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Report on
Preliminary Geotechnical and Salinity Assessment

Proposed Rezoning - Belmore Road Precinct
South Creek West, Bringelly, NSW

Prepared for
CKDI Bringelly Pty Ltd

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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1. Introduction

Douglas Partners Pty Ltd (DP) was commissioned by CKDI Pty Ltd to undertake a Preliminary Geotechnical and Salinity Assessment for proposed rezoning purposes for the Belmore Road Precinct, part of South Creek West in Bringelly. The initial phase of assessment and site work was undertaken in accordance with DP's proposal MAC180379 dated 17 September 2020, with the latest revision carried out in accordance with our email proposal dated 14 September 2023.

A preliminary soil contamination assessment was also undertaken together with the geotechnical investigation, with results presented in a separate report entitled 'Preliminary Site Investigation (Contamination), Proposed Rezoning - Belmore Road Precinct, South Creek West, Bringelly, NSW'. This report has also been updated (DP document reference 92336.04.R.001.Rev2, dated 26 September 2023).

This report provides details on the works undertaken, together with general comments and recommendations to assist in making decisions regarding design and construction. Comments are also provided on the need for further geotechnical investigations likely to be required for later stages of the development.

2. Background

It is understood that changes have been made to the development's indicative layout plan (ILP) and boundary following the previous revision of this report, to address comments from Council and public submissions. A summary of the proposed changes to the previous ILP (as supplied by the project's planner Urbis Pty Ltd, and included below for co-ordination across the project) is:

- Updates to the road network including:
  - Introduction of additional 'green streets' into the ILP;
  - Replacement of the landscape buffer along The Northern Road with a new street typology;
  - Additional north-south lots across the Precinct;
  - Removal of collector road between the two southern playing fields;
  - Introduction of laneways west of the northern playing fields; and
  - Removal of sub-arterial road to reflect Lowes Creek Maryland gazetted proposal.
- Updates to the Wentworth Road Investigation Area including:
  - Introduction of employment uses surrounding the local heritage item;
  - Introduction of Low-Density 'Band 1' residential; and
  - Introduction of an 8,000 m^2 local park.

- Updates to open space including:
  - Introduction of a new category 'Open Space – Tree Retention' (where tree retention is prioritised);
  - Introduction of a local park on the RMS landholdings north of Belmore Road;
  - Relocate and increase the size of 'Local Park 7' from 4,000 m^2 to 5,000 m^2;
  - Increase the size of 'Local Park 8' from 6,000 m^2 to 7,000 m^2; and
  - Introduction of a linear park in the south-west portion of the site, connecting the ridgeline to the riparian corridor.
- Changes to residential areas including:
  - Removal of any residential land lots which are below the peak maximum flood (PMF) level;
  - Introduction of additional medium density residential land lots on the RMS landholdings south of Belmore Road;
  - Replacement of Low-Density 'Band 2' residential with Medium Density 'Band 1' residential, north of the northern playing fields; and
  - Introduction of 'Environmental Living' lots on the south-western ridgeline.
- Relocation of the future educational establishment onto the proponent's landholdings; and
- Introduction of a small retail centre within the south-western portion of the site.

Although the footprint of the revised ILP has changed slightly, with some land added to the north-western margin of the development area whilst other small portions of land have been removed adjacent to the eastern boundary, the overall development area covered by the ILP is essentially unchanged at about 187 hectares.

A summary of the changes to land Lots incorporated within the ILP (based on data obtained from the NSW Government Spatial Services (NSW Government, 2023)) is:

- Lots removed:
  - Lot 501 in DP1219184;
  - Lot 19 in DP1216926;
  - Lot 18 in DP1216926;
  - Lot 17 in DP 1216926;
  - Lot 16 in DP1216926;
  - Lot 15 in DP1216926; and
  - Part Lot B in DP414758.
- Lots added (adjacent to the north-western site boundary):
  - Lot 14 in DP1222679;
  - Lot 15 in DP1222679;
  - Lot 4 in DP173593;
  - Lot 17 in DP1222679;
  - Lot 18 in DP1222679; and
  - Lot 2 in DP1280952.

- Lots returned (formerly associated with roads):
  - Lot 21 in DP1216926; and
  - Lot 20 in DP1216926; and

3. Scope of Works

The preliminary geotechnical and salinity assessment was based on the following scope of works:

- A review of aerial photography and available mapping across the entire precinct area;
- Site investigations of the southern portion of the site (where on-site access was available), which comprised:
  - A site walkover by a senior environmental / geotechnical engineer to map areas of potential slope instability, erosion risks and other geotechnical constraints;
  - Excavation of twelve test pits and drilling of four boreholes across the proposed development area in which groundwater monitoring wells were installed;
  - Recovery of disturbed soil and rock samples from test pits, to assist with strata identification and for laboratory testing; and
  - Laboratory testing of selected samples for the assessment of a range of geotechnical properties.
- Preparation of a report outlining the scope of works undertaken, together with field work results and recommendations based on test results from the southern portion of the site (which are expected to be relevant across the broader site).

4. Site Description

The site consists of 59 allotments (including Part Lots) comprising a total combined area of approximately 187 hectares with maximum north-south and east-west dimensions of 2100 m and 1700 m respectively. At the time of our investigation, the southern portion of the site was mostly covered with grass, with dense vegetation / trees present in areas that were mostly within the central and western parts of the site. Several farm dams were present scattered across the site. Residential dwellings and sheds were observed in the northern portion of the site, which has a fragmented land ownership. Several local roads are used to access these properties. The subject site is shown on Drawing 1 within Appendix C.

5. Regional Topography, Geology and Hydrogeology

5.1 Site Geology

Reference to the Penrith 1:100 000 Geological Map (Herbert & Smith, 1991) indicates that the site is underlain by the Bringelly Shale Formation (mapping unit 'Rwb') belonging to the Wianamatta Group of Triassic age. Bringelly Shale Formation typically comprises shale, carbonaceous claystone, claystone,

laminite, fine to medium-grained lithic sandstone, rare coal and tuff. The published geological mapping for the site is superimposed onto the revised ILP boundary presented as Drawing 2 in Appendix C.

The results of the investigation were generally consistent with the broad-scale geological mapping, with shale, siltstone and sandstone encountered in those test pits and boreholes that intersected rock. Sandstone outcrops were also observed at various locations across the site.

5.2 Topography

Reference to the Penrith 1:100 000 Soils Landscape sheet (Bannerman & Hazelton, 2011) indicates that the site is located on the residual Blacktown soil landscape (mapping unit 'bt'), with the western portion of the site located on the erosional Luddenham soil landscape (mapping unit 'lu'). The relevant portion of the Soils Landscape sheet is superimposed onto the revised ILP boundary presented as Drawing 3 in Appendix C.

The regional topography of the site is typically shown as gently undulating rises with broad rounded crests and ridges with gently inclined slopes, except to the south-west of the site which encompasses undulating rolling low hills with narrow ridges, hillcrests and valleys. The site generally slopes towards the east, with some gentle undulation towards a south-west to north-east trending creekline which traverses through the central portion of the site. Site levels fall towards the east, from an elevation of about RL134 m (relative to the Australian Height Datum (AHD)) to an elevation of about RL74 m near the south-western site boundary and adjacent to The Northern Road. The relevant contour plan is presented as Drawing 4 in Appendix C.

The Blacktown soil landscape covers most of the site, whilst the Luddenham soil landscape is associated with the steeper areas within the south-western portion of the site.

The Blacktown soil landscape is characterised by gently undulating rises on Wianamatta Group shales with slopes usually <5% and local relief to 30 m. Soils are shallow to moderately deep (<1.0 m) red and brown podzolic soils on crests, upper slopes and well drained areas, deep (1.5 - 3.0 m) yellow podzolic soils and soloths on lower slopes and in areas of poor drainage. Soils are typically moderately reactive with low fertility, have poor soil drainage and high plasticity subsoils.

The Luddenham soil landscape is characterised by undulating to rolling low hills on Wianamatta Group shales with slopes usually 5% to 20% and local relief of 50 m to 80 m. Soils are shallow to moderately deep (<1.0 m) dark or red podzolic soils on crests and upper slopes and moderately deep (<1.5 m) yellow podzolic soils on lower slopes and drainage lines. Soils are typically moderately reactive and susceptible to erosion.

5.3 Hydrogeology

A search of the publicly available registered groundwater bore database indicate that there are three registered groundwater bores within 1 km of the site. The three groundwater bores indicate that the depth to groundwater typically ranges from 15 m to 20 m below the ground surface level.

Based on the regional topography and the inferred flow direction of nearby watercourses, the anticipated flow direction of groundwater beneath the site is towards the east and South Creek, which is the likely receiving surface water body.

Some general features of the hydrogeology of Western Sydney considered to be relevant to this site (from McNally (2004)) are as follows:

- The shale terrain of much of Western Sydney is known for saline groundwater, resulting either from the release of connate salt in shales of marine origin or from the accumulation of windblown sea salt;
- The salt is concentrated by evapo-transpiration and often is most concentrated in the 'B-horizon' of residual soils;
- In areas of urban development, increased soil salinity can lead to damage of building foundations, lower courses of brickwork, road surfaces and underground services, where these coincide with the saline zone or where salts are re-mobilised due to a change in groundwater levels; and
- Seasonal groundwater level changes of 1 m to 2 m can occur in a shallow regolith aquifer or a deeper shale aquifer due to natural influences.

5.4 Soil Salinity

The former Department of Environment Climate Change (DECC), now the NSW Environment Protection Authority (EPA), infers a low salinity potential for the site on their salinity hazard map extracted from the Soil and Land Resources of the Hawkesbury Nepean Catchment (DECC, 2008).

Groundwater within the Wianamatta Group is typically brackish to saline, with total dissolved solids (TDS) in the range 4000 mg/L to 5000 mg/L (but with cases of TDS reported up to 31,750 mg/L). The dominant ions are typically sodium and chloride and the water being generally unsuitable for livestock or irrigation.

Western Sydney soil salinity mapping (NSW Department of Infrastructure, Planning and Natural Resources, 2002) indicates the site is bordered by areas of known salinity potential to the west and to a lesser extent to the east. An area of mapped high salinity potential runs through the site along the creek line whereas the remainder of the site is considered to have a moderate salinity potential.

Approximate salinity potential boundaries, as depicted on the salinity potential map, are presented on Drawing 5 in Appendix C. The mapping is based on soil type, surface level and general groundwater considerations but is not generally 'ground-truthed', hence actual soil salinity needs to be assessed to confirm the indicated potential salinity mapping.

6. Field Work Methodology

A site walkover was undertaken by a senior DP geotechnical /environmental engineer to identify both areas of potentially instability, and areas with the potential to be affected by salinity and/or erosion. Following the walkover, an investigation strategy was proposed to undertake a preliminary assessment of the subsurface conditions.

Surface and subsurface investigations included:

- Excavation of 12 test pits (Pits 1 – 12) across the accessible (southern) section of site, to provide advice on geotechnical matters;
- Drilling and installation of 4 groundwater wells (Bores 201 – 204) across the accessible (southern) portion of the site;
- Dynamic cone penetrometer (DCP) tests adjacent to the test pit locations, to assist with assessment of in-situ soil strength of near-surface soils; and
- Recovery of disturbed and undisturbed soil samples from test pits for geotechnical, contamination and soil salinity laboratory testing.

The test pits were excavated by a John Deere 315SE backhoe fitted with a toothed bucket (450 mm wide). The field work was undertaken between 28 and 31 January 2020. The test pit excavations were undertaken to a maximum depth of 3.0 m or prior refusal on inferred weathered bedrock. The test pits were reinstated upon completion by backfilling the excavated soils in layers and tamping them with the excavator bucket.

Geotechnical sampling from the test pits included the recovery of disturbed samples and 'undisturbed' 50 mm diameter tube samples, to aid visual classification and logging. Selected samples were submitted to a laboratory to assess a range of geotechnical engineering parameters.

The boreholes were drilled using a track-mounted drill rig on 20 February 2020. The boreholes were auger drilled to target depths at all locations, with the exception of Borehole 202 where a rotary air drilling method was used to penetrate into the weathered bedrock. Groundwater wells were installed at all the borehole locations to assist with future groundwater measurements and sampling, as required.

The coordinates of the test pits and borehole locations were recorded using a differential GPS receiver and a hand-held GPS unit. Horizontal positioning was referenced to the Map Grid of Australia 1994 (MGA94), Zone 56 datum. Vertical positioning was referenced to reduced levels (RL) relative to AHD.

7. Field Work Results

7.1 Subsurface Conditions

The field work was undertaken on Lot 6 (the southern-most lot, for which access was available). Descriptions of the subsurface conditions encountered in the boreholes and test pits together with the type of samples taken, sampling intervals, and the results of in-situ tests are presented on the logs in Appendix D. These logs should be read in conjunction with the 'Notes About This Report' and accompanying notes on soil and rock classification, sampling methods, and symbols & abbreviations included within Appendix B.

The subsurface conditions encountered in the test pit excavations (Locations 1 to 12) and boreholes (Locations 201 to 204) are considered to be generally consistent with the conditions anticipated from the geological maps. A summary of the subsurface conditions encountered is provided in Table 1.

Table 1: Summary of Subsurface Conditions

Unit	Inferred Stratigraphic Unit	Approx. Depth to Base of Unit (m bgl)	Typical Material Description
1	Topsoil	0.05 – 0.3	Silty Clay Pale brown / brown / grey / dark brown, trace gravel and sand, grass cover at surface
2	Residual Clay	0.7 – 3.5	Silty Clay Red mottled grey / brown / grey / red brown / pale brown, trace gravel, generally very stiff to hard
3	Extremely Weathered Shale Bringelly Shale Formation	1.9 – 3.0 (1)	Recovered as Silty Clay Pale grey / grey / red, hard, with occasional highly weathered, very low strength shale bands,
4	Weathered Shale Bringelly Shale Formation	0.9 – 7.3 (2)	Shale Brown and grey with iron staining, highly weathered, very low to low strength

Notes: 1) Not encountered in Pits 3, 5, 7, 8 and 12 or Bores 201 – 203.
2) Not encountered in Pits 6 and 11.

7.2 Surface Water and Groundwater

No free groundwater was observed in the test pit excavations at locations TP 1 to 12, a short time following completion of excavation and prior to backfilling. It should be noted that the pits were immediately backfilled following excavation which precluded any longer-term assessment of any groundwater that might be present.

Given the local geology (i.e: Bringelly Shale), the groundwater in the fractured rock beneath the site is anticipated to be brackish to saline and low groundwater flow is likely to be dominated by fracture flow with resultant low yields (typically < 1 L/s) in bores. Accordingly, it is considered unlikely there would be significant potential beneficial uses of the groundwater.

The standpipes within Bores 201 to 204 were installed on 20 February 2020. The wells were dipped on the same day and standing groundwater was only noted at the base of the standpipe installed at Bore 204.

It should be noted that groundwater levels can be affected by factors such as soil permeability, changes in drainage conditions, seasonal fluctuations, climatic effects and other factors.

8. Laboratory Testing

8.1 Soil Properties

Selected soil and weathered rock samples were collected from the test pits during the field investigation and submitted to DP's NATA-accredited laboratory for testing. Test reports are provided in Appendix E and the results are summarised in Tables 2 and 3.

Table 2: Laboratory Test Results for Field Moisture, Atterberg limits and Linear Shrinkage, Shrink-Swell index and Emerson Class number

Pit	Depth (m)	FMC	PL (%)	LL (%)	PI (%)	Linear shrinkage (%)	I_{ss} (%/ΔpF)	ECN	Material
1	0.5	-	-	-	-	-	-	3	Silty Clay
1	1.2	-	-	-	-	-	1.3	-	Silty Clay
2	0.5	-	-	-	-	-	-	2	Silty Clay
3	0.5	-	22	63	41	15	-	-	Silty Clay
3	1.5	15.1		-	-	-	-	2	Silty Clay
4	0-0.2	-	-	-	-	-	-	2	Silty Clay
4	0.5-0.9	-	-	-	-	-	1.0	-	Silty Clay
5	0.5	-	-	-	-	-	-	2	Silty Clay
6	1	14.7	17	57	40	14	-	-	Silty Clay
6	1.5	-	-	-	-	-	-	2	Silty Clay
7	0.5	-	-	-	-	-	-	5	Silty Clay
8	0.5	-	-	-	-	-	-	2	Silty Clay
8	0.5-0.9	-	-	-	-	-	1.1	-	Silty Clay
9	0.5	-	-	-	-	-	-	3	Silty Clay
9	1-1.4	-	-	-	-	-	4.2	-	Silty Clay
9	1.5	-	-	-	-	-	-	2	Silty Clay
10	0.5	13.3	21	60	39	13	-	2	Silty Clay
10	0.5-0.9	-	-	-	-	-	2.3	2	Silty Clay
11	0.5	-	-	-	-	-	-	2	Silty Clay
12	0.5	-	-	-	-	-	-	3	Silty Clay
12	1-1.4	-	-	-	-	-	1.9	3	Silty Clay

Where: FMC = Field Moisture Content; I_{SS} = Shrink-swell Index; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; ECN = Emerson Class Number

The laboratory test results for the tested samples are consistent with the clayey nature of the soils at the site and indicate soil classifications (in accordance with the unified soil classification system) corresponding with inorganic clays of high plasticity (CH).

The Emerson Class Number (ECN) for a soil relates to the potential for the soil to slake and disperse. Higher ECN test results correspond to soils with a lower tendency to disperse, with ECN results of 5 or 6 indicating a tendency for the soil to slake with a low susceptibility to dispersion whilst ECN results of 2 or 3 indicating a tendency for the soil to slake with some dispersion (possibly more when remoulded).

Testing for California bearing ratio (CBR: 4-day soak) was also undertaken on four samples to assist with pavement design. The test results are presented in Table 3.

Table 3: California Bearing Ratio Test Results (4-day soak)

Pit No	Depth (m)	FMC (%)	OMC (%)	MDD (t/m^3)	Swell (%)	CBR (%)	Material
2	0.5	10.9	14.5	1.78	5.5	2	Silty Clay
7	1.0	5.0	12.5	1.92	0.5	20	Silty Clay with gravel
11	0.5	12.7	18.5	1.69	0.5	8	Silty Clay

Where: FMC = Field Moisture Content OMC = Optimum Moisture Content
MDD = Maximum Dry Density

The test results presented in Table 3 indicate a broad range for CBR, therefore some variability in subgrade CBR should be expected across the site. It is noted that the Pit 7 sample returned a CBR of 20%, which is unusually high for a predominantly clay soil. It is considered that this test sample may have been affected by gravel within the sample, resulting in a test results higher than expected.

The range in CBR swell values (0.5% to 5.5%) is also very broad, indicating variability in the subgrade soils and the potential for expansive subgrade conditions in some areas.

8.2 Soil Salinity

Soil salinity is typically assessed with respect to electrical conductivity of a 1:5 (soil:water) extract ($EC_{1:5}$). This value can be converted to EC_e (electrical conductivity of a saturated extract) by multiplication with a factor dependent of soil texture ranging between 6 (heavy clays) and 17 (sands). In accordance with the methods set out in (Richards, 1954) and (Hazelton & Murphy, 1992), soil salinity has been classified on the basis of EC_e. The salinity classes and their implications on agriculture are summarised in Table 4.

Table 4: Soil Salinity Classification

Class	EC_e (dS/m)	Implication
Non Saline	<2	Salinity effects mostly negligible
Slightly Saline	2 – 4	Yields of sensitive crops affected
Moderately Saline	4 – 8	Yields of many crops affected

Class	EC_e (dS/m)	Implication
Very Saline	8 – 16	Only tolerant crops yield satisfactorily
Highly Saline	>16	Only a few very tolerant crops yield satisfactorily

Following the field investigation, 13 soil samples were submitted to Envirolab Services Pty Ltd (Envirolab), a NATA-accredited facility for soil salinity testing. Samples tested were generally in accordance with the guidelines presented in the Site Investigations for Urban Salinity booklet (Department of Land and Water Conservation, 2002).

Soil tests were performed for their physical and chemical properties and included pH, electrical conductivity, with soil texture classification undertaken internally by DP's laboratory staff.

The detailed test reports are presented in Appendix F and a summary of the test results is presented in Table 5.

Table 5: Laboratory Test Results for Salinity

Test Pit No.	Depth (m)	$EC_{1:5}$ (dS/m)	Texture Class	EC_e (dS/m)	pHw (1:5)	Aggr. to Concrete – from sample pH	Aggr. to Steel – from sample resistivity	Salinity Comments
TP1	0.5	109	6	0.654	7.5	Non-Aggressive	Non-Aggressive	Non-Saline
TP1	1.5	593	6	3.558	6.4	Non-Aggressive	Mild	Slightly Saline
TP1	2.5	-	8	-	-	-	-	-
TP3	0.5	78.9	7	0.552	7.0	Non-Aggressive	Non-Aggressive	Non-Saline
TP3	1.5	229	7	1.603	6.3	Non-Aggressive	Non-Aggressive	Non-Saline
TP5	0.5	117.2	7	0.820	6.4	Non-Aggressive	Non-Aggressive	Non-Saline
TP7	0.5	67.4	6	0.404	6.2	Non-Aggressive	Non-Aggressive	Non-Saline
TP9	0.5	217	7	1.519	7.7	Non-Aggressive	Non-Aggressive	Non-Saline
TP9	1.5	412	7	2.884	7.0	Non-Aggressive	Non-Aggressive	Slightly Saline
TP9	2.5	489	7	3.423	6.6	Non-Aggressive	Non-Aggressive	Slightly Saline
TP11	0.5	150.5	6	0.903	6.3	Non-Aggressive	Non-Aggressive	Non-Saline
TP11	1.5	483	6	2.898	7.3	Non-Aggressive	Non-Aggressive	Slightly Saline
TP11	2.5	515	6	3.090	6.8	Non-Aggressive	Mild	Slightly Saline

Where $EC_{1:5}$ = Electrical Conductivity pHw = pH in water
EC_e = Electrical Conductivity corrected for soil texture

Based on the limited extent of testing undertaken, the results indicate that *non-saline* to *slightly-saline* conditions and *non-aggressive* to *mildly aggressive* conditions to concrete and steel can generally be expected across the site.

9. Geotechnical Discussion

9.1 Site Classification

Classification of individual lots or residential building areas within the site should comply with the requirements of Australian Standard AS 2870 *"Residential Slabs and Footings"* (AS 2870, 2011). Individual allotments should be subject to specific site investigations to enable classification and assessment based on the actual subsurface conditions at the appropriate time.

The site classification for a particular allotment will depend on the presence and thickness of fill, the reactivity of the fill materials and natural clays, and the depth to rock. To assist with the preliminary assessment of reactivity, five shrink-swell tests were performed on selected samples of the natural clays from the southern portion of the site. The test results generally ranged from a shrink-swell index of 1% to 2.3%, with one result of 4.2%, which is indicative of considerable variation across the site. These results are considered generally typical of the region, though overall slightly lower than usual.

Based on the predominant clay subsurface profile encountered in the boreholes and the shrink-swell test results, site classifications may range from 'Class M' (moderately reactive) to 'Class H2' (highly reactive).

Further investigation and testing would be required to delineate between the various classifications for individual lots.

Areas with existing (uncontrolled) fill, such as that within the existing dam embankments, will be classified as 'Class P', which requires the design of footings based on engineering principles. Generally, footings would be founded beneath the fill on 'Class P' sites. Such sites may be reclassified if the existing fill were to be removed and/or replaced with engineered fill (i.e. placed and compacted in controlled under full-time 'Level 1' earthworks supervision in accordance with Australian Standard AS3798: AS 3798,2007). The revised site classification will depend on both the material used as fill and its thickness, and should be subject to further assessment once details are known.

Residential lots on areas of colluvium (steeper areas and hillside lots) will also likely receive a 'Class P' classification.

Site classification should consider the effects of site works in accordance with Section 2.5 of Australian Standard AS2870 (AS 2870, 2011), where cutting or filling is proposed for a particular allotment. The influence of such works can result in more severe classifications and therefore specific geotechnical advice should be sought.

It should be noted that the use of standard footings as presented in AS2870 are only applicable for footings founded within the natural ground (or engineered fill), and for buildings of one or two storeys with a loading and construction style as for a residential dwelling. For larger, more highly loaded structures, the standard footing systems presented in AS2870 are not considered to be appropriate.

Design of a footing system using engineering principles would be required, which take into account the structural loads and the subsurface conditions.

9.2 Slope Stability

Based on our observations and interpretation of the published topographic contours for the site (refer Drawing 6), the site typically comprises gently rolling slopes typically ranging from 1 to 5 degrees with the exception the south-eastern and south-western portions of the site. Slope angles for the south-eastern portion of the site appears to gently increase between 5 and 10 degrees, which should be able to be managed by standard engineering design. The south-western portion of the site is noted to be reasonably steep, with slope angles ranging from 15 to 25 degrees. Observations made during our site walkover was generally consistent with published data. It is recommended that further investigation be undertaken particularly for the western portions of the site as conceptual planning proceeds, to identify whether there are any areas of instability which may need to be remediated prior to development.

9.3 Erosion Potential

No obvious signs of significant active soil erosion were identified at the site during the site walkover inspection. The laboratory testing showed Emerson Class Number test results generally in the range 2 to 3, indicating the presence of dispersive soils that could be subject to erosion.

Given the potential of the site soils to erode, any development should avoid the construction of landforms that create a concentrated overland flow of surface waters. As this is not always possible, the following measures could be adopted to reduce the risk of soil erosion:

- Placement of fill within overland flow paths using select materials (i.e.: non-dispersive or least erodible), placed under controlled conditions;
- Provision of a temporary surface cover within overland flow paths (e.g.: biodegradable matting that is pegged in place) during the period of gully floor revegetation;
- Construction of channel lining in sections of rapid change in gully floor grade;
- Collection and discharge of water flows through a piped network, where appropriate; and
- The re-establishment of an appropriate vegetated zone to protect the ground surface over the longer term.

It is considered that the erosion hazard within the areas proposed for urban development could be managed by good engineering and land management practices.

9.4 Preliminary Soil Salinity and Aggressivity Assessment

The laboratory testing conducted indicates that the subsurface materials within the southern portion of the site are non-saline to slightly saline and non-aggressive to mildly aggressive to concrete and steel (AS 2159, 2009). The saline and aggressive soils are typical of the region and can be managed using

good engineering practice. Further salinity assessment will be required prior to Development Application for individual stages.

9.5 Site Preparation and Earthworks

9.5.1 Topsoil

Topsoil is relatively thin across the southern portion of the site, typically ranging in thickness between 0.05 m and 0.2 m (below the existing ground surface). Topsoil stripping should be relatively easily managed during bulk earthworks, and is unlikely to result in generation of significant excess material. Stripping operations should be undertaken under the guidance of a DP geotechnial engineer to assist with the delineation of the extent and depth of topsoil to be removed prior to the commencement of bulk earthworks.

9.5.2 Bedrock

Depth to the top of rock across the southern portion of the site was noted to be quite variable, typically ranging between 0.7 m and 3 m below the existing ground surface. Deeper soil profiles and significantly deeper weathering profiles were encountered at some test locations, however, these areas could not be clearly demarcated due to the limited number of test locations at this stage of the development. Generally, it is expected that cut-to-fill earthworks in these areas could be undertaken using conventional earthmoving equipment and, possibly, light ripping with small dozers (D6 or larger) in the deeper areas or where sandstone bands are present.

Several outcrops were also identified closer to the creek lines where thinner soil profiles and higher rock strengths (often interbedded with sandstone) are anticipated. Ripping or impact breakers may be required to loosen the rock in these areas prior to bulk excavation. Ripping may generate oversize rock which may need to be broken down using pneumatic hammers or crushing plant, prior to re-use as site-won fill. Oversize rock generated from Wianamatta Shale is generally not suitable to use as backfill for retaining walls or for structural fill, due to its propensity to degrade and weather over time. Further investigation of rock depth and rippability should be undertaken to inform the preparation of grading plans for the site, especially in the northern areas of the site.

9.5.3 Site Preparation

Site preparation for the construction of structures and pavements should include the removal of topsoils and other deleterious materials from the proposed development areas.

In areas where placement of fill material is required, the stripped surfaces should be benched to facilitate near-horizontal fill placement and test rolled in the presence of a DP geotechnical engineer. Any areas exhibiting significant deflections during test rolling should be rectified by excavation of the weak material and replacement with low plasticity fill material, placed in near-horizontal layers no thicker than 250 mm compacted thickness. Each layer should be compacted to a minimum dry density ratio of 98% (but no greater than 102%), relative to standard compaction with placement moisture contents maintained within 2% of standard optimum. In areas of pavement construction, the upper 0.5 m should be compacted to achieve a minimum dry density ratio of 100% relative to Standard compaction, with placement moisture contents similarly maintained.

To validate site classifications, field inspections and in situ testing of future earthworks should be undertaken in order to satisfy the requirements of 'Level 1' Inspection and Testing as defined in AS 3798 – 2007. It should be noted that 'Level 1' inspection and testing requires the full-time presence of an earthworks laboratory technician during all aspects of the earthworks program.

Batters required for pavement construction should be formed no steeper than 3H:1V in the residual clays and in any engineered fill material. All batters should be protected against erosion, with toe and spoon drains constructed to control surface flows and minimise flows down the batter slopes.

If embankments are proposed for use as water quality control ponds, then the results of testing completed to date indicates that the site soils may be suitable for re-use as embankment materials, subject to further testing of sodicity and erosion potential. Preliminary design of detention basins (i.e: short-term storage only) could be dimensioned with maximum batter slopes of 4H:1V, with allowance made for the results of erosion control (such as topsoiling and turfing) if soils with an ECN of less than 4 are used. Subject to design permeability requirements, the use of liners on both the embankments and within parts of the reservoir area may also be necessary.

Site observations have indicated the presence of silty topsoils and silty clays, which could be adversely affected by periods of wet weather. Whilst these soils are typically of a stiff to very stiff consistency when dry, they can rapidly lose strength during rainfall and subsequent partial saturation, and result in difficult trafficability conditions. As a result, surface drainage that directs runoff away from work areas should be installed prior to construction, possibly in conjunction with the designation of construction equipment haul routes to minimise trafficking of stripped areas.

Conventional sediment and erosion control measures should be implemented during the construction phase, with exposed surfaces to be covered with topsoil and vegetated as soon as practicable following the completion of earthworks.

9.6 Pavements

Due to the variability of CBR test results and the limited amount of testing of subgrade materials across the site, detailed pavement investigation will be required for DP to provide recommendations on and to attempt to optimise pavement thicknesses. Pavement thickness design should be undertaken during detailed subdivision design following a detailed site investigation, however, for preliminary assessment purposes a subgrade design CBR of 2% could be adopted. The test results indicate expansive subgrade conditions in some areas, which should be confirmed with further testing. Pavements on expansive subgrades can deteriorate due to environmental effects. To improve the performance of pavements on expansive subgrades, a layer of low permeability capping material could be placed over the subgrade, together with good drainage control and care with landscaping.

10. Further Investigation

The results of the land capability assessment to date have indicated that development of the site is geotechnically feasible, and that from a geotechnical point of view the land is suitable for rezoning for residential purposes. It is considered that testing to date has only been completed for the southern portion of the site. Further investigation will be required as the project progresses to development application, with additional investigation of the fragmented lot ownership areas to be undertaken well in advance of development applications.

Additional investigation of the steep hillside slopes within the south-western portion of the site will be required as planning continues, to assess the extent of engineering works required to stabilise the hill slopes in this area. Mapping of areas of colluvium (in and adjacent to steeper areas of the site) will also be required to determine the extent and characteristics of these materials, which will need to be considered for the bulk earthworks methodology.

Additional work will also be required prior to the project's construction phase. Specific investigation would typically be undertaken at the appropriate development application or construction certificate stage and would include (but not necessarily be limited to):

- Further rock depth and rippability assessment;
- Additional testing of site soils for erosion and dispersion for the detailed design and construction of future water bodies, and the ability of the soils to be used as clay liners (or similar);
- Detailed geotechnical investigations on a stage-by-stage basis to determine pavement thickness designs and lot classifications, as well as stage-specific issues, such as deep excavations and construction of roads, dwellings/structures on steeper landforms and crests; and
- Salinity Investigations on a stage-by-stage basis, prior to submission of development application(s).

11. References

AS 2159. (2009). *Piling - Design and Installation.* Standards Australia.

AS 2870. (2011). *Residential Slabs and Footings.* Standards Australia.

AS 3798. (2007). *Guidelines on Earthworks for Commercial and Residential Developments.* Standards Australia.

Bannerman, S. M., & Hazelton, P. A. (2011). *Soil Landscapes of the Penrith 1:100,000 Sheet report.* Office of Environment and Heritage, Sydney.

DECC, N. (2008). *Soil and Land Resources of the Hawkesbury - Nepean Catchment, digital dataset.* Sydney, Australia: NSW Department of Environmental and Climage Change.

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

Hazelton, P. A., & Murphy, B. W. (1992). *What do all the numbers mean? A Guide for the Interpretation of Soil Test Results.* Department of Conservation and Land Management, Sydney.

Herbert, C., & Smith, V. (1991). *Penrith 1:100,000 Geology Sheet, 1st edition.* Geological Survey of New South Wales, Sydney.

McNally, G. (2004). Shale, Salinity and Groundwater in Western Sydney. *Australian Geomechanics, Vol 39 No 3*, 107-121.

NSW Department of Infrastructure, Planning and Natural Resources. (2002). *Map of Salinity Potential in Western Sydney.*

NSW Government. (2023, September). *NSW Government Spatial Services*. Retrieved from https://maps.six.nsw.gov.au/

Richards, L. A. (1954). *Diagnosis of Saline and Alkaline Soils.* Washington D.C: US Department of Agriculture.

12. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at the Belmore Road Precinct, Bringelly, NSW, in accordance with DP's proposal MAC200294 dated 17 September 2020 and acceptance received from Tank Tan dated 17 September 2020, and our email proposal dated 14 September 2023. The work was carried out under DP's Conditions of Engagement.

This report is provided for the exclusive use of CKDI Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during the site investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life.

This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical and groundwater components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

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Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Notes on Sampling Methods
Notes on Soil Descriptions
Notes on Symbols and Abbreviations

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with 'Mix of Soil and Cobbles/Boulders' with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- 'Moist, dry of plastic limit' or 'w <PL' (i.e. hard and friable or powdery).
- 'Moist, near plastic limit' or 'w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- 'Moist, wet of plastic limit' or 'w >PL' (i.e. soils usually weakened and free water forms on the hands when handling).
- 'Wet' or 'w ≈LL' (i.e. near the liquid limit).
- 'Wet' or 'w >LL' (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive Strength MPa	Point Load Index * $Is_{(50)}$ MPa
Very low	VL	0.6 - 2	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Medium	M	6 - 20	0.3 - 1.0
High	H	20 - 60	1 - 3
Very high	VH	60 - 200	3 - 10
Extremely high	EH	>200	>10

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	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.
Extremely weathered	XW	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
Highly weathered	HW	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. 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.
Moderately weathered	MW	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.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base

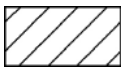

Concrete


Filling

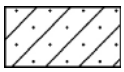
Soils

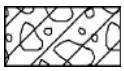

Topsoil

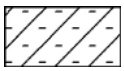

Peat


Clay


Silty clay


Sandy clay

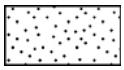

Gravelly clay


Shaly clay

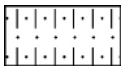

Silt


Clayey silt


Sandy silt

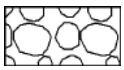

Sand

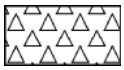

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

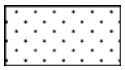

Talus

Sedimentary Rocks

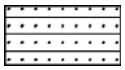

Boulder conglomerate

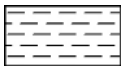

Conglomerate


Conglomeratic sandstone

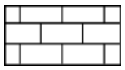

Sandstone


Siltstone

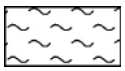

Laminite

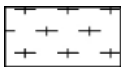

Mudstone, claystone, shale

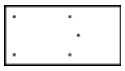

Coal


Limestone

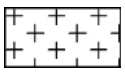
Metamorphic Rocks

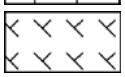

Slate, phyllite, schist

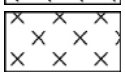

Gneiss

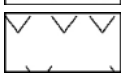

Quartzite

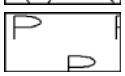
Igneous Rocks


Granite


Dolerite, basalt, andesite

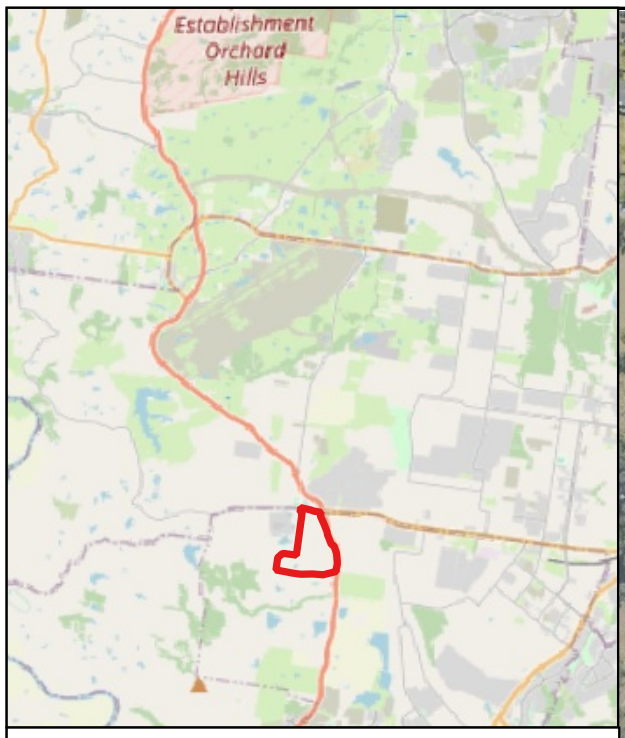

Dacite, epidote


Tuff, breccia


Porphyry

Appendix C

Drawings



Site Locality

Greendale Road

The Northern Road

1 201
2
3
4
5
6
7
8
202
9
203
10
11 204
12

Legend
- Site Boundary
- Borehole Locations
- Test Pit Locations

0 100 200 300 400 m

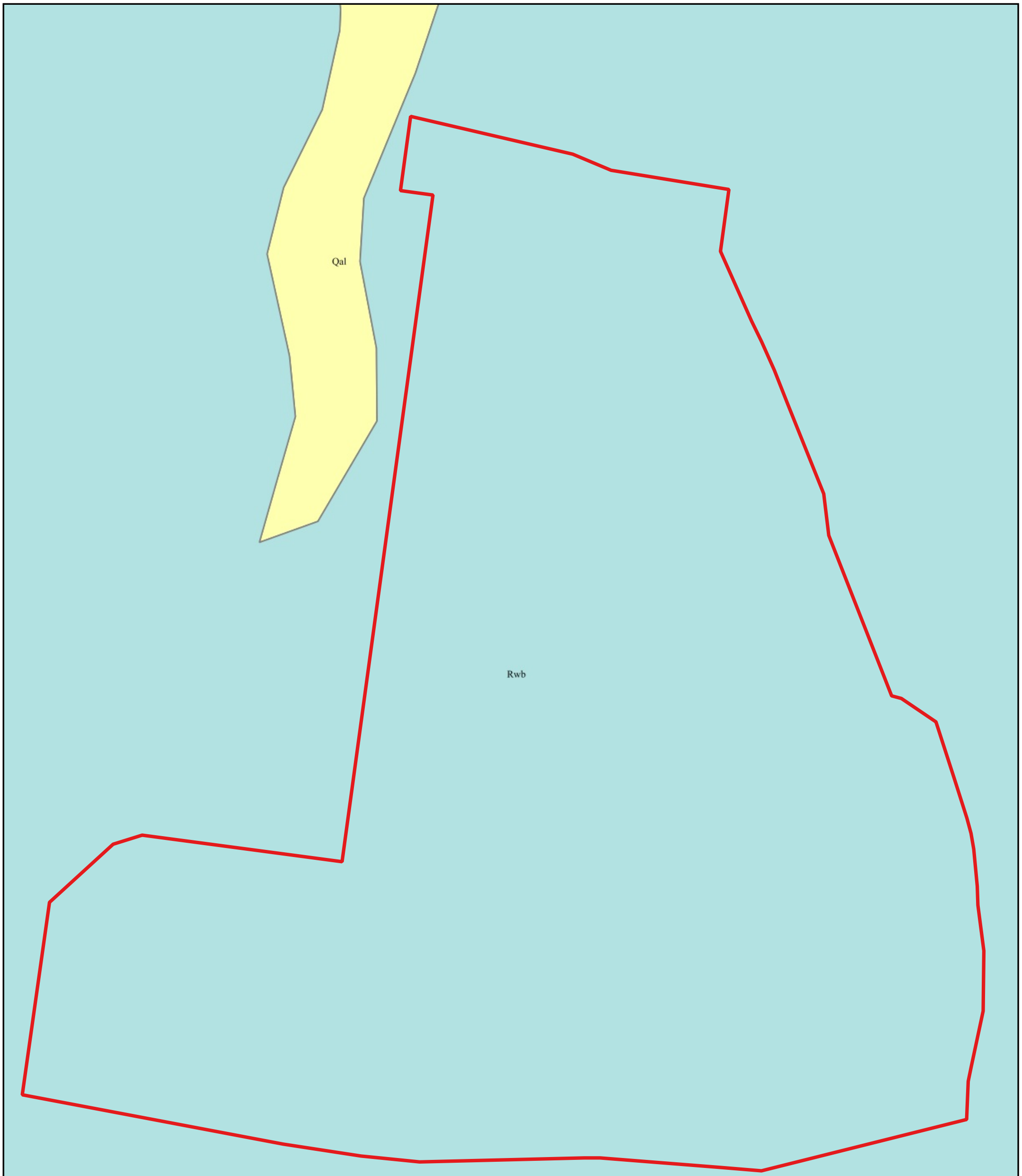
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Site Layout, Site Locality and Salinity Sample Locations**
Preliminary Geotechnical Assessment
South Creek West - Belmore Road Precinct, Bringelly, NSW

N
MGA

OFFICE: Macarthur
DRAWN BY: L Clement
DATE: 25/09/2023

CLIENT: CKDI Bringelly Pty Ltd
PROJECT: 92336.04
DRAWING No: 1
REVISION: 1
SCALE: As Shown

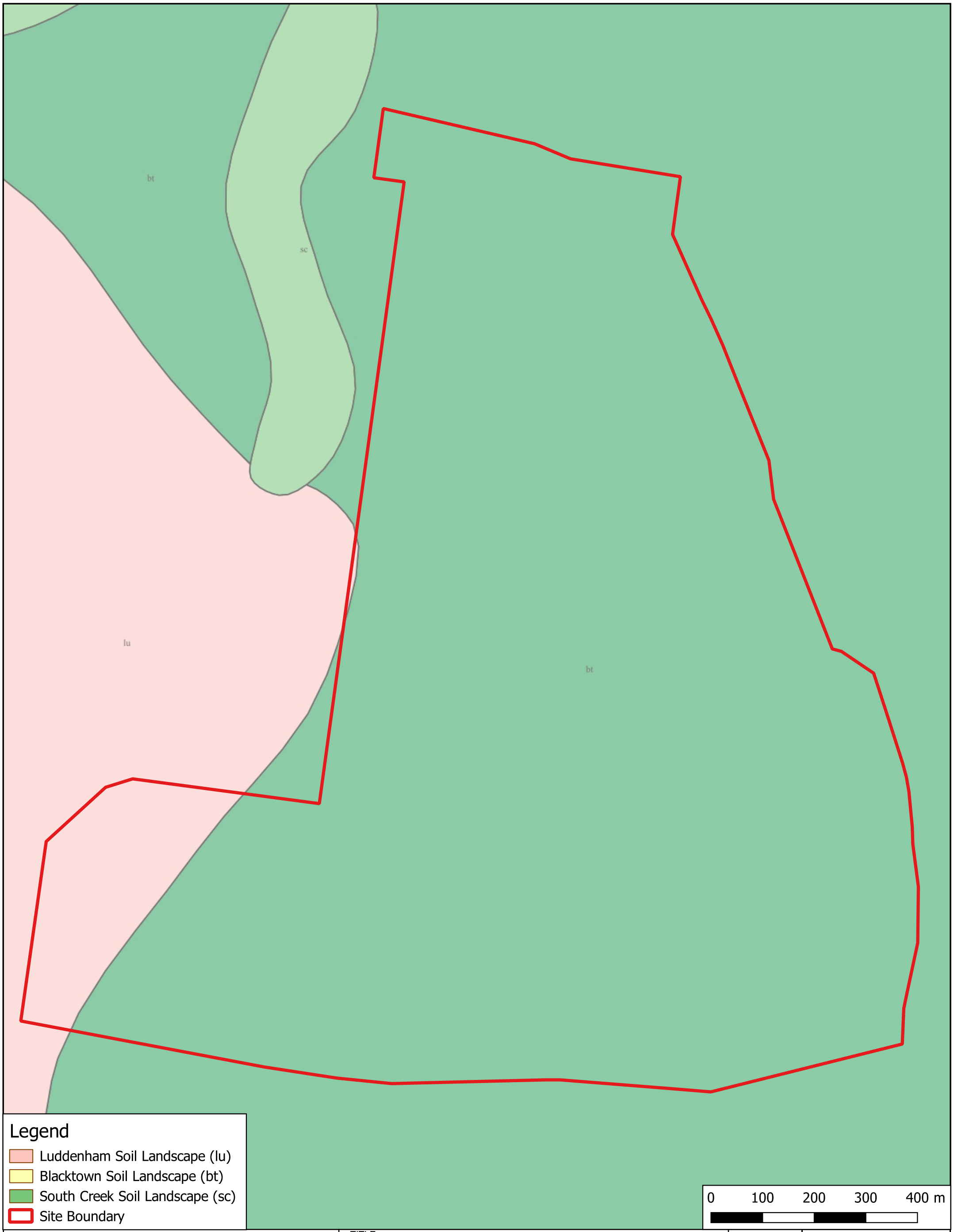


Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Site Geology**
Preliminary Geotechnical Assessment
South Creek West - Belmore Road Precinct, Bringelly, NSW

OFFICE: Macarthur
DRAWN BY: L Clement
DATE: 25/09/2023

CLIENT: CKDI Bringelly Pty Ltd
PROJECT: 92336.04
DRAWING No: 2
REVISION: 1
SCALE: As Shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Site Soil Landscape**
Preliminary Geotechnical Assessment
South Creek West - Belmore Road Precinct, Bringelly, NSW

OFFICE: Macarthur
DRAWN BY: L Clement
DATE: 25/09/2023

CLIENT: CKDI Bringelly Pty Ltd
PROJECT: 92336.04
DRAWING No: 3
REVISION: 1
SCALE: As Shown

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Site Contour Plan**
Preliminary Geotechnical Assessment
South Creek West - Belmore Road Precinct, Bringelly, NSW

OFFICE: Macarthur
DRAWN BY: L Clement
DATE: 25/09/2023

CLIENT: CKDI Bringelly Pty Ltd
PROJECT: 92336.04
DRAWING No: 4
REVISION: 1
SCALE: As Shown

Legend

Site Boundary

MAPPING CATEGORY

KNOWN SALINITY

Areas where there is a known occurrence of saline soil, or where air photo interpretation and field observations have confirmed more than one of these:

- a - scalding
- b - salt efflorescence
- c - vegetation dieback
- d - salt tolerant plant species
- e - waterlogging

A high relative wetness index occurs in these areas.

HIGH SALINITY POTENTIAL

Areas where soil, geology, topography and groundwater conditions predispose a site to salinity. These conditions are similar to areas of known salinity (see above). These areas are most common in lower slopes and drainage systems where water accumulation is high (ie. high relative wetness index).

MODERATE SALINITY POTENTIAL

Areas on Wianamatta Group Shales and Tertiary Alluvial Terraces. Scattered areas of scalding and indicator vegetation have been noted but no concentrations have been mapped. Saline areas may occur in this zone, which have not yet been identified or may occur if risk factors change adversely.

VERY LOW SALINITY POTENTIAL

Areas where salinity processes do not operate or are of minor significance. Soils are rapidly drained and underlaying strata (Hawkesbury/Narrabeen Sandstone) are highly permeable, resulting in continual flushing and removal of salts in the landscape. No salinity has been observed in these areas and is not expected to occur.

0 100 200 300 400 m

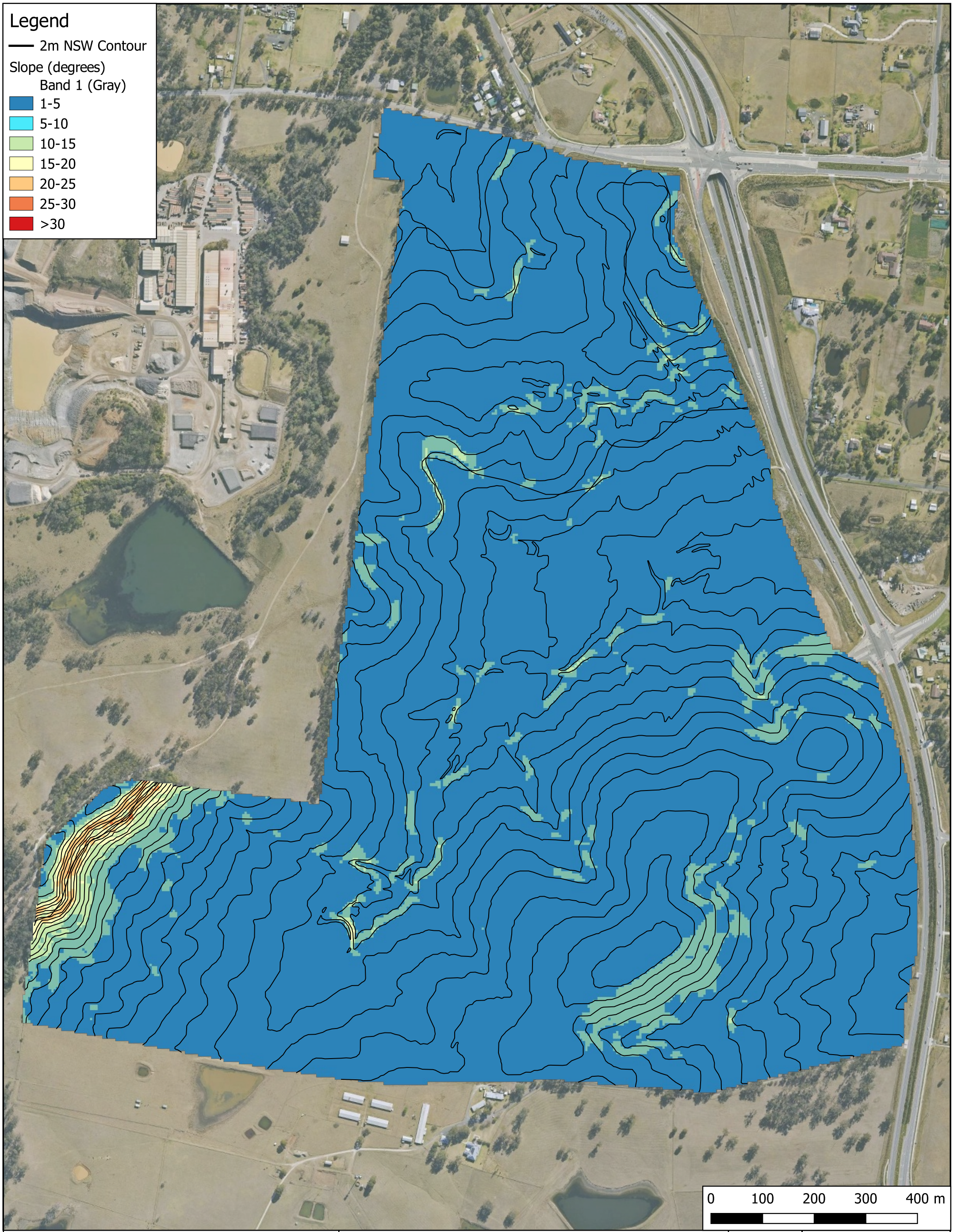
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Salinity Potential**
Preliminary Geotechnical Assessment
South Creek West - Belmore Road Precinct, Bringelly, NSW

N
MGA

OFFICE: Macarthur
DRAWN BY: L Clement
DATE: 25/09/2023

CLIENT: CKDI Bringelly Pty Ltd
PROJECT: 92336.04
DRAWING No: 5
REVISION: 1
SCALE: As Shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Slope Interpolation**
Preliminary Geotechnical Assessment
South Creek West - Belmore Road Precinct, Bringelly, NSW

N
MGA

OFFICE: Macarthur
DRAWN BY: L Clement
DATE: 25/09/2023

CLIENT: CKDI Bringelly Pty Ltd
PROJECT: 92336.04
DRAWING No: 6
REVISION: 1
SCALE: As Shown

Appendix D

Test Pit and Borehole Logs

TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 103.1 mAHD
EASTING: 289455
NORTHING: 6240625

PIT No: 1
PROJECT No: 92336.04
DATE: 28/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
103		TOPSOIL/Silty CLAY CI: pale brown, trace rootlets and fine grained sandstone gravel, w<PL		D	0.0				
	0.25	Silty CLAY CI: medium plasticity, red mottled grey, w<PL, very stiff, residual			0.2				
		- becoming hard below 0.5m		D	0.5				
		- becoming red and yellow mottled grey below 0.7m							
102	1			D	1.0				1
					1.2				
		- becoming pale grey, extremely weathered shale, with very low strength, highly weathered, iron-indurated shale bands below 1.4m		U_{50}					
				D	1.5		pp >400		
					1.6				
101	2			D	2.0		pp >400		2
100	3								3
	3.0	SHALE: brown, iron stained, very low strength, highly weathered, Bringelly Shale							
	3.3	Pit discontinued at 3.3m - limit of investigation							

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 108.8 mAHD
EASTING: 289493
NORTHING: 6240810

PIT No: 2
PROJECT No: 92336.04
DATE: 28/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
108	0.1	TOPSOIL/Silty CLAY CI: medium pasticity, brown, with rootlets, sandstone gravel and cobbles, w<PL		D	0.0				
		Silty CLAY CH: high plasticity, brown, trace sand and gravel, w<PL, stiff, residual			0.2				
		- becoming hard below 0.3m							
		- becoming grey and brown, without sand and gravel below 0.5m		D/B	0.5				
	1	- becoming pale grey, extremely weathered shale below 1.0m		D	1.0		pp >400		1
		- with very low strength, highly weathered, iron-indurated shale bands below 1.2m							
				D	1.5		pp >400		
107	1.9	SHALE: pale grey, iron stained, very low strength, highly weathered, with extremely weathered bands, Bringelly Shale							
	2			D	2.0				2
				D	2.5				
106	3								3
	3.0	Pit discontinued at 3.0m - refusal on low strength shale							
105									

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 102.8 mAHD
EASTING: 289638
NORTHING: 6240899

PIT No: 3
PROJECT No: 92336.04
DATE: 28/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
102	0	TOPSOIL/Silty CLAY CI: medium plasticity, with rootlets, trace sandstone gravel and cobbles, w<PL		D	0.0				
	0.25	Silty CLAY CH: high plasticity, brown and dark grey, w<PL, hard, residual			0.2				
					0.5				
		- becoming grey and red mottled, trace gravel below 0.8m							
	1			D	1.0		pp >400		1
				D	1.5		pp >400		
101	1.8	SHALE: brown, iron stained, low strength, highly weathered, Bringelly Shale							
	1.9	Pit discontinued at 1.9m - refusal on low strength shale		D	1.9				2
	2								
100	3								3
99									

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 86.2 mAHD
EASTING: 289906
NORTHING: 6240507

PIT No: 4
PROJECT No: 92336.04
DATE: 28/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
86	0.0	TOPSOIL/Silty CLAY CI: medium plasticity, brown, trace rootlets, w<PL		D	0.0				
	0.3	Silty CLAY CL: low plasticity, red and brown, trace ironstone gravel,, w<PL, hard, residual		D	0.2				
					0.5				
				U_{50}					
					0.9				
85	1			D	1.0		pp >400		1
		- becoming grey, extremely weathered shale, with very low strength, highly weathered, iron-indurated shale bands below 1.6m		D	1.5		pp >400		
84	2			D	2.0		pp >400		2
	2.4	SHALE: grey and brown, very low strength, highly weathered, with extremely weathered bands, Bringelly Shale		D	2.5				
83	3			D	3.0				3
	3.0	Pit discontinued at 3.0m - limit of investigation							

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 80.6 mAHD
EASTING: 290023
NORTHING: 6240693

PIT No: 5
PROJECT No: 92336.04
DATE: 28/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
80	0.1	TOPSOIL/Silty CLAY CI: medium plasticity, brown, trace gravel and rootlets, w<PL							
		Silty CLAY CI: medium plasticity, brown, trace gravel, w<PL very stiff, residual		D	0.5				
	0.7	SHALE: brown and grey, low strength, highly weathered, Bringelly Shale							
	0.9	Pit discontinued at 0.9m - refusal on low strength sandstone							
	1								
79	2								
78	3								
77									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 91.3 mAHD
EASTING: 290075
NORTHING: 6240405

PIT No: 6
PROJECT No: 92336.04
DATE: 28/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL/Silty CLAY CI: medium plasticity, grey and brown, trace rootlets, w<PL							
	0.15	Silty CLAY CH: high plasticity, red mottled grey, trace ironstone gravel, w<PL, hard, residual							
91				D	0.5		pp >400		
	1	- becoming grey below 0.9m		D	1.0		pp >400		1
90		- becoming extremely weathered shale, with very low strength, highly weathered, iron-indurated shale bands below 1.4m		D	1.5		pp >400		
	2			D	2.0		pp >400		2
89				D	2.5		pp >400		
	3	3.0 Pit discontinued at 3.0m - limit of investigation		D	3.0		pp >400		3
88									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 87.5 mAHD
EASTING: 290206
NORTHING: 6240619

PIT No: 7
PROJECT No: 92336.04
DATE: 28/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL/Silty CLAY CI: medium plasticity, grey and brown, trace rootlets, w<PL		D	0.0				
	0.2	Silty CLAY CI: medium plasticity, red and brown, trace ironstone gravel, w<PL, hard, residual			0.2				
87				D	0.5		pp >400		
		- becoming pale brown and dark grey below 0.8m							
	1			D/B	1.0		pp >400		1
	1.1	SHALE: pale grey and brown, very low strength, highly weathered, Bringelly Shale							
86				D	1.5				
	1.8	Pit discontinued at 1.8m - refusal on low strength shale							
	2								2
85									
	3								3
84									

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 87.9 mAHD
EASTING: 290263
NORTHING: 6240784

PIT No: 8
PROJECT No: 92336.04
DATE: 29/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
87	0.0	TOPSOIL/Silty CLAY CI: medium plasticity, dark brown, trace gravel, sand and rootlets, w<PL		D	0.0				
	0.2	Silty CLAY CL: low plasticity, red and brown, trace sand, w<PL, very stiff, residual		D	0.2				
		- becoming grey and brown, hard below 0.5m		U_{50}	0.5				
	1			D	0.9		pp >400		1
	1.0				1.0				
	1.4	SHALE: brown and grey, iron stained, very low strength, highly weathered, Bringelly Shale		D	1.5				
86	1.8	Pit discontinued at 1.8m - refusal on low strength shale							2
85	2								3
84	3								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 85.8 mAHD
EASTING: 290625
NORTHING: 6240497

PIT No: 9
PROJECT No: 92336.04
DATE: 29/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
85	0.05	TOPSOIL/Silty CLAY CI: medium plasticity, brown, trace rootlets, w<PL		D	0.0				
		Silty CLAY CH: high plasticity, red and brown, trace gravel, w<PL, hard, residual			0.2				
				D	0.5				
		- becoming grey and red below 0.8m							
1		- becoming extremely weathered shale below 1.0m		D	1.0				
				U_{50}					
					1.4				
				D	1.5		pp >400		
84	1.6	SHALE: pale grey and brown, iron stained, very low srength, highly weathered, with extremely weathered bands, Bringelly Shale							
				D	2.0				
				D	2.5				
83	3.0	Pit discontinued at 3.0m - limit of investigation		D	3.0				
82									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 88.4 mAHD
EASTING: 290723
NORTHING: 6240714

PIT No: 10
PROJECT No: 92336.04
DATE: 29/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL/Silty CLAY CI: medium plasticity, brown, trace gravel, with rootlets, w<PL		D	0.0				
	0.2	Silty CLAY CH: high plasticity, red and brown mottled grey, w<PL, very stiff		D	0.2				
88					0.5				
				U_{50}					
					0.9				
	1	- becoming grey mottled red, trace gravel, extremely weathered shale below 0.9m		D	1.0				1
87				D	1.5		pp >400		
	2								2
	2.2	SHALE: brown and pale grey, iron stained, very low strenth, highly weathered, Bringelly Shale		D	2.2				
86				D	2.5				
	2.8	Pit discontinued at 2.8m - refusal on low strength shale							
	3								3
85									

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 75.5 mAHD
EASTING: 290975
NORTHING: 6240529

PIT No: 11
PROJECT No: 92336.04
DATE: 29/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.05	TOPSOIL/Silty CLAY CI: medium plasticity, brown, trace gravel and rootlets, w<PL		D	0.0				
		Silty CLAY CH: high plasticity, brown, trace gravel, w<PL, hard, residual			0.2				
75				D/B	0.5				
	1			D	1.0				1
		- becoming grey and red, extremely weathered shale below 1.3m							
74				D	1.5		pp >400		
	2			D	2.0		pp >400		2
73				D	2.5		pp >400		
		- with very low strength, highly weathered, iron-indurated shale bands below 2.5m							
	3 3.0	Pit discontinued at 3.0m		D	3.0		pp >400		3
		- limit of investigation							
72									

Dynamic Penetrometer Test (blows per 150mm): 5 10 15 20

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: 75.8 mAHD
EASTING: 291045
NORTHING: 6240724

PIT No: 12
PROJECT No: 92336.04
DATE: 29/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
75	0.0	TOPSOIL/Silty CLAY CI: medium plasticity, brown, trace rootlets, w<PL		D	0.0				
	0.2	Silty CLAY CH: pale brown, trace gravel, w<PL, hard, residual		D	0.2				
		- becoming red, brown and grey, with very low strength, highly weathered, iron-indurated shale bands below 0.5m		D	0.5		pp >400		
	1			D	1.0		pp >400		1
				U_{50}					
	1.4	SHALE: brown, low strength, highly weathered, Bringelly Shale		D	1.4				
74				D	1.5				
	1.8	Pit discontinued at 1.8m - refusal on low strength shale		D	1.8				
	2								2
73	3								3
72									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: w = moisture content; PL = plastic limit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: --
EASTING: 289473
NORTHING: 6240642
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 92336.04
DATE: 20/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	TOPSOIL/Silty CLAY CI: medium plasticity, brown, with rootlets, w<PL							stick-up
		Silty CLAY CI: medium plasticity, red mottled grey, w<PL, appears to be very stiff to hard, residual							grout
	3.5	SHALE: grey and brown, low strength, highly weathered, Bringelly Shale							bentonite
									sand
									screen
	7.3	Bore discontinued at 7.3m - limit of investigation							

RIG: Hanjin D&B 8 **DRILLER:** Terratest **LOGGED:** ERL **CASING:** N/A

TYPE OF BORING: Solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering. Moisture observed 21/02/2020 whilst bailing

REMARKS: Location coordinates are in MGA94 Zone 56. w = moisture content; PL = plastic limit. Well installed: 0.8m stickup, 0.0 - 4.3m non-slotted, 4.3 - 7.3m slotted, 0.0 - 2.8m spoil, 2.8 - 3.8m bentonite, 3.8 - 7.3m sand.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: --
EASTING: 289903
NORTHING: 6240711
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 92336.04
DATE: 20/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	TOPSOIL/Silty CLAY CI: medium plasticity, brown, with rootlets, w<PL							stick-up
		Silty CLAY CI: medium plasticity, red, brown and grey, w<PL, appears to be very stiff to hard, residual							grout; bentonite
	3.5	SHALE: pale brown, low strength, highly weathered, Bringelly Shale							sand; screen
	7.0	Bore discontinued at 7.0m - limit of investigation							

RIG: Hanjin D&B 8 **DRILLER:** Terratest **LOGGED:** ERL **CASING:** N/A

TYPE OF BORING: Solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering. Moisture observed 21/02/2020 whilst bailing

REMARKS: Location coordinates are in MGA94 Zone 56. w = moisture content; PL = plastic limit. Well installed: 0.9m stickup, 0.0 - 4.0m non-slotted, 4.0 - 7.0m slotted, 0.0 - 2.5m spoil, 2.5 - 3.0m bentonite, 3.0 - 7.0m sand.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: --
EASTING: 290518
NORTHING: 6240467
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 92336.04
DATE: 20/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	TOPSOIL/Silty CLAY CI: medium plasticity, brown, with rootlets, w<PL							stick-up
		Silty CLAY CH: high plasticity, red and brown, trace gravel, w<PL, appears to be very stiff to hard, residual							
		- becoming grey and orange below 0.5m							grout
	2.3	SHALE: pale brown and grey, low strength, highly weathered, Bringelly Shale							bentonite
									sand
									screen
	7.1	Bore discontinued at 7.1m - limit of investigation							

RIG: Hanjin D&B 8 **DRILLER:** Terratest **LOGGED:** ERL **CASING:** N/A

TYPE OF BORING: Solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering. Moisture observed 20/02/2020 whilst bailing

REMARKS: Location coordinates are in MGA94 Zone 56. w = moisture content; PL = plastic limit. Well installed: 1.0m stickup, 0.0 - 4.1m non-slotted, 4.1 - 7.1m slotted, 0.0 - 3.0m spoil, 3.0 - 3.6m bentonite, 3.6 - 7.1m sand.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CKDI Pty Ltd
PROJECT: South Creek West - North West Precinct
LOCATION: The Northern Road, Bringelly, NSW

SURFACE LEVEL: --
EASTING: 290983
NORTHING: 6240527
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 92336.04
DATE: 20/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	TOPSOIL/Silty CLAY: brown, with rootlets							stick-up
		Silty CLAY CH: high plasticity, brown, trace gravel, w<PL, appears to be very stiff to hard, residual							
	1								grout
		- becoming pale grey and brown, extremely weathered shale below 1.3m							
	2								
	3								
	3.0	SHALE: pale grey and brown, low strengh, highly weathered, Bringelly Shale							bentonite
	4								
									sand
	5								
									screen
	6								
	6.9	Bore discontinued at 6.9m - limit of investigation							
	7								
	8								
	9								

RIG: Hanjin D&B 8 **DRILLER:** Terratest **LOGGED:** ERL **CASING:** N/A

TYPE OF BORING: Solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. w = moisture content; PL = plastic limit. Well installed: 1.0m stickup, 0.0 - 3.9m non-slotted, 3.9m - 6.9m slotted, 0.0 - 2.9m spoil, 2.9 - 3.9m bentonite, 3.9 - 6.9m sand.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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Appendix E

Laboratory Reports

Envirolab Services Pty Ltd
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12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 235945

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Chris Kline
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details

Your Reference	**92336.00, Bringelly**
Number of Samples	13 SOIL
Date samples received	04/02/2020
Date completed instructions received	04/02/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	11/02/2020
Date of Issue	11/02/2020

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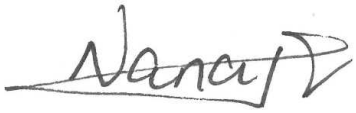
Results Approved By
Jaimie Loa-Kum-Cheung, Metals Supervisor
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

ESP/CEC						
Our Reference		235945-1	235945-2	235945-3	235945-4	235945-5
Your Reference	UNITS	TP1	TP1	TP3	TP3	TP5
Depth		0.5	1.5	0.5	1.5	0.5
Date Sampled		28/01/2020	28/01/2020	28/01/2020	28/01/2020	28/01/2020
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	07/02/2020	07/02/2020	07/02/2020	07/02/2020	07/02/2020
Date analysed	-	07/02/2020	07/02/2020	07/02/2020	07/02/2020	07/02/2020
Exchangeable Ca	meq/100g	1.6	0.1	7.3	1.7	4.2
Exchangeable K	meq/100g	0.1	<0.1	0.1	0.2	<0.1
Exchangeable Mg	meq/100g	8.7	6.6	12	11	5.1
Exchangeable Na	meq/100g	1.2	2.2	1.5	2.5	3.8
Cation Exchange Capacity	meq/100g	12	9.0	21	15	13
ESP	%	10	24	7	16	29

ESP/CEC						
Our Reference		235945-6	235945-7	235945-8	235945-9	235945-10
Your Reference	UNITS	TP7	TP9	TP9	TP9	TP11
Depth		0.5	0.5	1.5	2.5	0.5
Date Sampled		28/01/2020	29/01/2020	29/01/2020	29/01/2020	29/01/2020
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	07/02/2020	07/02/2020	07/02/2020	07/02/2020	07/02/2020
Date analysed	-	07/02/2020	07/02/2020	07/02/2020	07/02/2020	07/02/2020
Exchangeable Ca	meq/100g	2.9	1.7	0.2	<0.1	0.5
Exchangeable K	meq/100g	0.3	0.1	<0.1	0.1	0.1
Exchangeable Mg	meq/100g	6.2	8.8	6.6	6.1	9.1
Exchangeable Na	meq/100g	1.0	1.4	2.3	2.2	2.3
Cation Exchange Capacity	meq/100g	11	12	9.2	8.4	12
ESP	%	10	11	25	26	19

ESP/CEC				
Our Reference		235945-11	235945-12	235945-13
Your Reference	UNITS	TP11	TP11	TP1
Depth		1.5	2.5	2.5
Date Sampled		29/01/2020	29/01/2020	28/01/2020
Type of sample		SOIL	SOIL	SOIL
Date prepared	-	07/02/2020	07/02/2020	07/02/2020
Date analysed	-	07/02/2020	07/02/2020	07/02/2020
Exchangeable Ca	meq/100g	<0.1	<0.1	<0.1
Exchangeable K	meq/100g	<0.1	<0.1	0.1
Exchangeable Mg	meq/100g	3.3	6.4	9.9
Exchangeable Na	meq/100g	1.8	4.2	3.4
Cation Exchange Capacity	meq/100g	5.1	11	14
ESP	%	35	39	25

Misc Inorg - Soil						
Our Reference		235945-1	235945-2	235945-3	235945-4	235945-5
Your Reference	UNITS	TP1	TP1	TP3	TP3	TP5
Depth		0.5	1.5	0.5	1.5	0.5
Date Sampled		28/01/2020	28/01/2020	28/01/2020	28/01/2020	28/01/2020
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	07/02/2020	07/02/2020	07/02/2020	07/02/2020	07/02/2020
Date analysed	-	07/02/2020	07/02/2020	07/02/2020	07/02/2020	07/02/2020
Chloride, Cl 1:5 soil:water	mg/kg	200	650	49	240	1,100
Sulphate, SO4 1:5 soil:water	mg/kg	57	310	<10	58	390

Misc Inorg - Soil						
Our Reference		235945-6	235945-7	235945-8	235945-9	235945-10
Your Reference	UNITS	TP7	TP9	TP9	TP9	TP11
Depth		0.5	0.5	1.5	2.5	0.5
Date Sampled		28/01/2020	29/01/2020	29/01/2020	29/01/2020	29/01/2020
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	07/02/2020	07/02/2020	07/02/2020	07/02/2020	07/02/2020
Date analysed	-	07/02/2020	07/02/2020	07/02/2020	07/02/2020	07/02/2020
Chloride, Cl 1:5 soil:water	mg/kg	39	100	350	520	560
Sulphate, SO4 1:5 soil:water	mg/kg	58	110	270	260	150

Misc Inorg - Soil				
Our Reference		235945-11	235945-12	235945-13
Your Reference	UNITS	TP11	TP11	TP1
Depth		1.5	2.5	2.5
Date Sampled		29/01/2020	29/01/2020	28/01/2020
Type of sample		SOIL	SOIL	SOIL
Date prepared	-	07/02/2020	07/02/2020	07/02/2020
Date analysed	-	07/02/2020	07/02/2020	07/02/2020
Chloride, Cl 1:5 soil:water	mg/kg	730	740	800
Sulphate, SO4 1:5 soil:water	mg/kg	150	220	240

Method ID	Methodology Summary
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-009	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.

QUALITY CONTROL: ESP/CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			07/02/2020	1	07/02/2020	07/02/2020		07/02/2020	[NT]
Date analysed	-			07/02/2020	1	07/02/2020	07/02/2020		07/02/2020	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-009	<0.1	1	1.6	2.1	27	106	[NT]
Exchangeable K	meq/100g	0.1	Metals-009	<0.1	1	0.1	0.2	67	98	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-009	<0.1	1	8.7	11	23	105	[NT]
Exchangeable Na	meq/100g	0.1	Metals-009	<0.1	1	1.2	1.4	15	104	[NT]
ESP	%	1	Metals-009	[NT]	1	10	10	0	[NT]	[NT]

QUALITY CONTROL: ESP/CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	07/02/2020	07/02/2020		[NT]	[NT]
Date analysed	-			[NT]	11	07/02/2020	07/02/2020		[NT]	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-009	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Exchangeable K	meq/100g	0.1	Metals-009	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-009	[NT]	11	3.3	3.6	9	[NT]	[NT]
Exchangeable Na	meq/100g	0.1	Metals-009	[NT]	11	1.8	2.1	15	[NT]	[NT]
ESP	%	1	Metals-009	[NT]	11	35	37	6	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			07/02/2020	6	07/02/2020	07/02/2020		07/02/2020	[NT]
Date analysed	-			07/02/2020	6	07/02/2020	07/02/2020		07/02/2020	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	6	39	35	11	88	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	6	58	56	4	91	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Material Test Report

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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
Lab manager
Laboratory Accreditation Number: 828

Report Number: **92336.00-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *change of client name*
Date Issued: 04/03/2021
Client: CKDI Pty Ltd
Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086A
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP1 (0.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	Silty CLAY CI: red mottled grey, trace rootlets and charcoal		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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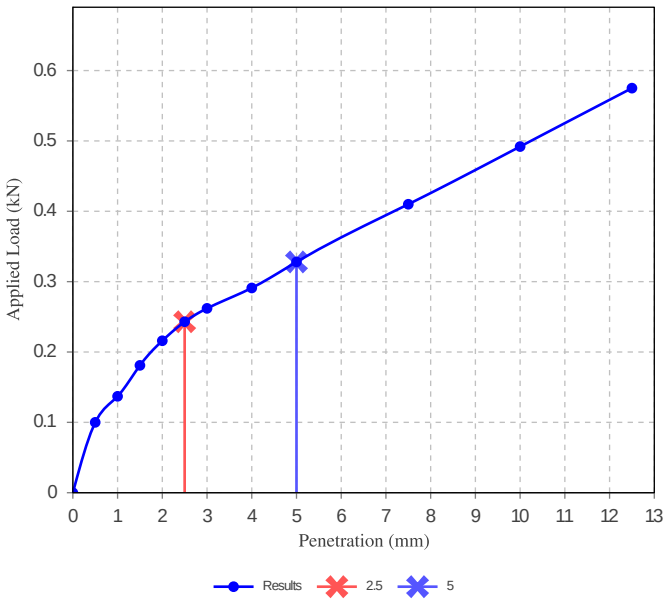
Client:	CKDI Pty Ltd
	Suite 703, North Tower, Chatswood NSW 2067
Contact:	Tank Tan
Project Number:	92336.04
Project Name:	South Creek West - North West Precinct
Project Location:	NWP 1037 The Northern Road, Bringelly
Work Request:	2086
Sample Number:	MA-2086G
Date Sampled:	28/02/2020
Dates Tested:	12/02/2020 - 18/02/2020
Sample Location:	**TP2 (0.5m)**
Material:	Soil

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**2.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.78		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.70		
Field Moisture Content (%)	10.9		
Moisture Content at Placement (%)	14.7		
Moisture Content Top 30mm (%)	21.3		
Moisture Content Rest of Sample (%)	19.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96		
Swell (%)	5.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY CI: grey and brown, with sandstone gravel		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

California Bearing Ratio



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Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086M
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP3 (0.5m)**
Material: Silty CLAY CI: brown and dark grey

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	63		
Plastic Limit (%)	22		
Plasticity Index (%)	**41**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	15.0		
Cracking Crumbling Curling	Curling		

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Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086O
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP3 (1.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY CI: grey, red mottled with sandstone gravel		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086R
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP4 (0-0.2M)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY CI: grey and brown with trace rootlets		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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Client: CKDI Pty Ltd
Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086Y
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP5 (0.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY CI: trace gravel and cobbles and rootlets		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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	Suite 703, North Tower, Chatswood NSW 2067
Contact:	Tank Tan
Project Number:	92336.04
Project Name:	South Creek West - North West Precinct
Project Location:	NWP 1037 The Northern Road, Bringelly
Work Request:	2086
Sample Number:	MA-2086AA
Date Sampled:	28/02/2020
Dates Tested:	05/02/2020 - 05/02/2020
Sample Location:	**TP6 (1.0m)**
Material:	Silty CLAY CI: grey, red mottled, trace ironstone and gravel

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	57		
Plastic Limit (%)	17		
Plasticity Index (%)	**40**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	14.0		
Cracking Crumbling Curling	Curling		

Material Test Report

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Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086AB
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP6 (1.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY CI: grey, with iron staining, low strength sandstone		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086AH
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP7 (0.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty CLAY CI: red brown, trace ironstone and gravel		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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Date Issued:	04/03/2021
Client:	CKDI Pty Ltd
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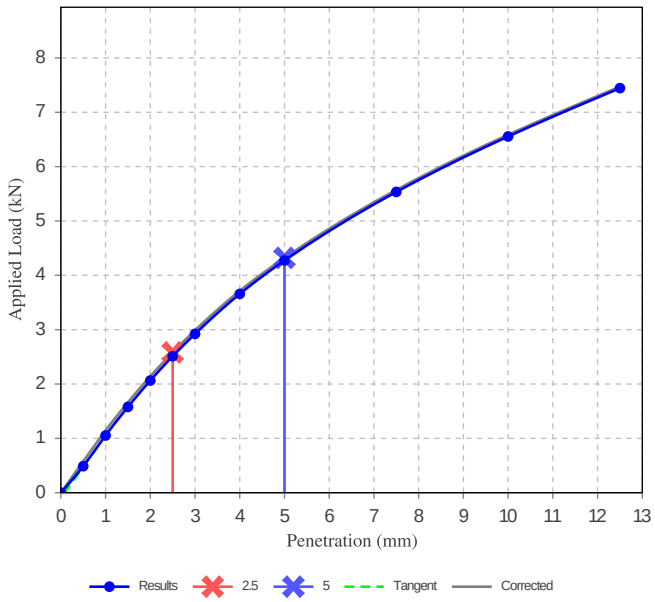
Contact:	Tank Tan
Project Number:	92336.04
Project Name:	South Creek West - North West Precinct
Project Location:	NWP 1037 The Northern Road, Bringelly
Work Request:	2086
Sample Number:	MA-2086AI
Date Sampled:	28/02/2020
Dates Tested:	18/02/2020 - 18/02/2020
Sample Location:	**TP7 (1.0m)**
Material:	Silty CLAY - red-brown with trace ironstone gravel

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**20**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.92		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.90		
Field Moisture Content (%)	5.0		
Moisture Content at Placement (%)	12.5		
Moisture Content Top 30mm (%)	15.3		
Moisture Content Rest of Sample (%)	13.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	7.9		

California Bearing Ratio



Material Test Report

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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
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Laboratory Accreditation Number: 828

Report Number: **92336.00-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *change of client name*
Date Issued: 04/03/2021
Client: CKDI Pty Ltd
Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086AO
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP8 (0.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	SILTY CLAY CI: red brown, trace sand		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086AT
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP9 (0.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	SILTY CLAY CI: red brown, trace gravel		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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Date Issued: 04/03/2021
Client: CKDI Pty Ltd
Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086AV
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP9 (1.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY CI: grey, with extremely weathered sandstone		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

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Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086BB
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP10 (0.5m)**
Material: Silty CLAY: red brown mottled grey

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	60		
Plastic Limit (%)	21		
Plasticity Index (%)	**39**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.5		
Cracking Crumbling Curling	Curling		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

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Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086BG
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP10 (0.5-0.9m)**
Material: Silty CLAY: red brown mottled grey

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

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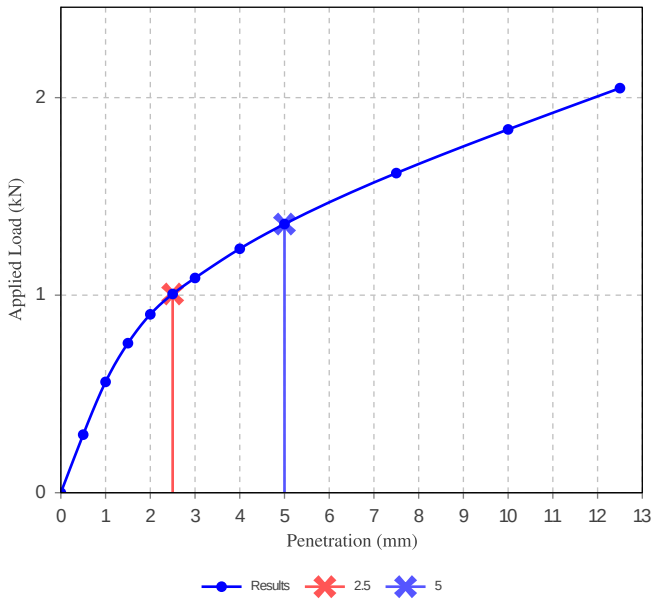
Contact:	Tank Tan
Project Number:	92336.04
Project Name:	South Creek West - North West Precinct
Project Location:	NWP 1037 The Northern Road, Bringelly
Work Request:	2086
Sample Number:	MA-2086BI
Date Sampled:	28/02/2020
Dates Tested:	12/02/2020 - 17/02/2020
Sample Location:	**TP11 (0.5m)**
Material:	SILTY CALY - grey and red mottled hard trace gravels

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**8**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.69		
Optimum Moisture Content (%)	18.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.68		
Field Moisture Content (%)	12.7		
Moisture Content at Placement (%)	18.6		
Moisture Content Top 30mm (%)	21.0		
Moisture Content Rest of Sample (%)	18.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

California Bearing Ratio



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Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Sample Number: MA-2086BO
Date Sampled: 28/02/2020
Dates Tested: 12/02/2020 - 12/02/2020
Sample Location: **TP12 (0.5m)**
Material: Soil

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	Silty CLAY CI: red brown and grey, with sandstone and ironstone		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	21		

Material Test Report

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Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Date Sampled: 28/02/2020
Dates Tested: 07/02/2020 - 07/02/2020

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Determination of EC of Soil (In-House) DP MAC2

Sample Number	Location	Depth (m)	Material	EC Value (µS/cm)
MA-2086A	TP1	0.5m	Soil	109.00
MA-2086B	TP1	1.0m	Soil	514.00
MA-2086C	TP1	1.5m	Soil	593.00
MA-2086D	TP1	2.0m	Soil	699.00
MA-2086F	TP2	0-0.2m	Soil	437.00
MA-2086G	TP2	0.5m	Soil	45.90
MA-2086H	TP2	1.0m	Soil	244.00
MA-2086I	TP2	1.5m	Soil	294.00
MA-2086J	TP2	2.0m	Soil	318.00
MA-2086K	TP2	2.5m	Soil	168.30
MA-2086L	TP3	0-0.2m	Soil	61.90
MA-2086M	TP3	0.5m	Silty CLAY CI: brown and dark grey	78.90
MA-2086N	TP3	1.0m	Soil	156.20
MA-2086O	TP3	1.5m	Soil	229.00
MA-2086P	TP3	2.0m	Soil	141.60
MA-2086R	TP4	0-0.2M	Soil	79.40
MA-2086S	TP4	0.5m	Soil	374.00
MA-2086T	TP4	1.0m	Soil	46.00
MA-2086U	TP4	1.5m	Soil	916.00
MA-2086V	TP1	2.0m	Soil	789.00
MA-2086W	TP4	2.5m	Soil	781.00
MA-2086X	TP4	3.0m	Soil	804.00
MA-2086Y	TP5	0.5m	Soil	117.20
MA-2086Z	TP6	0.5m	Soil	218.00
MA-2086AA	TP6	1.0m	Silty CLAY CI: grey, red mottled, trace ironstone and gravel	440.00
MA-2086AB	TP6	1.5m	Soil	624.00
MA-2086AC	TP6	2.0m	Soil	574.00
MA-2086AD	TP6	2.5m	Soil	653.00
MA-2086AE	TP6	2.5m	Soil	704.00
MA-2086AF	TP6	3.0m	Soil	502.00
MA-2086AG	TP7	0-0.2m	Soil	100.20

Sample Number	Location	Depth (m)	Material	EC Value (µS/cm)
MA-2086AH	TP7	0.5m	Soil	67.40
MA-2086AI	TP7	1.0m	Silty CLAY - red-brown with trace ironstone gravel	145.80
MA-2086AJ	TP7	1.5m	Soil	136.80
MA-2086AN	TP8	0-0.2m	Soil	86.30
MA-2086AO	TP8	0.5m	Soil	110.20
MA-2086AP	TP8	1.0m	Soil	230.00
MA-2086AQ	TP8	1.5m	Soil	401.00
MA-2086AS	TP9	0-0.2m	Soil	51.70
MA-2086AT	TP9	0.5m	Soil	217.00
MA-2086AU	TP9	1.0m	Soil	381.00
MA-2086AV	TP9	1.5m	Soil	412.00
MA-2086AW	TP9	0-0.2m	Soil	607.00
MA-2086AX	TP9	2.5m	Soil	489.00
MA-2086AY	TP9	3.0m	Soil	443.00
MA-2086BA	TP10	0-0.2m	Soil	85.30
MA-2086BB	TP10	0.5m	Silty CLAY: red brown mottled grey	256.00
MA-2086BC	TP10	1.0m	Soil	486.00
MA-2086BD	TP10	1.5m	Soil	368.00
MA-2086BE	TP10	2.0m	Soil	258.00
MA-2086BF	TP10	2.5m	Soil	352.00
MA-2086BH	TP11	0-0.2m	Soil	53.40
MA-2086BI	TP11	0.5m	SILTY CALY - grey and red mottled hard trace gravels	150.50
MA-2086BJ	TP11	1.0m	SILTY CALY - grey and red mottled hard trace gravels	412.00
MA-2086BK	TP11	1.5m	Soil	483.00
MA-2086BL	TP11	2.5m	Soil	515.00
MA-2086BM	TP11	3.0m	Soil	460.00
MA-2086BN	TP12	0-0.2m	Soil	74.60
MA-2086BO	TP12	0.5m	Soil	16.00
MA-2086BP	TP12	1.0m	Soil	227.00
MA-2086BQ	TP12	1.5m	Soil	223.00
MA-2086BR	TP12	1.8m	Soil	284.00

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Suite 703, North Tower, Chatswood NSW 2067
Contact: Tank Tan
Project Number: 92336.04
Project Name: South Creek West - North West Precinct
Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Date Sampled: 28/02/2020
Dates Tested: 07/02/2020 - 07/02/2020

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Determination of pH of Soil (In-House) DP MAC1

Sample Number	Location	Depth (m)	Material	pH Value
MA-2086A	TP1	0.5m	Soil	7.5
MA-2086B	TP1	1.0m	Soil	6.6
MA-2086C	TP1	1.5m	Soil	6.4
MA-2086D	TP1	2.0m	Soil	6.2
MA-2086F	TP2	0-0.2m	Soil	8.0
MA-2086G	TP2	0.5m	Soil	7.4
MA-2086H	TP2	1.0m	Soil	6.7
MA-2086I	TP2	1.5m	Soil	6.5
MA-2086J	TP2	2.0m	Soil	6.5
MA-2086K	TP2	2.5m	Soil	6.7
MA-2086L	TP3	0-0.2m	Soil	7.1
MA-2086M	TP3	0.5m	Silty CLAY CI: brown and dark grey	7.0
MA-2086N	TP3	1.0m	Soil	6.4
MA-2086O	TP3	1.5m	Soil	6.3
MA-2086P	TP3	2.0m	Soil	7.8
MA-2086R	TP4	0-0.2M	Soil	7.1
MA-2086S	TP4	0.5m	Soil	6.1
MA-2086T	TP4	1.0m	Soil	7.1
MA-2086U	TP4	1.5m	Soil	6.8
MA-2086V	TP1	2.0m	Soil	6.4
MA-2086W	TP4	2.5m	Soil	6.4
MA-2086X	TP4	3.0m	Soil	6.4
MA-2086Y	TP5	0.5m	Soil	6.4
MA-2086Z	TP6	0.5m	Soil	7.1
MA-2086AA	TP6	1.0m	Silty CLAY CI: grey, red mottled, trace ironstone and gravel	6.6
MA-2086AB	TP6	1.5m	Soil	6.0
MA-2086AC	TP6	2.0m	Soil	6.0
MA-2086AD	TP6	2.5m	Soil	5.8
MA-2086AE	TP6	2.5m	Soil	5.6
MA-2086AF	TP6	3.0m	Soil	5.6
MA-2086AG	TP7	0-0.2m	Soil	6.2

Sample Number	Location	Depth (m)	Material	pH Value
MA-2086AH	TP7	0.5m	Soil	6.2
MA-2086AI	TP7	1.0m	Silty CLAY - red-brown with trace ironstone gravel	7.7
MA-2086AJ	TP7	1.5m	Soil	7.7
MA-2086AN	TP8	0-0.2m	Soil	7.7
MA-2086AO	TP8	0.5m	Soil	7.5
MA-2086AP	TP8	1.0m	Soil	7.1
MA-2086AQ	TP8	1.5m	Soil	6.8
MA-2086AS	TP9	0-0.2m	Soil	7.6
MA-2086AT	TP9	0.5m	Soil	7.0
MA-2086AU	TP9	1.0m	Soil	6.5
MA-2086AV	TP9	1.5m	Soil	6.6
MA-2086AW	TP9	0-0.2m	Soil	6.2
MA-2086AX	TP9	2.5m	Soil	6.3
MA-2086AY	TP9	3.0m	Soil	6.3
MA-2086BA	TP10	0-0.2m	Soil	6.9
MA-2086BB	TP10	0.5m	Silty CLAY: red brown mottled grey	7.3
MA-2086BC	TP10	1.0m	Soil	6.8
MA-2086BD	TP10	1.5m	Soil	6.8
MA-2086BE	TP10	2.0m	Soil	7.4
MA-2086BF	TP10	2.5m	Soil	7.1
MA-2086BH	TP11	0-0.2m	Soil	7.9
MA-2086BI	TP11	0.5m	SILTY CALY - grey and red mottled hard trace gravels	7.3
MA-2086BJ	TP11	1.0m	SILTY CALY - grey and red mottled hard trace gravels	7.0
MA-2086BK	TP11	1.5m	Soil	6.8
MA-2086BL	TP11	2.5m	Soil	6.8
MA-2086BM	TP11	3.0m	Soil	6.8
MA-2086BN	TP12	0-0.2m	Soil	7.6
MA-2086BO	TP12	0.5m	Soil	8.3
MA-2086BP	TP12	1.0m	Soil	7.2
MA-2086BQ	TP12	1.5m	Soil	7.1
MA-2086BR	TP12	1.8m	Soil	7.1

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Project Number: 92336.04
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Project Location: NWP 1037 The Northern Road, Bringelly
Work Request: 2086
Date Sampled: 28/02/2020
Dates Tested: 06/02/2020 - 06/02/2020

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Moisture Content AS 1289 2.1.1			
Sample Number	Sample Location	Moisture Content (%)	Material
MA-2086M	TP3 (0.5m)	15.1 %	Silty CLAY CI: brown and dark grey
MA-2086AA	TP6 (1.0m)	14.7 %	Silty CLAY CI: grey, red mottled, trace ironstone and gravel
MA-2086BB	TP10 (0.5m)	13.3 %	Silty CLAY: red brown mottled grey

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Dates Tested: 05/02/2020 - 06/02/2020

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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
Lab manager
Laboratory Accreditation Number: 828

Shrink Swell Index AS 1289 7.1.1 & 2.1.1					
Sample Number	MA-2086E	MA-2086AR	MA-2086AZ	MA-2086BG	MA-2086BS
Date Sampled	28/02/2020	28/02/2020	28/02/2020	28/02/2020	28/02/2020
Date Tested	05/02/2020	06/02/2020	06/02/2020	05/02/2020	05/02/2020
Material Source	**	**	**	**	**
Sample Location	TP1 (1.2m)	TP8 (0.5-0.9m)	TP9 (1.0-1.4m)	TP10 (0.5-0.9m)	TP12 (1.0-1.4m)
Inert Material Estimate (%)	2	0	**	0	0
Pocket Penetrometer before (kPa)	495	600	600	600	600
Pocket Penetrometer after (kPa)	200	130	210	200	290
Shrinkage Moisture Content (%)	14.6	13.8	16.1	15.3	11.2
Shrinkage (%)	**1.5**	**1.0**	**2.6**	**1.8**	**0.9**
Swell Moisture Content Before (%)	14.1	13.8	15.2	13.9	8.0
Swell Moisture Content After (%)	19.7	24.8	23.2	24.7	19.3
Swell (%)	**1.6**	**1.9**	**9.9**	**4.6**	**5.1**
Shrink Swell Index Iss (%)	**1.3**	**1.1**	**4.2**	**2.3**	**1.9**
Visual Description	Silty CLAY CI: red and yellow mottled grey	SILTY CLAY CI: red brown, trace sand	Silty CLAY CI: grey, with extremely weathered sandstone	Silty CLAY: red brown mottled grey	Silty CLAY CI: red brown and grey with sandstone and ironstone
Cracking	MC	MC	SC	SC	UC
Crumbling	No	No	No	No	No
Remarks	**	**	**	**	**

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.
Cracking Terminology: UC Uncracked, SC Slightly Cracked, MC Moderately Cracked, HC Highly Cracked, FR Fragmented.
NATA Accreditation does not cover the performance of pocket penetrometer readings.

Material Test Report

Report Number:	**92336.00-1**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*change of client name*
Date Issued:	04/03/2021
Client:	CKDI Pty Ltd
	Suite 703, North Tower, Chatswood NSW 2067
Contact:	Tank Tan
Project Number:	92336.04
Project Name:	South Creek West - North West Precinct
Project Location:	NWP 1037 The Northern Road, Bringelly
Work Request:	2086
Date Sampled:	28/02/2020
Dates Tested:	05/02/2020 - 06/02/2020

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
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Shrink Swell Index AS 1289 7.1.1 & 2.1.1					
Sample Number	MA-2086BT				
Date Sampled	28/02/2020				
Date Tested	05/02/2020				
Material Source	**				
Sample Location	TP4 (0.5-0.9M)				
Inert Material Estimate (%)	1				
Pocket Penetrometer before (kPa)	560				
Pocket Penetrometer after (kPa)	400				
Shrinkage Moisture Content (%)	14.0				
Shrinkage (%)	**1.3**				
Swell Moisture Content Before (%)	13.4				
Swell Moisture Content After (%)	18.9				
Swell (%)	**1.0**				
Shrink Swell Index Iss (%)	**1.0**				
Visual Description	Silty CLAY CI: red brown, trace ironstone gravel				
Cracking	SC				
Crumbling	No				
Remarks	**				

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.
Cracking Terminology: UC Uncracked, SC Slightly Cracked, MC Moderately Cracked, HC Highly Cracked, FR Fragmented.
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