designed for the following classifications:

Hazard Factor (z): 0.08

Sub-soil Class: *Class Be – Rock* to *Class Ce – Shallow soil site*

BH03 is representative of a shallow soil site, BH01 is on the boarder line between rock and shallow soil, while other remaining boreholes would be classified as a rock site.

5.3 Residential Slabs and Footings – AS 2870

It is noted that the AS2870 classification is strictly only applicable to Class 1 and 10a structures in accordance with the Building Code of Australia, generally referring to residential dwellings or other lightweight structures. Notwithstanding the above, the classification is a useful measure of site reactivity and can be considered in the design of numerous lightweight structures likely to be influenced by surface movements resulting from soil suction (moisture) changes. Intrax understands proposed development is a multistorey residential building with basement and therefore does not fall within the scope of AS2870.

After considering the area geology, the soil profile encountered in the borehole, and the climatic zone of the area, this site has been classified as CLASS P with respect to Australian Standard 2870-2011 “Residential Slabs and Footings”. The site is categorised as CLASS P due to the prevailing abnormal moisture conditions resulting from existing buildings and trees removed trees. It is anticipated that in the absence of the abnormal moisture conditions and fill material the seasonal surface movement would be in the order of 20 to 40 mm.

Should alternative or additional geotechnical investigation data covering the project site be available, Intrax should be provided with this documentation. It is a condition of this report that any information the client may have with regards to the site and its history be provided to Intrax for review. This may lead to Intrax amending the above classification and recommending additional geotechnical investigation.

5.4 Foundations

The proposed development is understood to comprise a multi-use tower complex with up to two basement levels. Structural loading and building tolerance levels have not been provided to Intrax for assessment and incorporation into this report. However, Intrax anticipates that column loads for a 40-storey building could be up to 20 MPa.

The geotechnical investigation identified that two to seven metres contains hard clay soils (RS and EW BS) which is underlain by approximately five to ten metres of HW-MW BS and then MW-SW BS to the termination depth of investigation. It is anticipated that basement excavation level would be approximately 6 mbgl within the HW-MW BS, and piled foundations would be supported into the MW-SW BS. Spread footings may be possible subject to final basement level and design loads.

5.4.1 Piled Foundations

Piled foundations are a commonly adopted foundation system for heavily loaded structures such as the proposed development, the encountered ground profile of gradually improving rock profile is conducive to adopting a piled foundation.

Bored piles are the recommended piling method for the proposed development and existing ground conditions. Casing is not expected to be required to maintain a stable borehole in the encountered ground profile, however where sand layers or fill is encountered (particularly below the water table) casing may be required to maintain a clean pile base for socketing into the bedrock.

Bored piles should be supported within HW or better BS, heavily loaded piles should adopt the MW-SW BS as the founding medium. Bored piles founded in BS shall be socketed into stratum to adopt pressures presented below. Where alternative piling options are considered, Intrax should be contacted for commentary on their suitability and necessary design considerations.

Pile design and installation should be conducted in accordance with AS2159 (2009) Piling – Design and installation. AS2159-2009 requires that a geotechnical strength reduction factor (φ_g) be applied to the design ultimate geotechnical strength ($R_{d,ug}$) of the pile to provide the design geotechnical strength ($R_{d,g}$) of the pile. The $R_{d,g}$ should be less than the design action effect (E_d) on the pile.

Intrax recommend that a geotechnical strength reduction factor (φ_g) of 0.4 is adopted where no further assessments are undertaken. The design engineer may determine an alternative φ_g following the methodology of Section 4.3 of AS2159.

For estimation of the design ultimate geotechnical strength, the ultimate shaft resistance (Fs) and ultimate base resistance (Fb) are provided in the table below.

Table 5-1: Recommended ultimate pile resistance values (axial compression)

Unit	Ultimate Shaft Resistance (kPa)[1]	Ultimate Base Resistance (MPa)[2]
HW-MW BS	200	6
MW-SW BS	500	20

[1]*Shaft resistance is an average over the layer. Shaft resistance may be reduced if wall smear or polish is present*

[2]*Base resistance taken at the bottom of layer depth with minimum 0.3 m embedment into relevant rock class and clean bases. Bored piles shall have a cleaned socket with roughness of R2 or better.*

In addition to the above, the following recommendations are made:

- The contribution of the uppermost soil profile shall be considered ineffective in providing geotechnical shaft resistance, given the large stiffness variation between EW BS and the underlying HW or better BS Intrax recommend its contribution to shaft friction is ignored in axial capacity determination.
- Ultimate shaft friction values provided in the table above shall be reduced by a factor of 0.7 for determination of tensile capacity. The pile self-weight may be included in tension capacities. The tension capacity shall also be limited by the self-weight of cone pull-out. A pull-out angle of 30 degrees from vertical commencing at the base of the pile may be adopted for initial estimation. Consideration of defect orientation and block sizes shall be made for pull-out in rock.
- Engagement of shaft resistance requires mobilisation of the pile. It is anticipated that settlement of at least 1% of the pile diameter is required to mobilise full shaft friction.
- Ultimate base resistance values provided in the table above assume a minimum embedment of 0.3 m into the rock layer. Socks must be clean and roughened to achieve design values. Pile inspection by an experienced geotechnical engineer is recommended during construction of heavily loaded piles.
- It is likely that ultimate pile loads presented above would result in settlement exceeding typical tolerance levels (i.e. in the order of 5% of pile diameter). The settlement should be determined adopting modulus values presented in the ground model with serviceability loads.
- The values in the table above assume that pile shafts are clean (free from remoulded material) and that the pile base is clean (free of water, loose or softened material).

5.4.2 Spread Footings on Rock

Spread footings founded on bedrock (HW-MW BS or MW-SW BS) may be adopt allowable bearing pressures in Table 5-2. Spread footings adopting these allowable pressures should assume a settlement in the order of 1% of the minimum footing dimensions. Spread footings shall achieve a minimum embedment of 0.3 m into the nominated rock unit to adopt pressures. Where shaft friction is included in spread footing computations the side wall shall be roughened to at least R2 level.

Table 5-2: Allowable bearing capacities for spread footing on rock

Unit	Allowable Capacity (kPa)	
	End Bearing	Shaft Friction
HW-MW BS	1000	100
MW-SW BS	2000	200

Where detailed settlement predictions are required, modelling in appropriate stress-strain software such as PLAXIS should be conducted with the specific project loads and footing dimensions. It is recommended that further laboratory testing or insitu testing is undertaken to accurately determine soil stress-strain characteristics where stress-strain modelling is proposed.

5.4.3 Spread Footings on Soil

Spread footings on soil for surface level structures or separate smaller auxiliary buildings may adopted an allowable bearing pressure of 200 kPa in residual soil and 300 kPa in EW BS. A minimum embedment of 100 mm into the material medium, maintaining a minimum depth below adjacent surface level of 0.4 m. Higher bearing pressures may be possible in areas of the site, to adopt higher values specific assessment of the ground profile or inspection of footing excavations should be conducted.

At these pressures a settlement in the order of 25 mm may be assumed in the absence of settlement modelling and further investigation. Where detailed settlement predictions are required, modelling in appropriate stress-strain software such as PLAXIS should be conducted with the specific project loads and footing dimensions. It is recommended that further laboratory testing or insitu testing is undertaken to accurately determine soil stress-strain characteristics where stress-strain modelling is proposed.

5.4.4 General Footing Considerations

Note that it is our preference for the design engineer to adopt the same founding material throughout the entire foundation. Where footings are founded in different materials, especially materials with highly variable stiffness (soil and rock) or reactive soils (clay) and non-reactive soils (sand/gravel/rock), the designer should provide articulation for the structure to avoid potential damages which could be caused by differential movements due settlement or seasonal reactivity.

Intrax recommends that all piles or spread footings are inspected by a geotechnical engineer prior to pouring concrete to confirm the quality and strength of soil/rock meet design assumptions.

5.5 Excavation and Retention

5.5.1 Excavation & Temporary Stability

All excavation work must be completed in accordance with the relevant and current SafeWork guidelines at the time of completing the works.

Excavation to approximately 6 to 7 m is anticipated to be required for the proposed basement, footings and service trenches. Excavation of the soil profile will be readily achievable using standard earthworks equipment (digging buckets attached to hydraulic excavators). Excavation of extremely weathered rock or very low strength rock (if encountered) may require ripping. Reduced productivity and higher wear on attachments should be anticipated where ripping is required. Excavation of low strength rock or better should assume that hydraulic impact breaker (rock hammer), predrilling or saw cutting will be required.

Where groundwater is encountered, excavations will require temporary dewatering which may include pumping or gravity drainage where the excavation geometry allows. 'Perched water' can occasionally be trapped in permeable fill above the water table or in localised depressions underlain by bedrock or low permeability soils. Perched water is typically of a finite volume, however, may be 'recharged' by infiltration of surface water following rainfall. Increased rates of groundwater seepage and release of perched water are common following heavy or prolonged rainfall and may persist for some time following inclement weather.

Based on the groundwater measurements obtained to date, a 6 m basement excavation may intersect with the groundwater in the south portion (BH03) of the site below 3 m (RL 61 mAHD) or below 6.5 m over the northern portion (BH01, BH06) of the site (RL 62.5 mAHD). Therefore, allowance for at least partial dewatering should be considered during the construction planning and permanent basement design. Subject to the groundwater assessment (separate ECS report) it may be prudent to limit the double storey portion of the basement to the northern portion of the site or allow for tanking/permanent drainage design within the basement design over the southern portion of the site for at least the lower basement level.

Ingress of water from any source (including damaged plumbing) should be investigated and rectified without delay to prevent avoidable delays or complications throughout the project. Where applicable, temporary cut-off drains at existing surface level near the perimeter of the site or outside the footprint of the proposed development will help to reduce the volume of water requiring management within the excavation.

Intrax recommends the following batter angles for temporary slopes. Angles presented assume that the batter is not subject to surcharge loads and located above the water table. Any excavations requiring steeper grades shall be supported by suitable retaining walls or shoring – such as a piled retaining wall or trench shield. Where doubt exists regarding excavation safety, Intrax recommends that an experienced geotechnical engineer or engineering geologist inspects the excavation to provide further guidance.

Table 5-3: Short term batter angles

Unit	Short Term Batter Angles (horizontal:vertical)
Fill	2:1
RS	1:1
EW BS	1:1
HW-MW BS	Vertical*
MW-HS BS	Vertical*

**Excavations in rock may be conducted in a vertical manner, subject to onsite supervision of the excavation progression by an experienced geotechnical engineer, to monitor for and assign appropriate support for unfavourable defects in the rock mass.*

Intrax recommends that any excavation with structures or personnel within the zone of influence, any benched excavations or any batters steeper than 45° are inspected after the below events.

- Rainfall events in excess of 30 mm over a 24-hour period.
- At any sign of instability including but not limited to:
  - Water seepage through the excavation face
  - Fallen or slumped material observed at the base of the excavation
  - Tension cracks observed at the surface (behind the crest of the excavation)
  - Visible deflection of retention or measured movement beyond design intents

The zone of influence of an excavation can be determined the area rising upwards from the toe of the excavation at a gradient of 30 degrees for non-cohesive materials (sands) and 45 degrees cohesive materials (clays).

5.5.2 Retention

Preliminary retaining walls may be designed in accordance with AS4678 (2002) Earth Retaining Structures following parameters established from Rankine's theory are considered appropriate for the design of retention systems. The below values assume a vertical wall with horizontal ground surface. The design engineer should confirm their suitability for adoption based on the specifics of the design.

Table 5-4: Geotechnical soil and retention design parameters

Unit	Ka	Kp	Ko
Fill	0.36	2.77	0.53
RS	0.36	2.77	0.53
EW BS	0.36	2.77	0.53
HW-MW BS	0.33	3.00	0.5[3]
MW-HS BS	0.33	3.00	0.5[3]

[1] K_a, K_p and K_o are the active, passive and at-rest earth pressure coefficients.
[2] The at rest earth pressure above is based on the typically published formula $K_o = 1 - \sin(\phi')$, it does not account for the over consolidation ratio of soil, insitu rock stress, or kinematic wedges. Where a more accurate K_o value is required, it is recommended that additional investigation is conducted, which may incorporate pressuremeter testing and/or orientated defect analysis.

[3] *Initial ground movement assumed of about 0.1% to 0.2% of the wall height, causing a reduction of the initial horizontal stress condition for rocks, but still higher than active pressure. More sensitive structures should adopt a soil-structure interaction considering the initial stress condition, preliminary assessment of sensitive structures may chose to adopt a Ko = 1 for rock.*

Retention systems for basements generally comprise a piled outer wall which is either cantilevered for supported with anchors/props as excavation continues from top down. Preliminary design of ground anchors can assume an ultimate bond stress of 300 kPa and 600 kPa for HW-MW BS and MW-SW BS respectively. The bond length shall be not less than 3 m and note more than 7 m, and anchors stressed to 1.4 times the design working load before locking off at the design load.

Preliminary lateral earth pressure estimates may assume a uniform pressure of 4H kPa, where H is the total height of the wall in metres or anchored or propped walls. Walls adjacent to sensitive structures should adopt a uniform load of 6H kPa. Surcharge loads should be added to lateral earth pressures. This assumes positive drainage behind the wall (i.e. strip drains, permanently drained basement), tanked basement wall designs must consider hydrostatic forces and any uplift pressures on the basement slab.

5.5.3 Ground Monitoring

5.5.3.1 Movement during excavation

Excavation and construction of basements often result in ground movements of the surrounding soil. In general, vertical settlement of the surrounding soils are can be caused by two major mechanisms:

- Lateral movement/deflection of the basement wall into the excavation, which results in reduced confining stress and subsequent vertical settlement.
- Lowering of groundwater tables (where present) which causes a reduction in effective stress in he soil (from reduced porewater pressure), therefore leading to potential consolidation settlements. This mechanism is akin to surcharge loading from surface.

The extent of impacted land surrounding an excavation is typically 1 to 1.25 times the depth of the excavation. Negligible settlement typically occurs beyond this range. Given the limited developments surrounding the project site, shallow rock and the available offset from boundary the development is not anticipated to have significant negative impact on surrounding land from settlement induced by basement excavation. If surrounding sites change prior to construction and sensitive structures are present, dilapidation surveys and rigorous monitoring programs should be put in place.

As a guide, lateral deflection of retaining walls is typically in the order of 0.1% to 0.2% of the retained height. The magnitude of ground movements is highly dependant on the wall design, construction sequence and ground conditions. Mitigation of surface settlements can be achieved through use of systems such as anchored or tieback walls, adoption of higher lateral earth pressures and groundwater recirculation/recharge.

Where settlement outside the excavation occurs due to loss of material through or under the retaining wall, work within the excavation must cease and Intrax must be contacted immediately. If detailed settlement analysis is required, analysis using numerical stress-strain software such as PLAXIS may be appropriate.

5.5.3.2 Monitoring of ground movement

Survey monitoring of the retention system is recommended for all basement constructions, it should be undertaken prior to commencement of excavation, and at regular intervals during excavation until such time as the permanent support is applied. Survey points will need to be installed along the retaining walls (typically on the capping beam) at midspan and at approximate intervals of between 5 m (high sensitivity) and 10 m (low sensitivity). Baseline monitoring should be undertaken prior to commencement of excavation and subsequent monitoring should be completed at intervals of either one week (high sensitivity) or two weeks (low sensitivity) from the time that excavation commences until temporary ground anchors are destressed, or the retaining walls are propped by the basement structure / floor slabs. Maximum deflection criteria should be defined by the structural engineer in coordination with a design engineer experienced in soil-structural engineering design. The following alarm procedure are typical for basement projects:

- Amber Alarm: Lateral deflections reach 60% of the maximum anticipated lateral deflections. Frequency of monitoring should be increased to twice weekly.
- Red Alarm: Lateral deflections reach 95% of the maximum anticipated lateral deflections. Construction must be ceased, and this office and relevant authorities must be notified immediately. Frequency of monitoring should be increased to daily.

5.5.4 Vibrations

Basement excavation and construction equipment induce vibrations which can cause detrimental effects to nearby structures or human experience if over certain limits. Given the greenfield natures of this development site there are not any significant receptors therefore vibrations are not anticipated to be major factor of the proposed construction methodology. However, where site conditions change, and critical receptors develop adjacent to the site vibration monitoring and management plans should be implemented.

5.6 Pavement Subgrade

Basement flood slabs may be designed as rigid slabs, it is anticipated that the floor slab shall be supported on a compacted imported crushed rock medium which would be placed above the HW-MW BS. Pavement design may assume a 20% CBR where the HW-MW BS is adopted as the subgrade.

5.7 Other Geotechnical Matters

5.7.1 Soil Aggressivity

Based on the laboratory test results of the residual soil, soils on this site are considered non-aggressive for concrete and steel piles in accordance with AS21529-2009.

5.7.2 Drainage

Subsurface drainage is required around the site to manage surface runoff from impacting shallow footings or pavements. Basement drainage or tanking is anticipated to be required, subject to groundwater assessments, for at least the lower basement level to accommodate for or prevent water seepage into the basement.

5.7.3 Slope Stability

There are no credible landslide hazards which impact this project site. Temporary stability of excavations should be maintained following recommendations within this report.

5.7.4 Acid Sulfate Soils

The Preliminary Site Investigation environmental assessment for the site has concluded that there is very low probability of acid sulfate soils present on this site. This agrees with Intrax's assessment of the geological conditions present at the site.

5.7.5 Erosion

Clay and rock profiles encountered on this site are not typically highly suspectable to erosion, however it is noted that no dispersion testing has been completed within this assessment. All soils will erode to some extent when subjected to continued flow of water, dispersive soils tend to erode at higher rate. However, given the type of development erosion is not likely to have a major impact on construction practices or decision making, as all site areas will protected by structures, pavements or vegetation in a final arrangement.

5.7.6 Construction Inspections (indicative)

Intrax would expect geotechnical engineering inspections the following points during construction

1. Rock face mapping during vertical excavation through rock
2. Spread and pile footing inspections
3. Subgrade inspection of pavements
4. If unexpected ground conditions are encountered
5. If project design is altered significantly

6 Further Works

To facilitate detailed design of the proposed development Intrax recommends that additional geotechnical investigations are conducted that obtain at least the following data:

- Ground data to a depth of at least 5 m below pile toe depth
- Laboratory test data to support assignment of soil parameters such as c', φ', UCS, E', v, Ko
- Excavatabilty assessment
- Rock mass structure and defect orientation

7 References

AS 1170.4. (2007). Structural design actions – Part 4: Earthquake actions in Australia. Sydney: Standards Australia, Retrieved from SAI Global.

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8 Limitations of Report

1. The recommendations in this report are based on the following:
    a. Information about the site & its history, proposed site treatment and building type conveyed to us by the client and or their agent.
    b. Professional judgements and opinions using the most recent information in soil testing practice that is available to us.
    c. The location of our test sites and the information gained from this and other investigations.

    Should the client or their agent neglect to supply us with correct or relevant information, including information about previous buildings, trees or past activities on the site, or should changes be made to the building type, size and or/position, this report may be made obsolete, irrelevant or unsuitable. In such cases, Intrax will not accept any liability for the consequences and Intrax reserves the right to make an additional charge if more testing or a change to the report is necessary.
2. The recommendations made in this report may need to be reviewed should any site works disturb any soil below the proposed founding depth.
3. The descriptions of the soils encountered in the boreholes follow those outlined in AS1726-2017; Geotechnical Site Investigations. Colour descriptions can vary with soil moisture content and individual interpretation.
4. If the site conditions at the time of construction differ from those described in this report, then Intrax must be contacted so a site inspection can be carried out prior to any footing being poured. The owner/builder will be responsible for any fees associated with this additional work.
5. This report assumes that the soil profile(s) observed in the boreholes are representative of the entire site. If the soil profile and site conditions appear to differ substantially from those reported herein, then Intrax should be contacted immediately and this report may need to be reviewed and amended where appropriate. The owner/builder will be responsible for any fees associated with this additional work.
6. The user of this report must consider the following limitations. Soil and drilling depths are given to a tolerance reflective of the drilling methodology. Lower levels of accuracy are possible from wash boring or solid flight auger then is achievable from geoprobe sampling or diamond coring.

    It must be understood and a condition of acceptance of this report is that whilst every effort is made to identify fill material across the site, difficulties exist in determining fill material for example, well compacted site won or area derived fill, especially when utilising a small diameter auger. Consequently, Intrax emphasises that we will not be responsible for any financial losses, consequential or otherwise, that may occur as a result of not accurately determining the fill profile across the site.
7. Finally, no responsibility will be taken for this report if it is altered in any way or is not reproduced in full.

Appendix A

Site Plan

LEGEND

BHXX — Borehole

BHXX — Borehole with groundwater monitoring well installed

BH01

BH02

BH03

BH04

BH05

BH06

96°40'20"
25.195

323°20'10"
107.46
A120.355
R73.815

CAR SPACES : 171

CAR SPACES : 196

272
DP 803167

101
DP 1282949

2713
DP 1128906

273
DP 803167

2711
DP 1128906

R419
A125.215
1°26'10"
124.75

82.91
286°52'10"

R19
A23.36
45°10'20"
21.915

19.41
262°52'30"

THE RETREAT

N

Notes: borehole symbols shown are not plotted from survey data. Refer survey coordinates for specific borehole locations

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TITLE: Site Investigation Plan 40 The Retreat, Bradfield NSW 2556		DRAWN: J McPherson	PAGE SIZE: A3
		CHECKED: S Emmett	SITE NO.: 205892
CLIENT: Sathio Group		SCALE: 1:715 (APPROX)	DOC ID: 205892-PRJ1073940-GEO-DWG-01
		DATE: 15/02/2024	VERSION: 0

Appendix B

Borehole Log(s) and Explanatory Notes

HOLE ID: BH01

Project:	40 The Retreat	Surface Elevation:	69.56m	Date Started:	28/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291318.2, N: 6244492	Contractor:	BG Drilling	Date Logged:	28/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					Material					Observation
Progress: Drilling & Casing	Progress: Water	Penetration Resistance (L M H)	Samples & Tests	RL (m)	Depth(m)	Graphic Log	Group Symbol	Material Description (colour, grain characteristics, plasticity, structure, minor components)	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
AD/T			0.4 - 1m B	69	0.10		SM	FILL- Silty SAND (SM) : fine to medium grained, medium dense, brown.	M	MD	Fill 0.0m - 0.9m: DCP: 5,11,10,13,12,13,16,12,15
							CH	CLAY (CH) : high plasticity, red brown and light grey.	w<PL	H	Residual
					0.80			CLAY (CH) : high plasticity, orange brown and grey, with fine to medium sized gravel, trace fine to medium grained sand. Extremely Weathered Bringelly Shale			Siltstone
				68	1.45			**See next page for rock logging below 1.45m**			
				67	2						
				66	3						
				65	4						
				64	5						

HOLE ID: BH01

Project:	40 The Retreat	Surface Elevation:	69.56m	Date Started:	28/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291318.2, N: 6244492	Contractor:	BG Drilling	Date Logged:	28/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling | **Material** | **Defect & Observation**

Progress: Drilling & Casing; Water

TCR (%) | RQD (%) | Samples & Tests | RL (m) | Depth (m) | Graphic Log | Material Description (colour, grain characteristics,structure, minor components, formation) | Weathering | Strength Is^{50} (● - Axial, ○ - Diametral; EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | Defect Spacing (mm) (20, 40, 100, 300, 1000) | Visual | Discontinuities & other observations

See previous page for soil logging above 1.45m

1.45

1.50 — SILTSTONE: orange brown, fine grained, bedded at 0 to 5 deg. Bringelly Shale — HW

CLAY (CI-CH) : medium to high plasticity, and red brown, trace fine to medium sized gravel.

NMLC

100 | 0

100 | 0 — EW

3.04 — SANDSTONE: light orange brown and grey, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm. — HW to MW

Is_{50}: A=062MPa

3.33-3.35m, EW

3.57-3.59m, EW

3.59-4.30m, JT, UN, RF, SN, Open

3.70 — SANDSTONE: grey and red brown, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.

100 | 47

Is_{50}: A=044MPa

4.57 — SILTSTONE: dark grey and orange brown, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.

4.74 — SILTSTONE: dark grey and orange brown, fine grained. — HW

4.70-4.74m, EW

4.85-4.88m, EW

5.15-5.17m, EW

5.30-5.31m, EW

5.42-5.44m, EW

5.55-5.56m, EW

5.70-5.76m, CS, SN

Is_{50}: A=045MPa

5.78 — SILTSTONE: grey and light grey — MW to SW

100 | 70

RL (m): 69, 68, 67, 66, 65, 64

Depth (m): 0.10, 0.80, 1, 2, 3, 4, 5

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

HOLE ID: BH01

Project:	40 The Retreat	Surface Elevation:	69.56m	Date Started:	28/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291318.2, N: 6244492	Contractor:	BG Drilling	Date Logged:	28/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling						Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description (colour, grain characteristics, structure, minor components, formation)	Weathering	Strength Is^{50} (● - Axial, ○ - Diametral) EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) 20 40 100 300 1000	Visual	Discontinuities & other observations
		100	70	Is_{50}: A=062MPa	63	7		[CONT] SILTSTONE: grey and light grey	MW to SW				6.15-6.43m, JT, 85°, UN, RF, CN, Open
				Is_{50}: A=041MPa	62	8							6.50-6.70m, JT, 70°, PR, RF, CN, Open
		100	100	Is_{50}: A=153MPa	61	9							
					60	10							
						10.16		End Of Hole: 10.16m - Target depth - Monitoring well installed					
					59	11							
					58								

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

1.45-10.16m

HOLE ID: BH02

Project:	40 The Retreat	Surface Elevation:	67.18m	Date Started:	15/12/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291309.1, N: 6244430	Contractor:	Intrax	Date Logged:	15/12/23
Project No.:	205892	Drill Rig:	Drillman GT-30	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling				Material					Observation
Progress: Drilling & Casing	Progress: Water	Penetration Resistance (L M H R)	Samples & Tests	RL (m)	Depth(m)	Graphic Log	Group Symbol	Material Description (colour, grain characteristics, plasticity, structure, minor components)	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
AD/V			0.4 - 1m B	67	0.10		SM	FILL- Silty SAND (SM) : fine to medium grained, medium dense, brown.	M	MD	0.0m - 0.8m: DCP: 3,6,6,7,9,9,9,9/50mm
								CLAY (CH) : high plasticity, red brown, with fine grained sand.		Fr	Residual
					0.40		CH	CLAY (CH) : high plasticity, red brown mottled light grey, trace fine to coarse sized gravel, trace fine to coarse grained sand.	w<PL	VSt	Residual
				66	1 1.10			CLAY (CH) : high plasticity, brown orange brown grey, with fine sized gravel, sub-angular gravels. Extremely Weathered Bringelly Shale		H	Siltstone
					1.50			SILTSTONE: grey brown, fine grained. Bringelly Shale			Siltstone
					1.60			**See next page for rock logging below 1.6m**			
				65	2						
				64	3						
				63	4						
				62	5						

HOLE ID: BH02

Project:	40 The Retreat	Surface Elevation:	67.18m	Date Started:	15/12/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291309.1, N: 6244430	Contractor:	Intrax	Date Logged:	15/12/23
Project No.:	205892	Drill Rig:	Drillman GT-30	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description: colour, grain characteristics, structure, minor components, formation	Weathering	Strength Is^{50} ● - Axial ○ - Diametral (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	Defect Spacing (mm) (20, 40, 100, 300, 1000)	Visual	Discontinuities & other observations
					67	0.10							
						0.40							
					66	1							
						1.10							
						1.50		**See previous page for soil logging above 1.6m**					
						1.60							
NMLC		86	64	Is_{50}: A=294MPa	65	2		SILTSTONE: grey orange brown, fine grained, bedded at 0 to 10 deg, bed thickness between 2mm to 10mm, iron staining at joints.	MW				1.94m, JT, 25°, CU, RF, CN, Open 1.98m, P, 10° 2.00-2.17m, ?, 0.175m
						2.18		CORE LOSS					
								SILTSTONE: grey orange brown, fine grained, bedded at 0 to 10 deg, bed thickness between 2mm to 5mm.	MW				2.43m, JT, 5°, UN, RF, CN, Closed 2.65-2.75m, FZ 2.67-2.68m, CS, 5° 2.70m, JT, 5°, UN, RF, SN, Open
		100	67	Is_{50}: A=054MPa	64	3							2.94m, JT, 5°, UN, S, CN, Open
						3.23		SILTSTONE: grey brown orange brown, fine grained, bedded at 0 to 10 deg, bed thickness between 2mm to 10mm.	HW				3.25m, P, 10°
						3.36		SILTSTONE: grey, fine grained, bedded at 0 to 10 deg, bed thickness between 2mm to 10mm.	MW				3.45m, JT, 5°, PR, S, SN, Open 3.70m, JT, 10°, UN, RF, CN, Open
					63	4		SILTSTONE: grey brown orange brown, fine grained, bedded at 0 to 10 deg, bed thickness between 2mm to 10mm.	HW				4.29-4.32m, FZ, 5° 4.32m, JT, 50°, PR, RF, CN, Closed 4.38-4.41m, FZ, 5° 4.49-4.52m, FZ, 5° 4.57-4.60m, FZ, 5° 4.62-4.65m, FZ, 5°
		100	31	Is_{50}: A=057MPa	62	5							4.90m, JT, ST, RF, CN, Open 5.00m, JT, 25°, PR, S, CN, Open 5.21m, JT, 20°, PR, S, SN, Open 5.28m, JT, 10°, UN, S, CN, Closed 5.35-5.36m, EW, 5° 5.46-5.51m, JT, 45°, CU, RF, CN, Closed 5.54m, JT, 30°, UN, RF, Closed 5.66m, JT, 30°, CU, RF, CN, Closed
						5.75		CORE LOSS					
		87	18			5.93			MW				5.75-5.93m, ?, 0.18m

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

HOLE ID: BH02

Project:	40 The Retreat	Surface Elevation:	67.18m	Date Started:	15/12/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291309.1, N: 6244430	Contractor:	Intrax	Date Logged:	15/12/23
Project No.:	205892	Drill Rig:	Drillman GT-30	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling						Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description (colour, grain characteristics, structure, minor components, formation)	Weathering	Strength Is^{50} (● - Axial, ○ - Diametral) EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) 20 40 100 300 1000	Visual	Discontinuities & other observations
		87	18	Is_{50}: A=056MPa	61	7		SILTSTONE: grey, fine grained, bedded at 0 to 10 deg, fractured, bed thickness between 2mm to 20mm.					6.12m, JT, 20°, PR 6.30m, JT, 50°, PR 6.38m, JT, 40°, PR
		100	44	Is_{50}: A=044MPa	60	8							7.14m, JT, 60°, PR 7.30m, JT, 45°, PR 7.75m, JT, 60°, PR 8.09m, JT, 30°, PR 8.20m, JT, 60°, ST 8.24m, JT, 30°, PR
					59	8.45		SILTSTONE: dark grey, fine grained.	HW				8.45m, JT, 40°, PR, RF 8.53m, P, 5°
						8.65		SILTSTONE: dark grey, fine grained, bedded at 0 to 10 deg, bed thickness between 2mm to 5mm.	SW				
						8.85		CORE LOSS 0.08m					
		94	93	Is_{50}: A=1. 1MPa	58	8.93 9		SILTSTONE: light grey and grey, fine grained, bedded at 0 to 10 deg, bed thickness between 2mm to 20mm.	MW to SW				9.53m, P, 5°
					57	10							
						10.35		End Of Hole: 10.35m - Target depth - Backfilled with spoil					
					56	11							

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

Intrax LAND

CORE PHOTOS

HOLE NO.:	**BH02**
JOB NO.:	205892

1.60-10.35m

HOLE ID: BH03

Project:	40 The Retreat	Surface Elevation:	64.11m	Date Started:	12/12/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291304.6, N: 6244344	Contractor:	Intrax	Date Logged:	12/12/23
Project No.:	205892	Drill Rig:	Drillman GT-30	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling				Material					Observation
Progress: Drilling & Casing	Progress: Water	Penetration Resistance (L M H R)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description (colour, grain characteristics, plasticity, structure, minor components)	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
AD/V			1 - 1.5m B	64	0.10		SM	FILL- Silty SAND (SM) : fine to medium grained, medium dense, brown.	M	MD	0.0m - 0.8m: DCP: 7,12,12,13,12,10,12,12
								CLAY (CH) : high plasticity, red brown mottled light grey, with fine to medium grained sand.	w<PL	H	Residual
					0.80			CLAY (CH) : high plasticity, red brown mottled light grey, with fine to medium grained sand.	w>PL		Residual
			SPT 1.5-1.95m 1,3,7 N=10 Rec:450/450mm	63	1						
					1.50			CLAY (CH) : high plasticity, light grey and red brown.	w<PL	St	Residual
			SPT 2.5-2.95m 7,12,14 N=26 Rec:450/450mm	62	2		CH				
					2.50			CLAY (CH) : high plasticity, light grey mottled orange brown.			Residual
					3			CLAY (CH) : high plasticity, grey dark grey.	w=PL	VSt	Residual
			SPT 4-4.3m 13,16/150mm HB N=R Rec:300/300mm	61	4						
				60	4.50			CLAY (CH) : high plasticity, dark grey dark brown, fragments of siltstone layers. Extremely Weathered Bringelly Shale	w<PL	H	Siltstone
				59	5						
					5.40			CLAY (CH) : high plasticity, grey light grey orange brown. Extremely Weathered Bringelly Shale			Siltstone
					5.50			**See next page for rock logging below 5.5m**			

HOLE ID: BH03

Project:	40 The Retreat	Surface Elevation:	64.11m	Date Started:	12/12/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291304.6, N: 6244344	Contractor:	Intrax	Date Logged:	12/12/23
Project No.:	205892	Drill Rig:	Drillman GT-30	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description: colour, grain characteristics,structure, minor components, formation	Weathering	Strength Is^{50} ● - Axial ○ - Diametral: EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH	Defect Spacing (mm): 20, 40, 100, 300, 1000	Visual	Discontinuities & other observations
					64	0.10							
						0.80							
					63	1							
						1.50							
					62	2							
						2.50							
					61	3							
						4							
					60	4.50							
						5							
					59	5.40		**See previous page for soil logging above 5.5m**	EW				
NMLC		30	30	SPT 5.5-5.6m 12/100mm HB N=R Rec:100/100mm		5.60		CORE LOSS					5.50-5.85m, ?, Core Loss
						5.85		SILTSTONE: grey orange brown, fine grained, bedded at 40 to 50 deg, bed thickness between 2mm to 20mm. Bringelly	HW				5.92-6.00m, FZ, 80°

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

HOLE ID: BH03

Project:	40 The Retreat	Surface Elevation:	64.11m	Date Started:	12/12/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291304.6, N: 6244344	Contractor:	Intrax	Date Logged:	12/12/23
Project No.:	205892	Drill Rig:	Drillman GT-30	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling						Material			Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description: colour, grain characteristics, structure, minor components, formation	Weathering	Strength Is^{50} ● - Axial ○ - Diametral: EL, VL, L, M, H, VH, EH (0.03, 0.1, 0.3, 1, 3, 10)	Defect Spacing (mm): 20, 40, 100, 300, 1000	Visual	Discontinuities & other observations
NMLC		73	26	Is_{50}: A=254MPa	58	6.35		Shale CORE LOSS					6.00-6.35m, ?, Core Loss
								SILTSTONE: light grey light brown, fine grained, bedded at 40 to 50 deg, bed thickness between 2mm to 20mm.	MW				6.45m, JT, 30°, UN, RF, CN, Open 6.48m, JT, UN, RF, CN, Open 6.54m, JT, PR, S, SN, Open 6.62m, IS, 30°, CU, CT, Closed, Healed Joint 6.65m, JT, 20°, UN, RF, CN, Open 6.77m, P, 5°, UN, S, SN, Open 6.80-7.00m, FZ, 70°
					57	7							7.04-7.07m, EW, 5°, Clay 7.11m, JT, 10°, CU, S, CN, Closed
						7.30		CORE LOSS					7.30-7.85m, ?, Core Loss
		63	33	Is_{50}: A=062MPa		7.85		SILTSTONE: grey orange brown, fine grained, bedded at 40 to 50 deg, bed thickness between 2mm to 20mm, iron staining at joints.					7.98-8.00m, EW, sandy gravel 8.00-8.16m, FZ 8.20m, JT, 30°, CU, RF, CN, Closed
				Is_{50}: A=033MPa	56	8							8.46-8.58m, JT, 70°, PR, RF, Open 8.61m, P, 5°, UN, RF, CN, Closed
		100	78	Is_{50}: A=052MPa	55	9			SW				8.95m, JT, 10°, PR, S, CN, Open 9.43m, JT, 30°, CU, RF, SN, Open 9.43-9.52m, FZ 9.52m, JT, 20°, UN, RF, SN, Open
				Is_{50}: A=0. 6MPa	54	10							9.79-9.84m, EW, 5°
						10.20		End Of Hole: 10.20m - Target depth - Monitoring well installed					
					53	11							

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

Intrax LAND

CORE PHOTOS

HOLE NO.: BH03
JOB NO.: 205892

5.50-10.20m

HOLE ID: BH04

Project:	40 The Retreat	Surface Elevation:	66.94m	Date Started:	28/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291394.3, N: 6244337	Contractor:	BG Drilling	Date Logged:	28/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					Material					Observation
Progress: Drilling & Casing	Progress: Water	Penetration Resistance (L M H R)	Samples & Tests	RL (m)	Depth(m)	Graphic Log	Group Symbol	Material Description: colour, grain characteristics, plasticity, structure, minor components	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
AD/T			0.2 - 1.5m B	66	0.10		SM	FILL- Silty SAND (SM) : fine to medium grained, medium dense, brown.	M	MD	0.0m - 0.7m: DCP: 3,10,15,12,14,15,16
							CH	Silty CLAY (CH) : high plasticity, orange brown and grey, with fine grained sand.	w<PL	H	Residual
					1			Sandy CLAY (CL-CI): low to medium plasticity, orange brown, fine to medium grained sand. Extremely Weathered Bringelly Shale			Sandstone
					1.45			**See next page for rock logging below 1.45m**			
				65	2						
				64	3						
				63	4						
				62	5						
				61							

HOLE ID: BH04

Project:	40 The Retreat	Surface Elevation:	66.94m	Date Started:	28/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291394.3, N: 6244337	Contractor:	BG Drilling	Date Logged:	28/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling						Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description (colour, grain characteristics, structure, minor components, formation)	Weathering	Strength Is^{50} (● - Axial, ○ - Diametral) EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) 20 40 100 300 1000	Visual	Discontinuities & other observations
					66	0.10							
						1		**See previous page for soil logging above 1.45m**					
NMLC						1.45		Sandy CLAY (CL-CI) : low to medium plasticity, orange brown, fine to medium grained sand. Extremely Weathered Bringelly Shale	EW				
						1.74		SANDSTONE: light orange brown and brown, fine to medium grained. Bringelly Shale					1.74-2.07m, JT, 85°, PR, RF, CN, Open
		100	7		65	2			HW				2.07-2.21m, EW, 140mm
						2.48		dark grey and orange brown					2.29-2.32m, EW, 30mm
				Is_{50}: A=035MPa		2.80		grey and light brown					2.39-2.46m, EW, 70mm
					64	3			MW				2.72-2.76m, JT, 40°, PR, RF, CN, Open
						3.35		SILTSTONE: dark grey orange brown and light brown, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.					2.78-2.82m, JT, 40°, PR, RF, CN, Open
													2.85-2.89m, EW, 40mm
													2.89-3.06m, JT, 85°, PR, RF, CN, Open
													3.20-3.36m, JT, 85°, UN, RF, CN, Open
													3.42-3.43m, EW, 10mm
				Is_{50}: A=057MPa	63	4							3.60m, P, 5°, 10mm
						4.16		SANDSTONE: light grey, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	HW				3.98m, P, 10°, 10mm
		100	59										4.10-4.14m, EW, 40mm
				Is_{50}: A=042MPa									4.14-4.16m, CS, 20mm
					62	4.92							4.91-4.92m, EW, 10mm
						5		SANDSTONE: grey and light grey, fine to medium grained, bedded at 10 to 20 deg, bed thickness between 2mm to 20mm.	MW				5.15m, P, 40°
						5.63		SILTSTONE: dark grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.					
				Is_{50}: A=111MPa	61	5.92		SANDSTONE: grey and orange brown, fine to medium					
		100	60										

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

HOLE ID: BH04

Project:	40 The Retreat	Surface Elevation:	66.94m	Date Started:	28/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291394.3, N: 6244337	Contractor:	BG Drilling	Date Logged:	28/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description: colour, grain characteristics, structure, minor components, formation	Weathering	Strength Is^{50} (● - Axial, ○ - Diametral): EL, VL, L, M, H, VH, EH (0.03, 0.1, 0.3, 1, 3, 10)	Defect Spacing (mm): 20, 40, 100, 300, 1000	Visual	Discontinuities & other observations
					60	7		grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.					6.02-6.04m, JT, 30°, PR, RF, SN, Open 6.06-6.08m, CS, 20mm 6.13m, P, 10°
						7.10		SILTSTONE: dark grey and light grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.					7.00-7.07m, JT, 85°, PR, RF, SN, Open 7.07m, P, 10°
		100	60	Is_{50}: A=013MPa					MW				7.31-7.34m, CS, 30mm
					59	8							7.45m, P, 5° 7.50m, P, 5°
				Is_{50}: A=118MPa									8.08-8.40m, JT, 85°, UN, RF, SN, Open
													8.47-8.49m, JT, 70°, PR, RF, SN, Open
													8.63-8.69m, JT, 60°, UN, RF, SN, Open
					58	9		SILTSTONE: light grey and grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	SW				8.80m, P, 5°, PR, RF 8.87-8.90m, JT, 30°, PR, RF, SN, Open
						9.18		SILTSTONE: dark grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	HW				
		77	18			9.55		CORE LOSS 0.25m					
					57	9.80		SILTSTONE: dark grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	HW				
						10		End Of Hole: 10.00m - Target depth - Backfilled with spoil					
					56	11							
					55								

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

CORE PHOTOS

HOLE NO.: BH04
JOB NO.: 205892

1.45-10.00m

HOLE ID: BH05

Project:	40 The Retreat	Surface Elevation:	69.25m	Date Started:	22/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291403.7, N: 6244426	Contractor:	BG Drilling	Date Logged:	22/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					Material					Observation
Progress: Drilling & Casing	Progress: Water	Penetration Resistance (L M H)	Samples & Tests	RL (m)	Depth(m)	Graphic Log	Group Symbol	Material Description: colour, grain characteristics, plasticity, structure, minor components	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
AD/T			0.1 - 0.7m B	69	0.10		SM	FILL- Silty SAND (SM) : medium to coarse grained, loose, dark brown.	M	L	0.1m - 0.6m: DCP: 1,9,8,15,15,20
							CI-CH	CLAY (CI-CH) : medium to high plasticity, light grey and orange brown, with fine to medium sized gravel, trace fine grained sand.	w<PL	VSt	Residual
				68	0.80 1			SILTSTONE: orange brown and light grey, fine grained, with clay bands, bedded at 0 to 5 deg. highly weathered, very low strength. Bringelly Shale			Siltstone
					1.30			**See next page for rock logging below 1.3m**			
				67	2						
				66	3						
				65	4						
				64	5						

HOLE ID: BH05

Project:	40 The Retreat	Surface Elevation:	69.25m	Date Started:	22/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291403.7, N: 6244426	Contractor:	BG Drilling	Date Logged:	22/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description: colour, grain characteristics, structure, minor components, formation	Weathering	Strength Is^{50} ● - Axial ○ - Diametral: EL, VL, L, M, H, VH, EH (0.03, 0.1, 0.3, 1, 3, 10)	Defect Spacing (mm): 20, 40, 100, 300, 1000	Visual	Discontinuities & other observations
					69	0.10							
						0.80							
					68	1		**See previous page for soil logging above 1.3m**					
						1.30		CORE LOSS 0.25m					
NMLC		67	0	Is_{50}: A=0. 2MPa		1.55		SILTSTONE: grey and orange brown, fine grained, with clay bands, bedded at 0 to 5 deg, bed thickness between 2mm to 5mm. Bringelly Shale	HW				1.54-1.59m, EW, 50mm 1.62-1.65m, EW, 30mm 1.67-1.69m, EW, 20mm
						2							1.77-1.81m, EW, 40mm 1.88-1.93m, EW, 50mm 1.97-2.06m, EW, 90mm
						2.05		SANDSTONE: grey light grey and light orange brown, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 5mm.	HW to MW				
						2.15		CORE LOSS 0.10m					2.19-2.23m, CS, 40mm
					67	2.23		SILTSTONE: grey and light grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 5mm.					
		94	61	Is_{50}: A=046MPa				SANDSTONE: grey light grey and light orange brown, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 5mm.	HW				2.70m, P, 5° 2.81-2.82m, EW, 5mm
					66	3							3.02m, EW, 2mm 3.04m, EW, 2mm
				Is_{50}: A=1.05MPa									3.39-3.40m, EW, 10mm
		60	0			3.88		CORE LOSS 0.12m, drill error					3.83-3.85m, EW, 20mm
						4		SANDSTONE: grey light grey light orange brown, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 10mm.					4.03m, JT, 30° , PR, S 4.24m, P, 15°, PR, S
					65				HW				
		100	89	Is_{50}: A=052MPa		5							4.96m, P, 15°, PR, RF
						5.24		SILTSTONE: dark grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	MW				5.20m, P, 5°, PR, S 5.24-5.34m, EW, 100mm
					64	5.41		SANDSTONE: grey and light grey, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	HW to MW				5.42-5.43m, EW, 10mm
		100	57	Is_{50}: A=064MPa									5.94-6.04m, JT, 85°, UN, RF

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

HOLE ID: BH05

Project:	40 The Retreat	Surface Elevation:	69.25m	Date Started:	22/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291403.7, N: 6244426	Contractor:	BG Drilling	Date Logged:	22/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling

Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)
NMLC		100	57		63	6.61
						7
		100	400	Is_{50}: A=0.89MPa	62	
						8
					61	8.26
						8.30
						8.43
		91	40			9
				Is_{50}: A=0.76MPa	60	9.26
						10
		100	80	Is_{50}: A=1.03MPa	59	
						11
					58	
		100	94			

Material

Graphic Log	Material Description (colour, grain characteristics, structure, minor components, formation)	Weathering	Strength Is^{50} (● - Axial, ○ - Diametral)
	[CONT] SANDSTONE: grey and light grey, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	HW to MW	EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH
	SILTSTONE: grey and light grey, fine grained, bedded at 0 to 15 deg, bed thickness between 2mm to 20mm.		
	SILTSTONE: grey and light grey, fine grained, bedded at 0 to 5 deg.	MW	
	CORE LOSS 0.13m		
	SILTSTONE: dark grey and grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	HW	
	As above - SILTSTONE: dark grey and grey, fine grained.	MW	

Defect & Observation

Defect Spacing (mm)	Visual	Discontinuities & other observations
20, 40, 100, 300, 1000		6.08m, P, 5°
		6.24m, P, 5°
		6.34-6.38m, JT, 85°, UN, RF
		6.38-6.41m, EW, 30mm
		6.53m, P, 5°
		6.62-6.80m, CS, 180mm
		6.90-6.94m, JT, 45°, 180mm
		7.13-7.14m, EW, 10mm
		7.17-7.21m, JT, 45°, CU, 10mm
		7.35-7.43m, JT, 85°, PR, 10mm
		7.48-7.49m, EW, 10mm
		7.49-7.63m, JT, 85°, PR, 10mm
		7.63-7.69m, CS, 60mm
		7.81-7.82m, EW, 10mm
		7.94-8.30m, JT, 85°, PR
		8.21-8.30m, EW, 90mm
		8.53m, EW, 10mm
		8.59-8.61m, EW, 20mm
		8.64m, EW, 10mm
		8.76-8.78m, EW, 20mm
		8.85-8.90m, CS, 50mm
		9.00-9.12m, EW, 120mm
		9.21-9.24m, CS, 30mm
		9.59m, P, 30mm
		9.70-9.74m, EW, 40mm
		9.88m, P
		9.91m, P
		10.36-10.38m, CS
		10.38-10.42m, JT, 85°, PR

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

HOLE ID: BH05

Project:	40 The Retreat	Surface Elevation:	69.25m	Date Started:	22/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291403.7, N: 6244426	Contractor:	BG Drilling	Date Logged:	22/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling							Material				Defect & Observation		
Progress													
Drilling & Casing	Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description colour, grain characteristics,structure, minor components, formation	Weathering	Strength Is^{50} ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) 20 40 100 300 1000	Visual	Discontinuities & other observations
		100	94	Is_{50}: A=078MPa	57			[CONT] As above - SILTSTONE: dark grey and grey, fine grained.					12. 19-12.21m, EW, 20mm
					56	13			MW				
		100	100	Is_{50}: A=091MPa	55	14							13. 55-13.60m, JT, 80° , PR, RF
						15		End Of Hole: 15.00m - Target depth - Backfilled with spoil					
					54	16							
					53	17							
					52								

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

1.30-15.00m

HOLE ID: BH06

Project:	40 The Retreat	Surface Elevation:	69.33m	Date Started:	27/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291372.1, N: 6244500	Contractor:	BG Drilling	Date Logged:	27/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					***Material***					***Observation***
Progress		Penetration Resistance	Samples & Tests	RL (m) / Depth(m)	Graphic Log	Group Symbol	Material Description colour, grain characteristics, plasticity, structure, minor components	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
Drilling & Casing	Water	L M H R								
AD/T			0.1 - 0.7m B	69 0.80 1 1.20 1.30 68		CI-CH	CLAY (CI-CH) : medium to high plasticity, light grey and orange brown.	w<PL	VSt - H	Residual
						CH	Silty CLAY (CH) : high plasticity, orange brown and brown, with fine grained sand, trace fine to medium sized gravel.		St - VSt	Residual
							SANDSTONE: orange brown and brown, fine to medium grained, bedded at 0 to 5 deg. low strength, highly weathered. Bringelly Shale			Sandstone
				67 66 65 64			**See next page for rock logging below 1.3m**			

HOLE ID: BH06

Project:	40 The Retreat	Surface Elevation:	69.33m	Date Started:	27/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291372.1, N: 6244500	Contractor:	BG Drilling	Date Logged:	27/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling						Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description (colour, grain characteristics, structure, minor components, formation)	Weathering	Strength Is^{50} (● - Axial, ○ - Diametral) EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) 20 40 100 300 1000	Visual	Discontinuities & other observations
						0.80		**See previous page for soil logging above 1.3m**					
						1							
						1.20							
						1.30							
NMLC			41	Is_{50}: A=061MPa	68			SANDSTONE: orange brown and brown, fine to medium grained, bedded at 0 to 5 deg. Bringelly Shale	HW				1.44-1.46m, EW, 20mm
													1.59-1.64m, EW, 50mm
													1.72-1.76m, JT, 40°, PR, RF, Open, EW, 40mm
													1.86-1.89m, EW, 30mm
													1.94-1.96m, EW, 20mm
													2.00-2.03m, CS, 30mm
													2.10-2.16m, EW, 60mm
						2							
					67								2.30-2.34m, EW, 40mm
						2.84							2.77-2.84m, EW, 70mm
						3		iron indurated band.					
						3.07							2.95-3.07m, JT, 85°, PR, Infilled
						3.15		Silty CLAY (CI-CH) : medium to high plasticity, orange brown, trace fine grained sand.					
								SANDSTONE: orange brown and brown, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.					
		100	50	Is_{50}: A=051MPa	66								
						3.72		SANDSTONE: orange brown and brown, fine to medium grained, iron indurated band.					3.72-3.90m, JT, 60°, UN, Infilled
						3.90		SANDSTONE: orange brown and brown, fine to medium grained.	HW to MW				
						4							4.15-4.25m, JT, 70°, PR, RF, Open
					65								4.46-4.52m, JT, 60°, PR, RF, Open
				Is_{50}: A=051MPa									
						4.92		SILTSTONE: dark grey and orange brown, grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.					4.92-4.94m, EW, 20mm
						5			HW				5.00-5.11m, JT, 70°, PR, RF, Open, CS, 110mm
		100	56		64	5.33		SILTSTONE: grey light grey and orange brown, grained.	HW to MW				5.25-5.33m, CS, 80mm
				Is_{50}: A=0. 3MPa									

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

HOLE ID: BH06

Project:	40 The Retreat	Surface Elevation:	69.33m	Date Started:	27/11/23
Location:	40 The Retreat, Bringelly	Inclination:	90°	Date Completed:	
Position:	E: 291372.1, N: 6244500	Contractor:	BG Drilling	Date Logged:	27/11/23
Project No.:	205892	Drill Rig:	Christie Engineering CE180	Logged By:	DF
Client:	Sathio Group	Driller:		Checked By:	JM

Drilling					Material				Defect & Observation		
Progress: Drilling & Casing	Progress: Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description (colour, grain characteristics, structure, minor components, formation)	Weathering	Strength Is^{50} (● - Axial, ○ - Diametral) EL, VL, L, M, H, VH, EH (0.03, 0.1, 0.3, 1, 3, 10)	Defect Spacing (mm) 20, 40, 100, 300, 1000	Visual	Discontinuities & other observations
		100	56	Is_{50}: A=0. 2MPa	63			[CONT] SILTSTONE: grey light grey and orange brown, grained.	HW to MW				6.00-6.18m, JT, 80°, PR, RF, Open
						7							6.18-6.28m, CS, 100mm
					62								6.95-7.03m, JT, 80°, PR, RF, Infilled
						7.37		SANDSTONE: grey and light grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	MW to SW				7.24-7.27m, CS, 30mm
				Is_{50}: A=217MPa									7.32-7.37m, CS, 50mm
						7.88							7.76-7.77m, EW, 10mm
						8		SILTSTONE: grey and light grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.					7.86-7.88m, EW, 20mm
		100	81		61				SW				
						9							8.62-8.66m, EW, 40mm
					60								
						9.82							9.50-9.52m, EW, 20mm
						10		End Of Hole: 9.82m - Target depth - Monitoring well installed					
					59								
						11							
					58								

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

Prepared for Sathio Group

Intrax LAND

CORE PHOTOS

HOLE NO.:	**BH06**
JOB NO.:	205892

1.30-9.82m

EXPLANATORY NOTES AND ABBREVIATIONS

The following presents a depiction and explanation of terms adopted by Intrax Land in geotechnical borehole logs, test pits and other soil and rock descriptions. Soil and rock descriptions are in accordance with Australian Standard 1726-2017, Geotechnical Site Investigations.

Investigation methods, sampling, testing & groundwater

Drilling Method	
AD/V	Auger drilling with V bit
AD/T	Auger drilling with TC-Bit
DPT	Direct push tube
HA	Hand auger
WB	Wash boring
HOA	Hollow auger
AH	Air Hammer
SPT	Standard Penetration Test
NQ	Diamond Core – 47mm
NMLC	Diamond Core – 52mm
HQ	Diamond Core – 63mm
PQ	Diamond Core – 81mm
SO	Sonic drilling
NDD	Non-destructive digging
EX	Excavator bucket
BH	Backhoe bucket
EE	Existing Excavation

Groundwater & Support	
▼	Standing water level at date shown
►	Water inflow
◄	Water loss
GROUNDWATER NOT OBSERVED	Observation of groundwater, whether present or not, was not possible due to drilling water, seepage or cave in
GROUNDWATER NOT ENCOUNTERED	Borehole was dry soon after excavation, however, no well was installed to monitor seepage from low permeability materials
C	Casing
M	Mud

Field Sampling & Testing	
W	Water Sample
D	Disturbed Sample
B	Bulk Disturbed Sample
U50 / U63	Undisturbed Tube Sample (50/63mm diameter tube)
E	Environmental Sample
PP	Pocket Penetrometer Test (kPa)
FV	Field Shear Vane (kPa)
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure measurement
DCP	**Dynamic Cone Penetrometer (blows / 100mm)**
R	DCP refusal condition 20 blows with less than 100mm penetration
SPT	**Standard penetration Test**
5, 8, 22	SPT blow counts (150mm increments)
N = 30	SPT N count (blows for final 300mm)
30/100mm	Refused test with partial penetration
R	SPT refusal conditions. 30 blows with less than 100mm penetration or 5 blows with hammer bounce or no measurable movement
RW	Rod Weight only causing penetration (SPT N < I)
HW	Hammer and rod weight only causing full penetration (N < I)
HB	Hammer Bouncing

Core Recovery Measurements		Definition
TCR	Total Core Recovery (%)	$\frac{Lenth\ of\ core\ recovered}{Length\ of\ core\ run} \times 100$
SCR	Solid Core Recovery* (%)	$\frac{\sum Lenth\ of\ cylindrical\ core\ recovered}{Length\ of\ core\ run} \times 100$
RQD	Rock Quality Designation* (%)	$\frac{\sum Length\ of\ sound\ core\ pieces > 100\ mm\ length}{Length\ of\ core\ run} \times 100$

*Only natural breaks considered, mechanical breaks shall be ignored, and core shall be marked with chalk

Penetration / Excavation Resistance

Symbol	Term	Description
L	Low resistance	Rapid penetration with little effort from equipment used
M	Medium resistance	Penetration progresses at normally accepted rate with moderate effort from equipment
H	High resistance	Penetration rate is slow and requires significant effort from equipment
R	Practical Refusal	Further progress is not practical without damage or unacceptable wear to the equipment

SOIL DESCIPTION

Soil classification symbols

Classification Symbol	Typical Soil Name
GW	Well graded gravels, sand-gravel mixtures – little or no fines
GP	Poorly graded gravels, sand-gravel mixtures – little or no fines, uniform gravels
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
ML	Inorganic silts of low plasticity
MH	Inorganic silts of high plasticity
OL	Organic silts of low plasticity
OH	Organic clay of medium to high plasticity

Classification Symbol	Typical Soil Name
SW	Well graded sands, gravel-sand mixtures – little or no fines
SP	Poorly graded sands, gravel-sand mixtures – little or no fines, uniform sands
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures
CL	Inorganic clay of low plasticity
CI	Inorganic clay of medium plasticity
CH	Inorganic clay of high plasticity
Pt	Peat – highly organic material

Dual classification (SP-SM, GP-GC) may be adopted for coarse grained soils with fines contents between 5% and 12%

Particle size distributions and material components

Particle Size Divisions			
Group	**Name**	**Division**	**Size (mm)**
Coarse	BOULDERS		> 200
	COBBLES		63 to 200
	GRAVEL	coarse	19 to 63
		medium	6.7 to 19
		fine	2.36 to 6.7
	SAND	coarse	0.6 to 2.36
		medium	0.21 to 0.6
		fine	0.075 to 0.21
Fine	SILT		0.002 to 0.075
	CLAY		< 0.002

Minor and Secondary Components			
Fine Grained Minor Component		**Coarse Grained Minor Component**	
≤5%	Trace clay/silt	≤15%	Trace sand/gravel
>5%, ≤12%	With clay/silt	>15%, ≤30%	With sand/gravel
>12%	Prefix 'Silty' or 'Clayey'	>30%	Prefix 'Sandy' or 'Gravelly'

Plasticity

Descriptive Term	Range of liquid limit or silt	Range of liquid limit for clay
Low	≤50	≤35
Medium	Not Applicable	>35 and ≤50
High	>50	>50

Moisture Condition

Fine grain soils		Coarse grain soils	
w < PL	Moist, dry of plastic limit	D	Dry, non-cohesive and free running
w ≈ PL	Moist, near plastic limit	M	Moist, soil feels cool tends to stick together
w > PL	Moist, wet of plastic limit	W	Wet, soil feel cool, free water forms when handling
w ≈ LL	Wet, near liquid limit		
w > LL	Wet, wet of liquid limit		

Consistency of cohesive soils

Abbreviation	Term	Undrained Shear Strength (kPa)	Indicative SPT N*	Indicative DCP per 100mm*	Pocket Penetrometer	Visual Assessment
VS	Very Soft	≤ 12	0 to 2	0 to 1	25	Exudes between the fingers when squeezed in hand
S	Soft	>12 to ≤25	2 to 4	1 to 2	25 to 50	Can be moulded by light finger pressure
F	Firm	>25 to ≤50	4 to 8	2 to 3	50 to 100	Can be moulded by strong finger pressure
St	Stiff	>50 to ≤100	8 to 15	3 to 5	100 to 200	Cannot be moulded by fingers
VSt	Very Stiff	>100 to ≤200	15 to 30	5 to 10	200 to 400	Can be indented by thumb nail
H	Hard	> 200	> 30	> 10	> 400	Can be indented with difficulty with thumb nail
Fr	Friable	-	-	-	-	Can be easily crumbled or broken into small pieces by hand

*Indicative correlations, accuracy will vary with soil type, testing equipment and groundwater conditions. Site specific correlations developed with more accurate testing methods would take precedence over the above relationships.

Relative density of non-cohesive soils

Abbreviation	Term	Density Index (%)	Indicative SPT (N) blows per 300mm	Approximate DCP per 100mm	Approximate PSP per 100mm
VL	Very Loose	0 to ≤15	0 to 4	0 to 1	0 to 2
L	Loose	>15 to ≤35	4 to 10	1 to 3	2 to 6
MD	Medium Dense	>35 to ≤65	10 to 30	3 to 8	6 to 8
D	Dense	>65 to ≤85	30 to 50	8 to 15	8 to 15
VD	Very Dense	> 85	> 50	> 15	> 15

Relative density is typically only provided where testing is conducted, where testing is not conducted the relative density shall be noted as inferred by use of an asterisk (*) symbol

ROCK DESCIPTION

Rock weathering

Abbreviation		Term		Definition
RS		Residual Soil		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
XW		Extremely Weathered		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
HW	DW	Highly Weathered	Distinctly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.
MW		Moderately Weathered		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.
SW		Slightly Weathered		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
FR		Fresh		Rock shows no sign of decomposition of individual minerals or colour changes.

Residual soil and extremely weathered materials are to be described using soil descriptions

Rock strength

Symbol	Term	UCS* (MPa)	Is50* (MPa)	Field Assessment
VL	Very Low Strength	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm thick can be broken by finger pressure.
L	Low Strength	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium Strength	6 to 20	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High Strength	20 to 60	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
VH	Very High Strength	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High Strength	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Material with strength less than 'Very Low' shall be described using soil characteristics.

*Point load test values are provided a guide, however UCS strengths take precedence, and no correlation between the two measurements should be interpreted from the above

Defect type

Abbr.	Type	Definition	Diagram
P	Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.	
JT	Joint	A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or sub-parallel to layering or to planar anisotropy in the rock material. May be open or closed.	
SF	Sheared Surface (fault)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.	
SZ	Sheared Zone (fault)	Zone of rock material with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
SS	Sheared Seam (fault)	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
CS	Crushed Seam (fault)	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.	
IS	Infilled Seam	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1 mm thick may be described as a veneer or coating on a joint surface.	
XS	Extremely Weathered Seam	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.	
FZ	Fractured Zone	Heavily fractured section of containing large number of defects	

Defect type

Surface Roughness		Surface Shape		Coating / Infill	
VR	Very Rough	ST	Stepped	CN	Clean
RO	Rough	CU	Curved	SN	Stained
SM	Smooth	UN	Undulating	VN	Veneer
PO	Polished	IR	Irregular	CT	Coating
SL	Slickensided	PL	Planar	Infill described separately	

Appendix C

Site Photography

Intrax
LAND









Appendix D

Laboratory Test Reports

Material Test Report

Report Number: **PRJ1073940 -1**
Issue Number: 1
Date Issued: 31/01/2024
Client: SCG Developments Pty Ltd
Suite 13.01 , 44 Market Street, Sydney NSW 2000
Project Number: PRJ1073940
Project Name: SSD- Geo and ground assessment
Project Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556
Work Request: 3532
Sample Number: SC24-3532A
Date Sampled: 10/01/2024
Dates Tested: 19/01/2024 - 29/01/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH01 , Depth: 0.4-1.0m**
Material: CLAY, brown, high plasticity, trace sand & gravel

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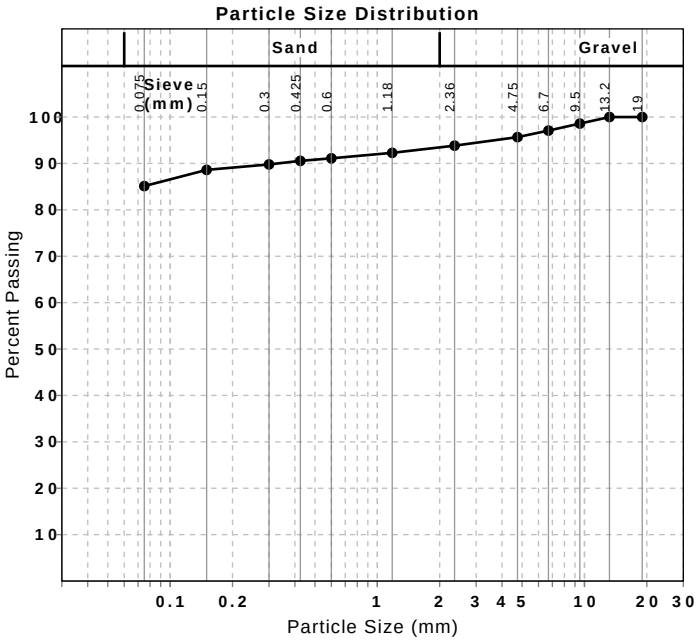
Approved Signatory: Darryl Pather
State Laboratory Manager
NATA Accredited Laboratory Number: 19862

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**99**			1		
6.7 mm	**97**			2		
4.75 mm	**96**			1		
2.36 mm	**94**			2		
1.18 mm	**92**			2		
0.6 mm	**91**			1		
0.425 mm	**91**			1		
0.3 mm	**90**			1		
0.15 mm	**89**			1		
0.075 mm	**85**			3		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	55		
Plastic Limit (%)	17		
Plasticity Index (%)	**38**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.5**		
Cracking Crumbling Curling	Curling		



Material Test Report

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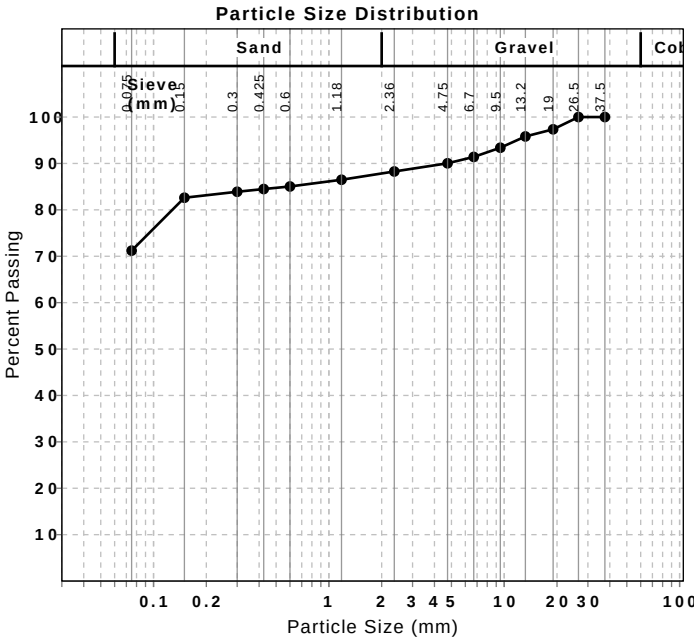
Approved Signatory: Darryl Pather
State Laboratory Manager
NATA Accredited Laboratory Number: 19862

Report Number: **PRJ1073940 -1**
Issue Number: 1
Date Issued: 31/01/2024
Client: SCG Developments Pty Ltd
Suite 13.01 , 44 Market Street, Sydney NSW 2000
Project Number: PRJ1073940
Project Name: SSD- Geo and ground assessment
Project Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556
Work Request: 3532
Sample Number: SC24-3532B
Date Sampled: 10/01/2024
Dates Tested: 19/01/2024 - 29/01/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH02 , Depth: 0.4-1.0m**
Material: CLAY, brown, high plasticity, with sand, trace gravel

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
37.5 mm	**100**			0		
26.5 mm	**100**			0		
19 mm	**97**			3		
13.2 mm	**96**			2		
9.5 mm	**93**			2		
6.7 mm	**91**			2		
4.75 mm	**90**			1		
2.36 mm	**88**			2		
1.18 mm	**86**			2		
0.6 mm	**85**			1		
0.425 mm	**84**			1		
0.3 mm	**84**			1		
0.15 mm	**83**			1		
0.075 mm	**71**			11		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	66		
Plastic Limit (%)	19		
Plasticity Index (%)	**47**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**14.5**		
Cracking Crumbling Curling	Cracking & Curling		



Material Test Report

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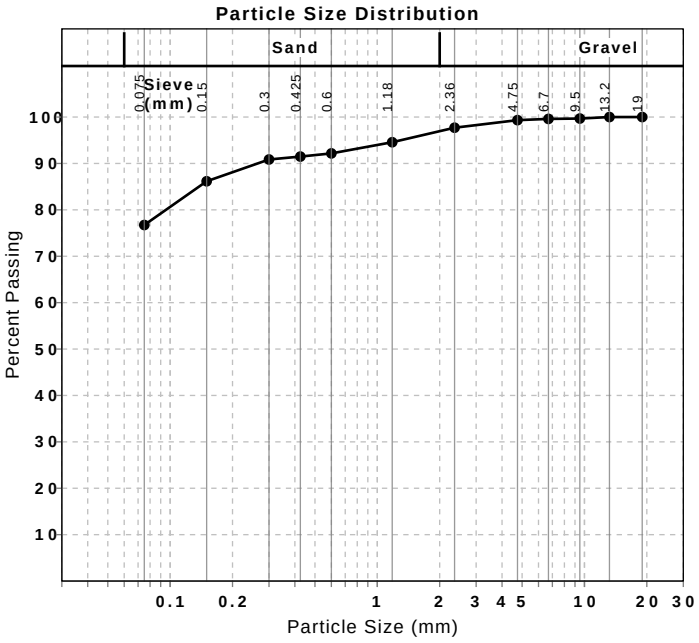
State Laboratory Manager
NATA Accredited Laboratory Number: 19862

Report Number: **PRJ1073940 -1**
Issue Number: 1
Date Issued: 31/01/2024
Client: SCG Developments Pty Ltd
Suite 13.01 , 44 Market Street, Sydney NSW 2000
Project Number: PRJ1073940
Project Name: SSD- Geo and ground assessment
Project Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556
Work Request: 3532
Sample Number: SC24-3532C
Date Sampled: 10/01/2024
Dates Tested: 19/01/2024 - 29/01/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH03 , Depth: 1.0-1.5m**
Material: CLAY, brown, high plasticity, with sand, trace gravel

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**99**			0		
2.36 mm	**98**			2		
1.18 mm	**95**			3		
0.6 mm	**92**			2		
0.425 mm	**91**			1		
0.3 mm	**91**			1		
0.15 mm	**86**			5		
0.075 mm	**77**			9		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	60		
Plastic Limit (%)	16		
Plasticity Index (%)	**44**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**14.0**		
Cracking Crumbling Curling	Curling		



Material Test Report

Report Number: **PRJ1073940 -1**
Issue Number: 1
Date Issued: 31/01/2024
Client: SCG Developments Pty Ltd
Suite 13.01 , 44 Market Street, Sydney NSW 2000
Project Number: PRJ1073940
Project Name: SSD- Geo and ground assessment
Project Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556
Work Request: 3532
Sample Number: SC24-3532D
Date Sampled: 10/01/2024
Dates Tested: 19/01/2024 - 29/01/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH04 , Depth: 0.2-1.0m**
Material: CLAY, brown, high plasticity, with sand, trace gravel

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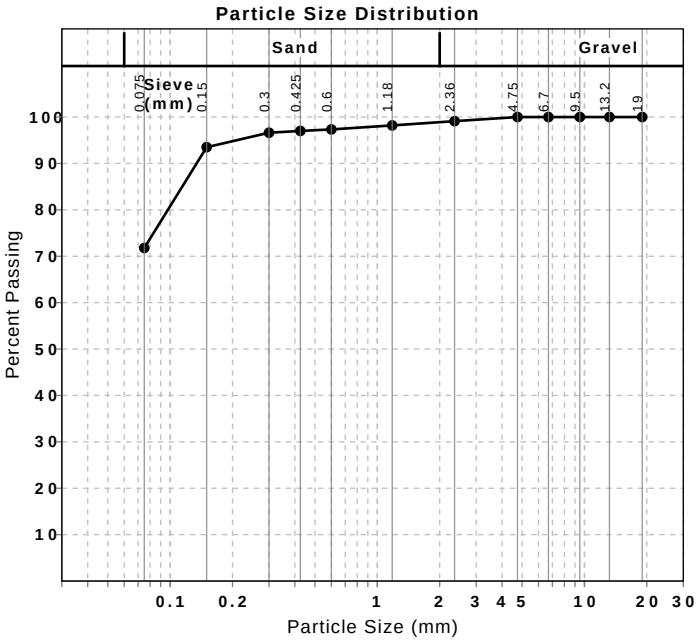
Approved Signatory: Darryl Pather
State Laboratory Manager
NATA Accredited Laboratory Number: 19862

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**99**			1		
1.18 mm	**98**			1		
0.6 mm	**97**			1		
0.425 mm	**97**			0		
0.3 mm	**97**			0		
0.15 mm	**93**			3		
0.075 mm	**72**			22		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	54		
Plastic Limit (%)	16		
Plasticity Index (%)	**38**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.5**		
Cracking Crumbling Curling	Curling		



Material Test Report

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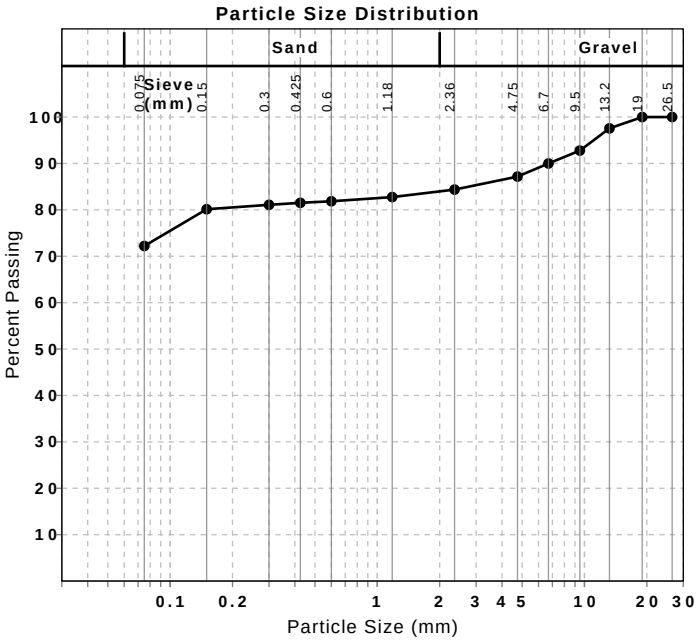
NATA Accredited Laboratory Number: 19862

Report Number: **PRJ1073940 -1**
Issue Number: 1
Date Issued: 31/01/2024
Client: SCG Developments Pty Ltd
Suite 13.01 , 44 Market Street, Sydney NSW 2000
Project Number: PRJ1073940
Project Name: SSD- Geo and ground assessment
Project Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556
Work Request: 3532
Sample Number: SC24-3532E
Date Sampled: 10/01/2024
Dates Tested: 19/01/2024 - 29/01/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH05 , Depth: 0.1-0.7m**
Material: CLAY, brown, high plasticity, with gravel, trace sand

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**98**			2		
9.5 mm	**93**			5		
6.7 mm	**90**			3		
4.75 mm	**87**			3		
2.36 mm	**84**			3		
1.18 mm	**83**			2		
0.6 mm	**82**			1		
0.425 mm	**82**			0		
0.3 mm	**81**			0		
0.15 mm	**80**			1		
0.075 mm	**72**			8		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	52		
Plastic Limit (%)	17		
Plasticity Index (%)	**35**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**11.0**		
Cracking Crumbling Curling	Curling		



Material Test Report

Report Number: **PRJ1073940 -1**
Issue Number: 1
Date Issued: 31/01/2024
Client: SCG Developments Pty Ltd
Suite 13.01 , 44 Market Street, Sydney NSW 2000
Project Number: PRJ1073940
Project Name: SSD- Geo and ground assessment
Project Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556
Work Request: 3532
Sample Number: SC24-3532F
Date Sampled: 10/01/2024
Dates Tested: 19/01/2024 - 29/01/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **BH06 , Depth: 0.1-0.7m**
Material: CLAY, brown, high plasticity, with sand, trace gravel

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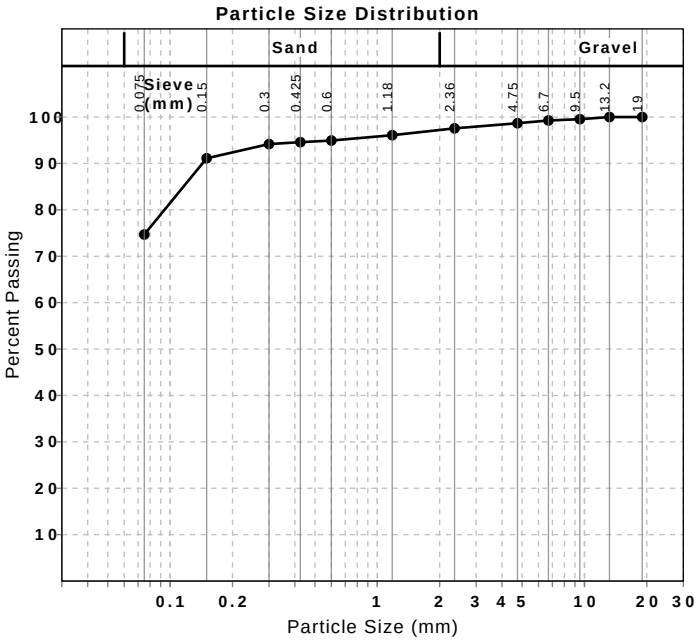
Approved Signatory: Darryl Pather
State Laboratory Manager
NATA Accredited Laboratory Number: 19862

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**99**			0		
4.75 mm	**99**			1		
2.36 mm	**98**			1		
1.18 mm	**96**			1		
0.6 mm	**95**			1		
0.425 mm	**95**			0		
0.3 mm	**94**			0		
0.15 mm	**91**			3		
0.075 mm	**75**			16		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	60		
Plastic Limit (%)	16		
Plasticity Index (%)	**44**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**14.0**		
Cracking Crumbling Curling	Cracking & Curling		



Material Test Report

Report Number: **PRJ1073940 -1**
Issue Number: 1
Date Issued: 31/01/2024
Client: SCG Developments Pty Ltd
Suite 13.01 , 44 Market Street, Sydney NSW 2000
Project Number: PRJ1073940
Project Name: SSD- Geo and ground assessment
Project Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556
Work Request: 3532
Dates Tested: 19/01/2024 - 23/01/2024
Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556

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Moisture Content AS 1289 2.1.1

Sample Number	Sample Location	Moisture Content (%)	Min	Max	Material
SC24-3532A	BH01 , Depth: 0.4-1.0m	14.0 %	**	**	CLAY, brown, high plasticity, trace sand & gravel
SC24-3532B	BH02 , Depth: 0.4-1.0m	13.8 %	**	**	CLAY, brown, high plasticity, with sand, trace gravel
SC24-3532C	BH03 , Depth: 1.0-1.5m	15.0 %	**	**	CLAY, brown, high plasticity, with sand, trace gravel
SC24-3532D	BH04 , Depth: 0.2-1.0m	15.8 %	**	**	CLAY, brown, high plasticity, with sand, trace gravel
SC24-3532E	BH05 , Depth: 0.1-0.7m	13.1 %	**	**	CLAY, brown, high plasticity, with gravel, trace sand
SC24-3532F	BH06 , Depth: 0.1-0.7m	15.0 %	**	**	CLAY, brown, high plasticity, with sand, trace gravel

Material Test Report

Report Number: **PRJ1073940 -1**
Issue Number: 1
Date Issued: 31/01/2024
Client: SCG Developments Pty Ltd
Suite 13.01 , 44 Market Street, Sydney NSW 2000
Project: PRJ1073940 - SSD- Geo and ground assessment
Project Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556
Work Request: 3532
Dates Tested: 19/01/2024 - 31/01/2024
Location: S#205892 No. 40, The Retreat, Bringelly, NSW, 2556

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Approved Signatory: Darryl Pather
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Determination of Point Load (AS 4133.4.1)										
Sample #	Specimen	Location	Test Type	I_s (Mpa)	$I_{s(50)}$ (Mpa)	$I_{s(50)}$ Min	$I_{s(50)}$ Max	Rock Type	Moisture Condition	Failure Mode
SC24-3532G	1	BH01, Depth: 3.04-3.09m	Axial	0.60	0.62	**	**	Sandstone	Dry	Valid
SC24-3532H	2	BH01, Depth: 4.45-4.50m	Axial	0.45	0.44	**	**	Sandstone	Dry	Valid
SC24-3532I	3	BH01, Depth: 5.80-5.85m	Axial	0.43	0.45	**	**	Sandstone	Dry	Valid
SC24-3532J	4	BH01, Depth: 6.83-6.88m	Axial	0.61	0.62	**	**	Sandstone	Dry	Valid
SC24-3532K	5	BH01, Depth: 7.75-7.80m	Axial	0.39	0.41	**	**	Sandstone	Dry	Valid
SC24-3532L	6	BH01, Depth: 9.80-9.85m	Axial	1.42	1.5	**	**	Sandstone	Dry	Valid
SC24-3532M	7	BH02, Depth: 1.75-1.80m	Axial	2.82	2.9	**	**	Sandstone	Dry	Valid
SC24-3532N	8	BH02, Depth: 3.40-3.45m	Axial	0.50	0.54	**	**	Sandstone	Dry	Valid
SC24-3532O	9	BH02, Depth: 4.76-4.81m	Axial	0.55	0.57	**	**	Sandstone	Dry	Valid
SC24-3532P	10	BH02, Depth: 6.49-6.54m	Axial	0.56	0.56	**	**	Sandstone	Dry	Valid
SC24-3532Q	11	BH02, Depth: 7.90-7.95m	Axial	0.44	0.44	**	**	Sandstone	Dry	Valid
SC24-3532R	12	BH02, Depth: 9.40-9.45m	Axial	1.03	1.1	**	**	Sandstone	Dry	Valid
SC24-3532S	13	BH03, Depth: 6.66-6.78m	Axial	2.37	2.5	**	**	Sandstone	Dry	Valid
SC24-3532T	14	BH03, Depth: 7.85-7.97m	Axial	0.57	0.62	**	**	Sandstone	Dry	Valid
SC24-3532U	15	BH03, Depth: 8.61-8.82m	Axial	0.31	0.33	**	**	Sandstone	Dry	Valid
SC24-3532V	16	BH03, Depth: 9.57-9.80m	Axial	0.48	0.52	**	**	Sandstone	Dry	Valid
SC24-3532W	17	BH03, Depth: 10.00-10.21m	Axial	0.55	0.60	**	**	Sandstone	Dry	Valid
SC24-3532X	18	BH04, Depth: 2.50-2.56m	Axial	0.32	0.35	**	**	Sandstone	Dry	Valid
SC24-3532Y	19	BH04, Depth: 3.60-3.65m	Axial	0.54	0.57	**	**	Sandstone	Dry	Valid
SC24-3532Z	20	BH04, Depth: 4.59-4.65m	Axial	0.39	0.42	**	**	Sandstone	Dry	Valid
SC24-3532AA	21	BH04, Depth: 5.72-5.77m	Axial	1.13	1.1	**	**	Sandstone	Dry	Valid
SC24-3532AB	22	BH04, Depth: 7.45-7.49m	Axial	0.13	0.13	**	**	Sandstone	Dry	Valid

Determination of Point Load (AS 4133.4.1)										
SC24-3532AC	23	BH04, Depth: 8.52-8.58m	Axial	1.06	1.2	**	**	Sandstone	Dry	Valid
SC24-3532AD	24	BH05, Depth: 1.71-1.76m	Axial	0.23	0.20	**	**	Sandstone	Dry	Valid
SC24-3532AE	25	BH05, Depth: 2.54-2.59m	Axial	0.45	0.46	**	**	Sandstone	Dry	Valid
SC24-3532AF	26	BH05, Depth: 3.65-3.70m	Axial	1.07	1.1	**	**	Sandstone	Dry	Valid
SC24-3532AG	27	BH05, Depth: 4.70-4.75m	Axial	0.51	0.52	**	**	Sandstone	Dry	Valid
SC24-3532AH	28	BH05, Depth: 5.59-5.64m	Axial	0.60	0.64	**	**	Sandstone	Dry	Valid
SC24-3532AI	29	BH05, Depth: 7.85-7.90m	Axial	0.87	0.89	**	**	Sandstone	Dry	Valid
SC24-3532AJ	30	BH05, Depth: 9.49-9.52m	Axial	0.74	0.76	**	**	Sandstone	Dry	Valid
SC24-3532AK	31	BH05, Depth: 10.83-10.88m	Axial	0.98	1.0	**	**	Sandstone	Dry	Valid
SC24-3532AL	32	BH05, Depth: 12.70-12.75m	Axial	0.75	0.78	**	**	Sandstone	Dry	Valid
SC24-3532AM	33	BH05, Depth: 14.80-14.85m	Axial	0.85	0.91	**	**	Sandstone	Dry	Valid
SC24-3532AN	34	BH06, Depth: 1.75-1.80m	Axial	0.58	0.61	**	**	Sandstone	Dry	Valid
SC24-3532AO	35	BH06, Depth: 3.61-3.66m	Axial	0.49	0.51	**	**	Sandstone	Dry	Valid
SC24-3532AP	36	BH06, Depth: 4.78-4.83m	Axial	0.47	0.51	**	**	Sandstone	Dry	Valid
SC24-3532AQ	37	BH06, Depth: 5.73-5.78m	Axial	0.30	0.30	**	**	Sandstone	Dry	Valid
SC24-3532AR	38	BH06, Depth: 6.34-6.39m	Axial	0.20	0.20	**	**	Sandstone	Dry	Valid
SC24-3532AS	39	BH06, Depth: 7.66-7.71m	Axial	2.13	2.2	**	**	Sandstone	Dry	Valid

CERTIFICATE OF ANALYSIS

Work Order	: **EM2401063**	Page	: 1 of 4
Client	: **INTRAX CONSULTING ENGINEERS**	Laboratory	: Environmental Division Melbourne
Contact	: GEOTECHNICAL CONSULTING	Contact	: Customer Services EM
Address	: LEVEL 4 469 LATROBE STREET MELBOURNE 3003	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61 3 8549 9600
Project	: 205892	Date Samples Received	: 24-Jan-2024 10:13
Order number	: 205892	Date Analysis Commenced	: 25-Jan-2024
C-O-C number	: ----	Issue Date	: 01-Feb-2024 18:05
Sampler	: Dave Fisher		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 6		
No. of samples analysed	: 6		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Jarwis Nheu	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC

General Comments

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

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

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

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

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

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

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

- Corrosion assessment for Concrete and Steel piles in soil per Australian Standard AS2159-2009 uses a combination of soil and groundwater data (Tables 6.4.2 C & 6.5.2 C). In the absence of groundwater data, assessment has been made against soil criteria only. Refer to AS2159-2009 section 6.4 for further interpretation of corrosion assessment. ALS is not NATA accredited for Corrosion Assessment comments
- EA167: Soil Condition A – High permeability soils (e.g. sands and gravels) which are in groundwater
- EA167: Soil Condition B – Low permeability soils (e.g. silts and clays) or all soils above groundwater
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01 0.4 - 1.0	BH02 0.4 - 1.0	BH03 1.0 - 1.5	BH04 0.2 - 1.0	BH05 0.1 - 0.7
			Sampling date / time	28-Nov-2023 00:00	18-Dec-2023 00:00	12-Dec-2023 00:00	28-Nov-2023 00:00	22-Nov-2023 00:00
Compound	CAS Number	LOR	Unit	EM2401063-001	EM2401063-002	EM2401063-003	EM2401063-004	EM2401063-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.9	5.2	5.6	5.6	5.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	112	35	422	32	89
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	11.4	13.2	12.4	13.3	10.9
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	8930	28600	2370	31200	11200
EA167: Corrosion Classification (per AS2159-2009)								
ø Exposure Classification - Concrete Piles Soil Condition A	----	-	-	Mild	Mild	Mild	Mild	Mild
ø Exposure Classification - Concrete Piles Soil Condition B	----	-	-	Non Aggressive	Non Aggressive	Non Aggressive	Non Aggressive	Non Aggressive
ø Exposure Classification - Steel Piles Soil Condition A	----	-	-	Non Aggressive	Non Aggressive	Mild	Non Aggressive	Non Aggressive
ø Exposure Classification - Steel Piles Soil Condition B	----	-	-	Non Aggressive	Non Aggressive	Non Aggressive	Non Aggressive	Non Aggressive
ED040S: Soluble Major Anions								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	120	40	320	40	90
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	50	10	450	<10	40

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH06 0.1 - 0.7	----	----	----	----
			Sampling date / time	27-Nov-2023 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM2401063-006	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.2**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**63**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**12.5**	----	----	----	----
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	**15900**	----	----	----	----
EA167: Corrosion Classification (per AS2159-2009)								
ø Exposure Classification - Concrete Piles Soil Condition A	----	-	-	**Mild**	----	----	----	----
ø Exposure Classification - Concrete Piles Soil Condition B	----	-	-	**Non Aggressive**	----	----	----	----
ø Exposure Classification - Steel Piles Soil Condition A	----	-	-	**Non Aggressive**	----	----	----	----
ø Exposure Classification - Steel Piles Soil Condition B	----	-	-	**Non Aggressive**	----	----	----	----
ED040S: Soluble Major Anions								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**40**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**20**	----	----	----	----