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Report on
Preliminary Geotechnical Assessment

Rosalind Park Planning Proposal
Medhurst Road, Menangle

Prepared for
Leda Holdings Pty Ltd

Project 205817.05
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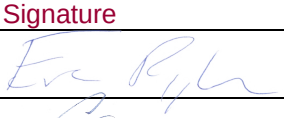
Author			26 August 2022
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Report on Preliminary Geotechnical Assessment
Rosalind Park Planning Proposal
Medhurst Road, Menangle

1. Introduction

This report presents the results of a preliminary geotechnical assessment carried out for "Rosalind Park" at Medhurst Road, Menangle (the site). The investigation was commissioned by Nathan Cutler of Leda Holdings Pty Ltd and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal P205817.02.P.001.Rev0 dated 24 February 2022.

The purpose of this assessment is to support a planning proposal for rezoning by providing preliminary geotechnical comment of the risk of slope instability of the site, the soil and rock profiles for excavation assessment, presence (if any) of uncontrolled fill, potential for water logging, erosion, salinity and mine subsidence. The results build upon and consolidate multiple previous investigations undertaken by DP in 2016, 2021 and 2022. Where relevant, the observations and findings of the earlier reports have been reproduced within this report.

The assessment included site inspection, review of previous DP investigations followed by engineering analysis and reporting. The details of the field work are present in this report, together with comments and recommendations on the items discussed above.

2. Background

DP has previously undertaken geotechnical investigations within the proposed Rosalind Park site boundary, which include:

- Project 20020A Report on Geotechnical Investigation, Proposed Landscape and Horticultural Products Facility, Menangle Park Quarry, dated November 1994. Investigation included the excavation of 9 test pits (101 to 109) and drilling of 3 boreholes (1 to 3) with pressure testing of rock
- Project 76649.01 Report on Geotechnical Investigation, Preliminary Stability Assessment, 33 Medhurst Road, Gilead, dated 16 May 2016. The investigation included information review, field mapping and the excavation of 14 test pits (Pits 1 -14).
- Project 205817.00 Report on Preliminary Geotechnical Investigation, Proposed Residential Subdivision, Rosalind Park, Medhurst Road, Menangle Park dated 13 August 2021. The investigation included information review, field mapping and the drilling of 7cored boreholes (Bores 201, 202, 206, and 208 – 211).
- Project 205817.03 Report on Desktop Geotechnical Assessment, Proposed Residential Subdivision, 111 Medhurst Road, Menangle Park dated 21 March 2022. The investigation included information review and field mapping.

The locations of previous testing are shown on the Drawing 1 (Appendix B).

The relevant information from the above site investigations has been incorporated into discussions in this report.

3. Site Description

Site Address	Medhurst Road, Menangle
Legal Description	Lot 1 in Deposited Plan 589241 Part Lot 35 in Deposited Plan 230946 Lot 2 in Deposited Plan 622362 Lot 3 in Deposited Plan 622362 Lot 1 in Deposited Plan 622362 Lot 58 in Deposited Plan 632328
Area	264 ha
Zoning	Zone RU2 Rural Landscape
Local Council Area	Campbelltown City Council
Current Use	Rural Residential
Surrounding Uses	North – Rural agricultural land Northeast - Sydney water canal beyond which is a residential development East – Rural agricultural land South – Rural agricultural land which is the Mount Gilead Residential Release Area West – Highway beyond which is the Menangle Park Residential Release area

The overall site comprises an irregular shaped area of about 264 ha known as “Rosalind Park” and is identified as 33 Medhurst Road, Menangle Park. The site is located on the eastern side of Medhurst Road and is bounded to the north by similar undeveloped rural properties and to the south and east by Menangle Creek. Several perennial creeks and tributaries of Menangle Creek traverse the site. The site location, boundaries and topographic features are shown on Drawing 1, attached.

The site comprises two north-south oriented ridgelines, separated by an unnamed tributary of Menangle Creek, with a number of easterly and westerly spurs and an east-west oriented ridge line in the northern part of the site which connects the north-south ridges. Much of the site comprises moderate (10 – 18°, grades of 18% - 34%) to steep (18 – 27°, grades of 34% - 50%) slopes with some locally very steep slopes (27 – 45°, grades of 50% - 100%), particularly in the southerly facing slopes lying between approximately RL 106 relative to Australian Height Datum (AHD) to RL 152 in the central third of the site. The ridge above the site rises to approximately RL 172 within the overall site. Gentle slopes (0 – 10°, grades of 0% - 18%) are located on crest of the ridges, the bases of the spurs in the north and west portions of the site and floodplains located adjacent to Menangle Creek in the southern parts of the site. Slope angles based on 1 m LIDAR data are shown on Drawing 2, attached.

Figure 1: Site Location

At the time of the investigation, much of the site had been generally cleared of most of its original tree cover and is now mainly grass covered and used for grazing. Creek lines appear to have been revegetated and a number of farm dams ranging in size from 600 m^2 to 8000 m^2 are located along the water courses. There are areas of regrowth shrubs and small trees, particularly on very steep slopes and adjacent to major tributaries.

An active sandstone quarry (Menangle Park Quarry) is located in the central southern part of the site. The Rosalind Park Gas Plant (RPGP) is located adjacent and to the east of the quarry.

In addition, two high pressure gas mains, understood to be within the one easement, traverse the central portion of the site from north to south.

Residential dwellings and associated sheds were observed within the northern portion of the site.

Various topographical features of the site are shown in Photos 1 – 36 (refer Plates 1 – 9) in Appendix C.

4. Regional Geology, Soil Landscapes, Salinity and Hydrology

4.1 Geology

The site is primarily underlain by sedimentary bedrock, however, minor volcanic intrusions are also mapped within the site (Refer Figure 1). Stroud, W J et al (1985) indicates that the site is underlain by rocks of the Hawkesbury Sandstone, Mittagong Formation and the Wianamatta Group (Bringelly and Ashfield Shale) of Triassic age, the distribution of which are shown on Figure 2.

Most of the higher elevations and northern part of the site are underlain by the Bringelly Shale (mapping unit Rwb) which typically comprises thinly bedded shale, siltstone, carbonaceous claystone, fine grained sandstone, laminite and some minor coaly bands. These rocks typically weather to form clays of high plasticity.

The Ashfield Shale (map unit Rwa), which predominantly comprises laminite and claystone, underlies the lower reaches and southern part of the site (refer Figure 1). The boundary between the Bringelly Shale and Ashfield Shale is typically marked by the Minchinbury Sandstone which ranges from approximately 1.5 m to 3.5 m thick.

The Mittagong Formation (map unit Rm) and Hawkesbury Sandstone (map unit Rh) are inferred at shallow depths in the southern part of the site and exposed within the Menangle Park Quarry. The Mittagong Formation is a transitional unit between the Ashfield Shale and Hawkesbury Sandstone Formation and typically comprises interbedded siltstone and fine to medium grained sandstone. The Hawkesbury Sandstone typically comprises medium to coarse grained quartz sandstone.

A diatreme (i.e. a vertical pipe or funnel-shaped igneous intrusion) of Jurassic age comprising breccia, basalt and dolerite are mapped (map unit Jv) in the central southern and central part of the site.

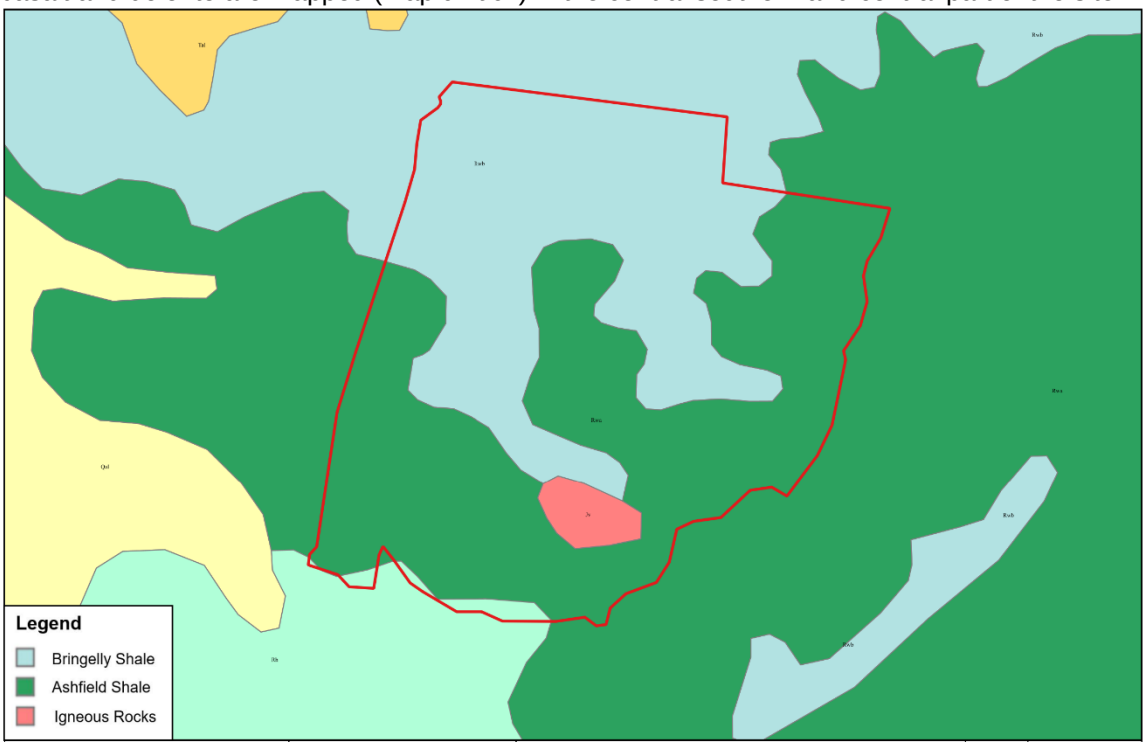

Figure 2: Site geology with approximate site boundary

4.2 Soil Landscapes

Soil landscapes over the site generally reflect the underlying geology and topography. With reference to Hazelton, P.A. et al (1990) the site is broadly divided into five distinct soil landscapes, the Blacktown residual soil present along the western fringes of the site, the Theresa Park alluvial soil present along the eastern part of the site (primarily in line with Menangle Creek), Luddenham erosional soil in the central and northern portions of the site, Hawkesbury colluvial soil located along the southern boundary and Volcanic residual soil capping a ridgeline in the northern portion of the site.. The soil landscapes are further described below:

The Blacktown Soil Landscape (map unit bt) is a residual soil group associated with the gently undulating slopes and broad rounded crests and ridges on the Wianamatta Group in the eastern part of the site. The unit comprises up to four soil horizons that range from shallow red-brown hard-setting sandy clay soils on crests and upper slopes to deep brown to yellow sand and clay soils overlying grey plastic mottled clay on mid- to lower slopes. These soils are typically of low fertility, are moderately reactive and have a generally low wet bearing strength.

The Theresa Park Soil Landscape (map unit tp) is an alluvial unit associated with Tertiary and Quaternary flood plains and terraces of the Nepean River. Soil types include brown sandy loam, reddish-brown sandy clay, and light clay. Fluvial bedding is sometimes evident, and their sand-rich nature is reflected in typically higher permeability and low available water holding capacity. These soils are typically prone to seasonal and localised permanent waterlogging, are a high erosion hazard, in areas considered as localised flood hazards, hard setting surfaces and are generally of low fertility.

The Luddenham Soil Landscape (map unit lu) is an erosional soil group characterised by undulating to rolling low hills on Wianamatta Group shales, often associated with Minchinbury Sandstone. Local relief is between 50 – 80 m and slopes from 5 – 20%. Typical landscape features include narrow ridges, hillcrests, and valleys. The unit comprises three soil horizons that range from shallow dark podzolic soils to massive earthy clays on crests and moderately deep red podzolic soils on upper slopes. These soils are typically moderately reactive, with a high soil erosion hazard, and localised impermeable highly plastic subsoil.

The Hawkesbury Soil Landscape (map unit ha) is an erosional soil group and prone to slope instability characterised by rugged, rolling to very steep hills on Hawkesbury Sandstone. Local relief 40 – 200 m and slopes >25%. Rock outcrop >50%. Typical landscape features include narrow crests and ridges, narrow incised valleys, steep side slopes with rocky benches, broken scarps, and boulders. These soils are typically an extreme soil erosion hazard, a mass movement (rock fall) hazard, leading to steep slopes and rock outcrops, typically shallow in nature, stony, of highly permeability and low soil fertility.

The Volcanic Soil Landscape (map unit vo) is a residual soil group associated with gently inclined valley floors surrounded by steep colluvial side slopes formed on volcanic intrusions within the Hawkesbury Sandstone and Wianamatta Group shales with local relief of up to 80 m. These soils are typically moderately reactive subsoils with low wet strength, moderate erosion hazard and mass movement hazard on steep slopes.

The approximate extents of the soil landscapes are shown in Figure 3.

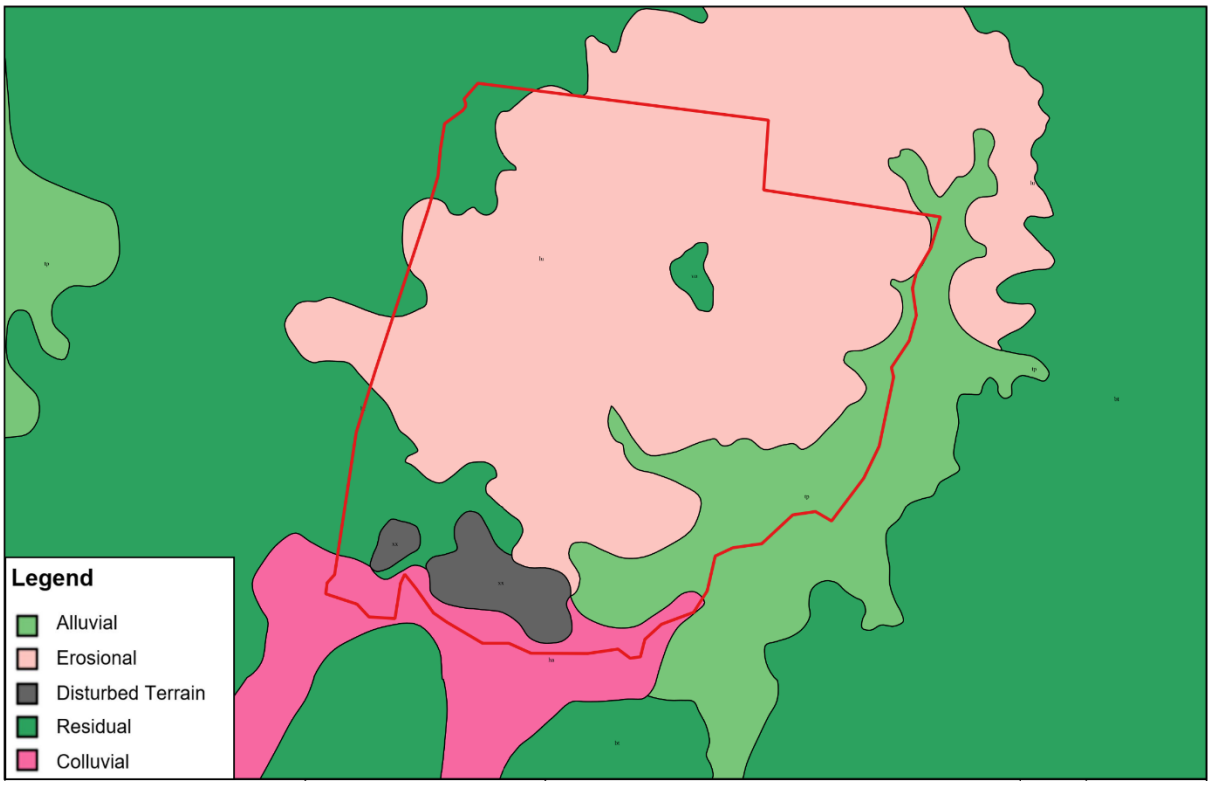

Figure 3: Site soil landscapes with approximate site boundary

4.3 Salinity

Reference to the Map of Salinity Potential in Western Sydney, indicates that the site is located in an area of predominantly *"Moderate salinity potential"* where *"saline areas may occur .... which have not yet been identified or may occur if risk factors change adversely"*. However, some lower lying areas in the western fringes of the site are mapped as *"High salinity potential"* where *"these areas are most common on lower slopes and drainage systems where water accumulation is high …"*. The classification is based on the landform and geology and it is noted that due to the resolution at the scale of the mapping, it is not possible to delineate the zone boundaries with precision.

4.4 Hydrogeology

McNally (2005) describes some general features of the hydrogeology of Western Sydney which are relevant to this Site. 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. Seasonal groundwater level changes of 1 – 2 m can occur in a shallow regolith aquifer or a deeper shale aquifer due to natural influences.

5. Field Work

5.1 Site Inspection

Inspection of the north eastern portion of the site was carried out by a senior engineering geologist in May 2022. The main features observed during the inspection are summarised below and selected items are additionally shown on Drawing 1 and Photos 29 - 32.

- The various farm dams typically comprise a filled embankment on one side up to 3 m in height with batter slopes up in the range 2H:1V to 4H:1V (Photos 29 and 31).
- Water logged areas were noted downstream of the farm dams and in flat areas with poor drainage
- Sandstone boulders and gravel were noted at the surface of the slopes below the power line easement (Photo 33);
- A collapsed rabbit warren indicated topsoil thicknesses of about 400 mm (Photo 34);
- The steeper portions of the site were heavily overgrown with African olive shrubs which prevented detailed observations of the slopes (Photo 30).
- High voltage power lines and high pressure gas mains traverse the site (Photos 35 and 36);

5.2 Previous Site Inspections

Previous walkover inspections were carried out by a DP senior geotechnical engineer and engineering geologists in April 2016, July 2021 and March 2022 with relevant features observed during the inspections summarised below. Selected items are additionally shown on Drawing 1 and Photos 1 – 28.

- Gully erosion and entrenchment of perennial creek lines including over-steepened batters and near-vertical faces exposing bedrock were observed within the very steep, southerly facing hillsides in the central and southern parts of the site (refer Photo 6).
- The toe of a small to medium sized slump, estimated to be 500 – 1000 m^3 is located at the base of the very steep hillside in the central-eastern part of the site at the entrance to a large erosion gully (refer Photos 7 and 8).
- Tension cracking was observed on the bare slope adjacent to gully erosion and near rabbit burrows in the south-western part of the site.
- Surficial slump-flow slides and soil terracing with back-scarps up to 1 m high were observed on the very steep hillsides adjacent to gully erosion (refer Photos 9 – 11).
- Trees with downslope bows in the base of the trunks were observed in the very steep hillsides in the central and southern parts of the site (refer Photo 12) indicative of soil creep.
- Lush, green areas of grass were noted in many of moderate and steep hillside around the site (refer Photos 13 and 14), typically associated with local depressions and perennial watercourses which can be indicative of groundwater seepage.
- Sandstone boulders (including tabular slabs) were observed at a number of locations around the site. Tabular slabs located in the central eastern hillside appear to be from an erosion-resistant sandstone band close to the expected location of the Minchinbury Sandstone Member (refer Photo 15) which marks the boundary between the Ashfield Shale and Bringelly Shale.

- Surficial slumping was also observed in many of the moderate to steep hillsides and watercourse embankments within the site.
- A small quarry within a dolerite diatreme is located in the southern part of the site (example of exposed rock shown in Photo 16). A dolerite boulder/core stone was also observed within the hillside in the central northern part of the site (refer Photos 17 and 18).
- An area in the central part of the site appears to have been re-vegetated in the last 5 – 10 years. Some gully erosion was observed in the area however access and closer assessment was precluded due to blackberry bushes within the area.
- Erosion rills were present in the bare batters within a number of the erosion gullies (refer Photo 19).
- Erosion was observed above the Medhurst Road batter (Photo 21) and along the southern ridge line (Photo 22);
- Waterlogging was noted and is typically associated with local depressions and perennial watercourses which is indicative of groundwater seepage (Photo 27). Areas of groundwater seepage have also been identified on Drawing 1.
- Uncontrolled fill observed on the western embankment of the dam wall (Photo 28).

5.3 Results of Previous Subsurface Investigations

Details of the subsurface conditions encountered during the current field investigation are given on the borehole logs attached. These logs and results should be read in conjunction with the notes defining classification methods and descriptive term, also attached.

The field testing encountered generally uniform conditions underlying the site consistent with the geological mapping. Noting that only ridgeline areas were investigated (as this is where shallowest rock was anticipated) the succession of strata for these ridge top areas is broadly summarised as follows:

TOPSOIL:	Silty clay topsoil to depths of 0.1 – 0.4 m in all bores and pits with the exception of Bores 2 and 3 within the quarry which had been stripped prior to excavation;
FILL:	Silty clay, gravelly sand and sandy clay fill to depths of 0.2 – 3.4 m in Bores 201, 206, 208 and 209;
RESIDUAL SOIL:	Stiff to hard silty clay and sandy clay to depths in the range of 0.9 – 3.7 m in all pits and boreholes ;
WEATHERED ROCK:	Interbedded shale, siltstone and sandstone directly underlies the residual clays at depths of 0.9 – 3.7 m, generally varying in strength from extremely low up to high strength with a variable strength profile, however, generally increasing in strength with depth to the termination depths of 6.0 – 13.1 m in all boreholes.

Different conditions were initially encountered in Pits 1, 3 and 12 (Project 76649.01), with colluvial soil comprising silty clay to depths of 0.2 – 2.5 m. Alluvial soils were also initially encountered in Pits 9 and 13, comprising silty clay to depths of 1.1 m to in excess of 3.5 m.

No free groundwater was observed in the test pits or boreholes during augering. The use of water as drilling fluid precluded groundwater observations during core drilling. A standpipe piezometer was installed in Bore 3 of DP (1994a) to a depth of 17 m at the completion of drilling to allow for longer-term monitoring of groundwater levels. A summary of the groundwater observations made within the well is presented in Table 1. It should be noted that groundwater levels are affected by factors such as climatic conditions, which will therefore vary with time, and soil/rock permeability.

Table 1: Groundwater Observations in Monitoring Wells

Bore No.	Date Measured	Groundwater Depth (m)	Groundwater Level (m AHD)
3(1)	26 May 1994	13.1	75.9
	16 August 1994	14.3	74.7

Notes: (1) Project 20020A – DP (1994a)

The soil depths and depths to surface of the rock with increasing strength are summarised in Table 2.

Table 2 Summary of Subsurface Conditions

Test	Surface RL (mAHD)	Topsoil / Fill	Silty Clay	Surface of Rock					
				Very Low Strength		Low Strength		Medium Strength or higher	
		Depth (m)	Depth (m)	Depth (m)	RL (AHD)	Depth (m)	RL (AHD)	Depth (m)	RL (AHD)
201(1)	160.6	0.7 (fill)	0.9	0.9	159.7	2.8	157.8	4.9(1)	155.7
202(1)	171.7	0.1 (topsoil)	1.8	1.8	169.9	6	165.7	2.4(2)	169.3
206(1)	129.7	0.2 (fill)	0.9	0.9	128.8	4.3	125.4	4.9	124.8
208(1)	127.8	2.0 (fill)	0.3	0.3	127.5	3.1	124.7	-	-
209(1)	157.6	3.4 (fill)	3.7	3.7	153.9	10.1	147.5	-	-
210(1)	161	0.3 (topsoil)	2.1	2.1	158.9	3.8	157.2	6.0(3)	155
211(1)	153.6	0.4 (topsoil)	1.2(4)	1.2(4)	152.4	9.4	144.2	-	-
1(2)	157.9	0.2 (topsoil)	0.9	0.9	157	1.4	156.5	-	-
2(2)	145.2	0.2 (topsoil)	0.9	0.9	144.3	-	-	-	-
3(2)	112.5	0.2 (topsoil)	2.9	2.9	109.6	-	-	-	-
4(2)	144.5	0.2 (topsoil)	1.5	1.5	143	-	-	-	-
5(2)	153.9	0.2 (topsoil)	0.7	0.7	153.2	1.2	152.7	-	-
6(2)	161.5	0.2 (topsoil)	0.4	0.4	161.1	-	-	-	-
7(2)	154.3	0.2 (topsoil)	1	1	153.3	-	-	-	-
8(2)	146.9	0.2 (topsoil)	0.8	0.8	146.1	-	-	-	-
9(2)	88.3	0.2 (topsoil)	1.1	1.1	87.2	1.8	86.5	-	-

Test	Surface RL (mAHD)	Topsoil / Fill	Silty Clay	Surface of Rock					
				Very Low Strength		Low Strength		Medium Strength or higher	
		Depth (m)	Depth (m)	Depth (m)	RL (AHD)	Depth (m)	RL (AHD)	Depth (m)	RL (AHD)
10(2)	123.8	0.1 (topsoil)	0.2	0.2	123.6	-	-	-	-
11(2)	147.7	0.1 (topsoil)	0.9	0.9	146.8	1.3	146.4	-	-
12(2)	150.5	0.2 (topsoil)	0.7	0.7	149.8		150.5		150.5
13(2)	108.6	0.2 (topsoil)	>3.5	>3.5	-	-	-	-	-
14(2)	164.8	0.15 (topsoil	1	1	163.8	1.6	163.2	-	-
1(3)	84	1.0 (fill)	1	1	80.5	-	-	5.5	78.5
2(3)	75	-	0.8	0.8	74.2	-	-	1	74
3(3)	89	-	1	1	88			1.5	87.5
101(3)	99.5	0.4 (topsoil)	0.8	0.8	98.7	2.2	97.3	-	-
103(3)	92	0.4 (topsoil)	2.4	2.4	89.6	-	-	-	-
104(3)	95.5	0.2 (topsoil)	0.7	0.7	94.8	-	-	-	-
105(3)	92.5	0.3 (topsoil)	0.8	0.8	91.7	1.2	91.3	-	-
106(3)	90.5	0.3 (topsoil)	0.9	0.9	89.6	-	-	-	-
107(3)	87	0.2 (topsoil)	0.9	0.9	86.1	1.5	85.5	-	-
108(3)	73	0.4 (topsoil)	1.1	1.1	71.9	1.2	71.8	-	-
109(3)	87.5	0.2 (topsoil)	0.8	0.8	86.7	-	-	0.7	86.8

Notes:

(1) Project 205817.00 borehole data.

(2) Project 76649.01 test pit data

(3) Project 20020A borehole and test pit data.

6. Proposed Development

It is understood that consideration is being given to the potential re-zoning of the site for urban (residential) development. It is expected that bulk earthworks required for subdivision construction will include significant depths of excavation and fill areas. The following sections provide a preliminary geotechnical assessment of the existing site and general comments on development constraints related to the risk of slope instability of the site, soil and rock profiles to determine reuse potential of site-won materials in fill areas, earthworks including rock excavation and fill placement, uncontrolled fill, water logging, erosion, salinity mapping and mine subsidence based on the surface and subsurface profiles encountered during the current and previous investigations. It is noted that further investigations will need to be undertaken as the planning, design and construction of the subdivision proceeds.

7. Comments

7.1 Geological Model

The inferred geological model for the investigated portions of the site (i.e. the hill tops and ridgelines) is as follows:

- Colluvial soils encountered or inferred at a number of locations around the site including locally on the steep to very steep hillsides and toe of the same hillsides.
- Alluvial soils encountered within the relatively flat areas located adjacent to Menangle Creek in the south-eastern and south-western parts of the site.
- Residual clay soils grading into weathered siltstone, shale and sandstone, typically at depths of about 1 m, within the moderate to very steep slopes and crests of the ridgelines.
- Bedrock, of both the Bringelly Shale and underlying Ashfield Shale, comprising weathering-prone shales, claystone, siltstone and laminite with more resistant sandstone bands, underlying much of the site. The Mittagong Formation and Hawkesbury Sandstone are located at shallow depths in the southern part of the site and exposed within Menangle Park Quarry (DP 2016).
- Preferential weathering of the fine-grained rocks resulting in over-steepening of the slopes below sandstone bands with resulting susceptibility for slumping of residual and accumulated colluvial material in slopes in excess of 15°.
- Moderately and steeply dipping, clay-infilled discontinuities within the bedrock, dipping out of the slope may indicate a current or potential landslide.
- Groundwater flow through thinner sandstone bands within the hillside may trigger slumping at both new and previous slump and flow debris locations.
- Additional slumping and creep flow is also likely to be exacerbated by tension cracks in the hillside and internal drainage within previously slumped debris, together with scarp and gully geometry which provides for concentration of stormwater and infiltration. At residual shear strength parameters, groundwater levels above slide planes need only reach ground level to trigger movement (DP 2016).
- Ongoing erosion and/or deposition of colluvial materials (DP 2016) may hide older landslide features within the lower elevations of the site.

7.2 Topsoil and Uncontrolled Filling Depths

Based on available information from previous and current investigations, topsoil was encountered from the surface to depths in the range 0.1 – 0.4 m at most locations (refer Drawing 1) with the exception near Bores 201, 206, 208 and 209 where uncontrolled filling was encountered to depths of 0.2 – 3.4 m and Bore 3 of DP (1994a).

7.3 Excavation

The DP 2021 report provides detailed excavation recommendations. In summary, topsoil, filling and natural soils could be readily removed using a conventional medium sized excavator with a toothed bucket or elevating scraper.

Excavation of rock up to low strength will probably require the use of conventional earthmoving equipment with some heavy ripping using a D9 or larger equipment, whilst limited excavation (such as service trenches) may require the use of pneumatic hammers.

Excavation of medium and high strength rock will require the use of D10 – D11 dozers (or equivalent), or alternatively 45 – 80 tonne excavators using 5 or 8 tonne hammers.

7.4 Reuse of Excavated Materials

Generally the soils encountered will be suitable for reuse as engineered fill within the site. The natural clayey, sandy soils and ripped shale/siltstone/sandstone bedrock will be best suited for bulk filling within allotments. Even where soils are wet of their plastic limits, these can be moisture conditioned prior to reuse.

Ripped sandstone, will be best suited as select fill to improve pavement subgrades and building platforms where structures are to be founded in the fill. It is expected that bedrock of low strength or less should readily break down beneath the action of the rollers, however, bedrock of low to medium strength or higher may potentially need, mechanical crushing as it is not expected to break down under the action of compactors during filling works. Rock crushing methods could include excavator hammers or crushers. Rock crushing can add significant expense and time to typical bulk earthwork programmes.

7.5 Erosion Potential

Water erosion forms a minor landscape limitation for the site. The site inspections identified gullies entrenching of recent alluvial deposits within stream courses and the residual soil and bedrock profiles.

Soils of the Volcanic Soil Landscapes are typically of moderate erodibility, whilst the Theresa Park and Luddenham Soil Landscapes are typically of high erodibility and the Hawkesbury Soil Landscapes are of extreme erodibility. The more sodic or saline soils of the Blacktown Soil Landscape can have high erodibility and the erosion hazard for this landscape is estimated as moderate to very high in accordance with DECC (2008).

To minimise the constraints imposed by erosion potential, earthworks in the steep sections of the site should be undertaken in small stages, with adequate erosion and sedimentation controls in place. It is considered that the erosion hazard within the remaining areas of the site would be within usually accepted bounds which may be managed by good engineering and land management practices.

It is anticipated that the treatment of the existing gullies as part of an overall site development would include:

- Filling using select materials (i.e. non–dispersive or erodible) placed under controlled conditions;
- Provision of temporary surface cover (e.g. pegged matting) during the period of gully floor revegetation;
- Channel lining in sections of rapid change in gully floor grade;
- Piping of flow where appropriate; and

- The re-establishment of a zone of tree cover or appropriate vegetation along gully, creek, and riverbanks.

7.6 Salinity

In the wider Western Sydney area and throughout the Sydney Basin, soil in areas underlain by the Bringelly Shale can be of moderate salinity. This is due to the rocks having been formed in a marine environment with the saline conditions caused by the low permeability of the strata and hence the lack of natural flushing of the salt from the soil profile since the Bringelly Shale since geological deposition. It will therefore be necessary that sensitive urban design principles be adopted for the site development, taking into consideration the possibility that salt will be released into the environment if large areas of soil are left disturbed and untreated during rainfall events. This constraint would be addressed in a Salinity Investigation and Management Plan developed for the site prior to construction.

7.7 Mine Subsidence

The site is located within the current South Campbelltown Mine Subsidence District. As described in DP (2016), potential subsidence effects resulting from longwall coal mining is dependent on a number of factors, including coal seam depth, extraction thickness, the wide of the mined panel, stratigraphy of the overlying strata and regional structural features, particularly faulting. Documented cases of subsidence monitoring within the Southern Coalfield, according to Holla, L et al (2000), indicates that for individual longwall panels, subsidence is typically 7 – 20% of the seam thickness (i.e. 175 – 600 mm for seams of up to 3 m thick). For multiple longwall panels, subsidence can approach 50% of the seam thickness.

Subsidence development comprises an 'active' component that constitutes 90 – 95% of the total subsidence and a 'residual' component resulting in the consolidation of the disturbed ground. The active component for a single longwall normally develops within weeks or months of the longwall advance, but as each panel may take a year or more to complete, additional subsidence resulting from adjacent panels may take several years to develop. Although the residual component is relatively small, this can also take 2 – 3 years to develop following the completion of mining.

Consultation should be carried out with the Subsidence Advisory NSW to determine the extent of previous and proposed mining and consideration given to the effects of subsidence on surface infrastructure, particularly:

- Damage to road pavements, kerbs, gutters and surface or subsurface drainage systems;
- The potential for cracking of bedrock beneath creeks and pondages;
- Disruption of groundwater with permanent changes to near-surface bedrock aquifers; and
- The likelihood that conventional residential structures of 'rigid' construction will be more prone to subsidence related damage than 'flexible' lightweight structures.

7.8 Assessment of Slope Instability

The site has been assessed with reference to Walker, B, et al (2007) and has included consideration of the surface features observed during the site investigation, surface slopes and DP's experience in the area.

7.8.1 Landslide Susceptibility

Based on Chestnut W (1982), the site lies within the area mapped for engineering geological hazards which indicates that the site is located in a broadly defined area potentially at risk of landslip due to mudflow failure of thick, clayey soils developed mostly on Wianamatta Group shales. Due to the resolution of the mapping, it is not possible to delineate the area with precision.

Soil hazard mapping by DECC (2008) indicates localised mass movement hazards within the Blacktown, Luddenham, Hawkesbury and Volcanic soil landscape classifications.

7.8.2 Slope Instability Hazards

This assessment has included consideration of:

- the susceptibility of the residual and colluvial soil profiles and fine grained rocks to develop slope instability as the result of over-steepening by erosion or human intervention (e.g. by excavation or removal of areas of remaining tree cover), surface saturation and groundwater rise during periods of prolonged or extreme rainfall events.
- the susceptibility of areas of previous slope instability to remobilisation, particularly as a result of surface saturation and groundwater rise during periods of prolonged or extreme rainfall events.
- *Almost Certain*, extremely slow to very slow soil creep (which may develop into landslide activity) on steeper slopes.
- *Likely to Possible*, slow to moderate rotational or translational landslides or rapid to very rapid debris flow landslides developing within areas about subsurface discharge zones and extending downslope for up to 100 m.
- *Likely,* slow remobilisation of previous landslide debris fields on even moderate slopes as a result of groundwater saturation/pressure and probable residual soil parameters along relict failure surfaces. Such remobilisation may result in additional downslope movement or regression along the sides and head of the crown of the landslide.
- Limiting engineering works as far as possible to achieve no greater than *Moderate* risk to property and *Acceptable* risk to life after development. While extensive ground works may be able to extend areas for development, it is highly likely that the cost of detailed investigation and development would be unacceptable.

7.8.3 Risk of Slope Instability

Stability of existing undeveloped slopes is typically dependant on a number of key factors including the slope of the ground, the type and strength of soil or rock and the presence of water. While an area may be assessed as being currently stable, unsuitable development or poor construction techniques may trigger slope instability. Alternatively, sites which are assessed as having some risk of slope instability may be improved by installation of such features as sub-surface drains or retaining structures.

A preliminary assessment of the risk to property from slope instability has been undertaken and includes consideration of susceptibility, hazard characteristics and consequence to property in accordance with Walker, B, et al (2007). The assessment of risk to property (by necessity) assumes that the whole of investigation area is available for development and that precautionary and remedial works (briefly described in Section 6.6) are implemented, and that the landslide affected areas will be included in individual property lots.

The site has been subdivided into four geotechnical zones with two sub-zones (Zones B – E, refer Drawing 3, Appendix B). The risk to property adopted for these zones is summarised in Table 3.

Table 3: Summary of assessed slope instability risk to property

Zone	Instability Classification	Susceptibility Descriptor	Hazard Descriptor[1]	Risk to Property Descriptor[2,3]
B	No observed instability	Very Low	Low	Low
C	Soil creep on steeper slopes	High	Moderate	Low
C1	Soil creep, adjacent to landslide zones	High	Moderate	Low to Moderate
C2	Bank erosion and minor slumping, impact from slump-flow	High	Moderate	Low to Moderate
D	Active, inactive or potential slump-flow landslides	High	High	Moderate
E	Active or potential slump-flow landslides	Very High	Very High	High

Notes: 1. Descriptor of current hazard level.
2. Dual descriptors indicate level of uncertainty in consequence for development elements.
3. Assessed risk levels after inclusion of precautionary and remedial works.

The development should generally include works to result in acceptable risk levels to property and life after completion of construction. In some cases, subject to appropriate monitoring and maintenance programs, a tolerable risk may be accepted. Definitions of acceptable and tolerable risk, as included in Walker, B, et al (2007), are as follows:

Acceptable Risk: A risk which, for the purposes of life or work, society is prepared to accept as it is with no regard to its management. Society does not generally consider expenditure warranted in further reducing such risks. An acceptable risk to property is typically qualitatively described as being of low or very low classification.

Tolerable Risk: A risk within a range that society can live with so as to secure certain net benefits. It is a range of risk regarded as non-negligible and needing to be kept under review and reduced further if possible. Areas initially of moderate or high risk level to property may be accepted for development subject to detailed investigation to define hazards, provided that planning and treatment options can be implemented to reduce risks to acceptable levels.

It is assessed that the site development of the existing site will result in acceptable risk levels (low) within Zone B and C following the implementation of hazard reduction and precautionary works. There is the

proviso that development is carried out in accordance with good engineering practice for hillside sites and the recommendations of this report.

7.8.4 Geotechnical Constraints

Geotechnical constraints for the zones (Zones B – E) with two possible sub-zones (Zones C1 and C2), for the site in its current state, are as follows:

Zone B Ridge crest and upper slope areas with minimal geotechnical constraints and where normal residential intensity is envisaged.

Zone C Uniform flanking slopes with no observed active or historical instability however requiring buffer zones plus surface/subsurface drainage to protect margins. Inter-area drainage of any identified seepage will be required to protect sites from encroachment or development of slope instability. Usual hillside geotechnical constraints apply to development. Normal residential intensity envisaged excluding buffer zone. Additional investigation should be undertaken to confirm the absence of landslide features in this area.

Zone C1 Steep flanking slopes and ridge crests adjacent to landslide-affected areas requiring buffer zones. Geotechnical constraints to apply to development including restricted building areas with larger block sizes. Inter-area drainage of any identified seepage will also be required to protect sites from encroachment or development of slope instability. Additional investigation should be undertaken to confirm the absence of landslide features in this area.

Zone C2 Floodplains adjacent to landslide-affected slopes and riparian areas requiring buffer zones. Minimal geotechnical constraints regarding slope instability and otherwise normal residential intensity are envisaged. Consideration of bank erosion and flood levels will also be required.

Zone D Areas of possible landsliding or ancient landsliding. Detailed geotechnical investigation required to fully assess these areas. Slope re-construction and drainage will probably be required to develop these areas.

Zone E Landslide/creep affected areas on very steep slopes that, in their current state, are unsuitable for development however will require remedial works to protect the adjacent areas.
The volumes of material required to re-construct slopes may preclude these areas from future development.

It is noted that areas can potentially be re-classified once the extent of bulk earthworks is known. The extent of the area that can be re-classified will depend on the depth of cut/fill, site features and appropriate remedial and precautionary works being carried out. Once concept plans are further developed, review and confirmation of these areas will be required by the geotechnical consultant.

Whilst the Menangle Park Quarry site has not been considered as part of the preliminary stability assessment, re-development of the quarry site will require consideration of batter and rock face stability, the likely placement of uncontrolled filling (which may require subsequent removal if the quarry is to be filled with engineered filling) as part of quarry abandonment, as well as the depth of any new engineered filling across individual lots and secondary consolidation of deep filling.

7.8.5 Slope Instability Conclusion

In its current state, Zones B and C are considered suitable for development from a geotechnical perspective. Some geotechnical constraints including buffer zones, surface and subsurface drainage

and design of dwellings in accordance with accepted practice for hillside developments in Zones C, C1 and C2. Specific geotechnical input will be required once concept plans have been further refined.

8. Conclusions and Further Investigation

The geotechnical assessment undertaken to date has indicated that most of the site will be suitable for residential development, with comments given on geotechnical limitations. Detailed geotechnical investigation and assessment will be required as the design of the development proceeds and, as such, this report must be considered as being preliminary in nature. Specific geotechnical investigation would include (but not necessarily be limited to):

- Detailed landslide investigation providing remedial recommendations for Zone D;
- Assessment of proposed backfilling of the quarry site;
- Higher density of rock depth investigation, to better characterise the subsurface excavatability conditions to aid in planning and design;
- Detailed geotechnical investigations on a stage-by-stage basis for determination of pavement thickness designs and lot classifications;
- Routine inspections and earthworks monitoring during construction; and
- Further investigation into the potential for future coal mining and correspondence with the relevant authorities regarding mine subsidence and any foreseen restrictions on development.

9. References

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10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Rosalind Park, Medhurst Road, Menangle NSW in accordance with DP's proposal P0205817.00 dated 11 June 2021 and acceptance received from Nathan Cutler on behalf of Leda Holdings Pty Ltd dated 15 June 2021. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Leda Holdings Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or 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 subsurface conditions on the site only based on the desktop investigation and a limited site walkover. 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 site inspection has been completed.

DP's advice is based upon the conditions encountered during this 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.

The assessment of atypical safety hazards arising from this advice is restricted to the (geotechnical/environmental/groundwater) components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

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.

Douglas Partners Pty Ltd

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.

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 based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. 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	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

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

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

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	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

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;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and 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 test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

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

* 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
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

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 some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or better. 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

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

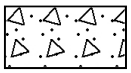
Symbols & Abbreviations

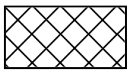
Graphic Symbols for Soil and Rock

General

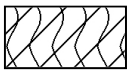

Asphalt

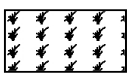

Road base

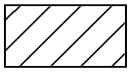

Concrete

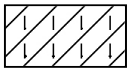

Filling

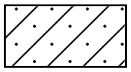
Soils


Topsoil

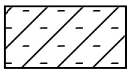

Peat

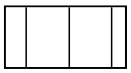

Clay

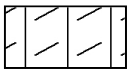

Silty clay

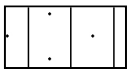

Sandy clay

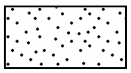

Gravelly clay

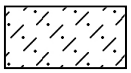

Shaly clay

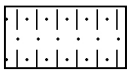

Silt


Clayey silt


Sandy silt

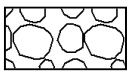

Sand

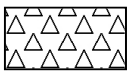

Clayey sand


Silty sand


Gravel

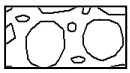

Sandy gravel


Cobbles, boulders

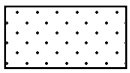

Talus

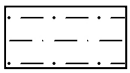
Sedimentary Rocks

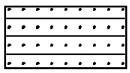

Boulder conglomerate

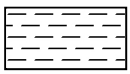

Conglomerate


Conglomeratic sandstone

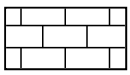

Sandstone


Siltstone

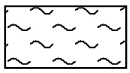

Laminite

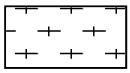

Mudstone, claystone, shale

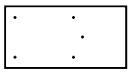

Coal


Limestone

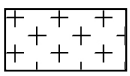
Metamorphic Rocks

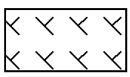

Slate, phyllite, schist

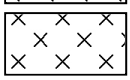

Gneiss

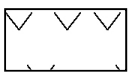

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

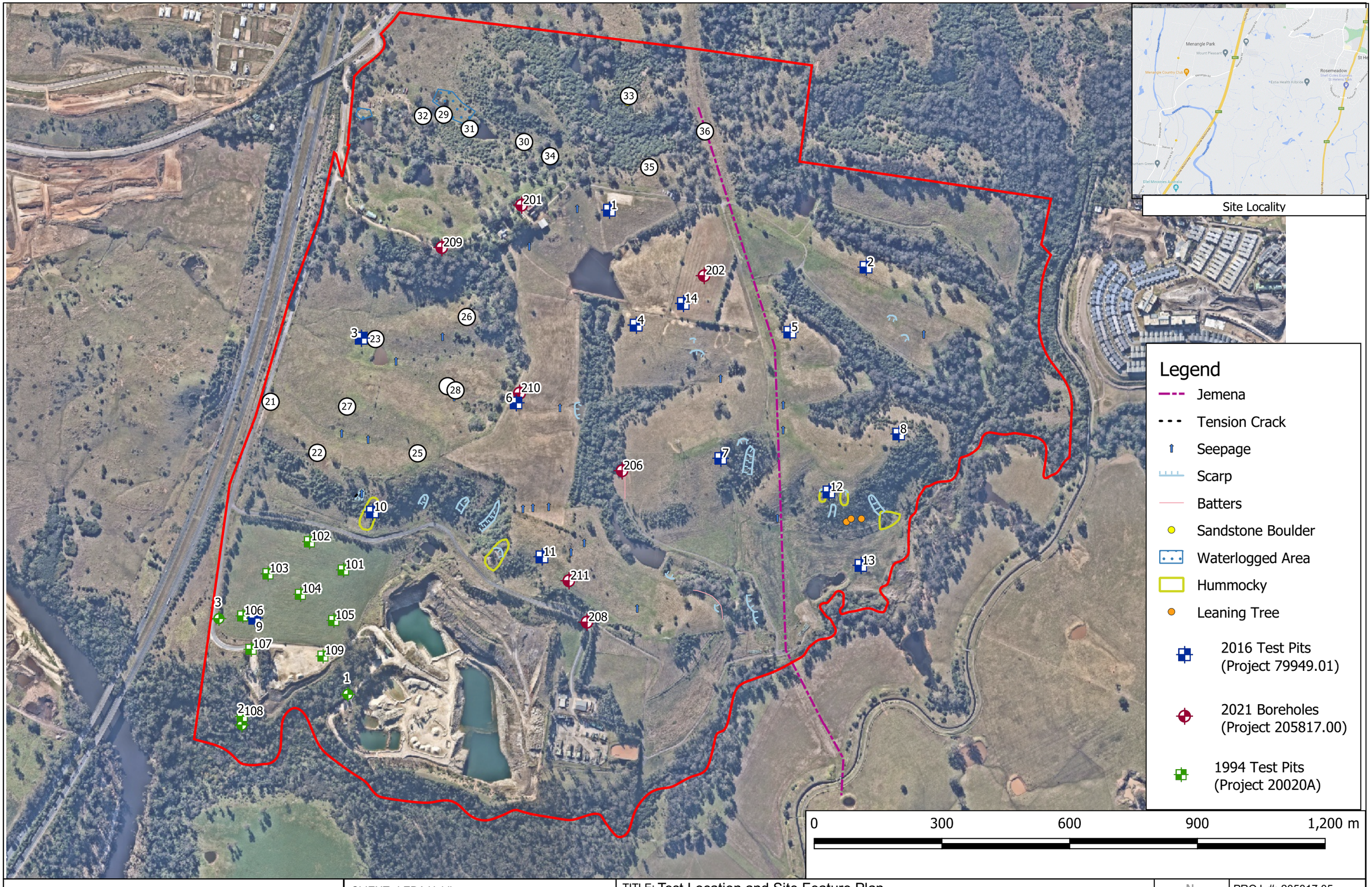
Appendix B

Drawings 1 – 3

Borehole Logs (DP Project 205817.00)

Test Pit Logs (DP Project 76649.01)

Test Pit and Borehole Logs (DP Project 20020A)



Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: LEDA Holdings		
OFFICE: Macarthur	DRAWN BY: ECR	
SCALE: As shown	DATE: 9 August 2022	

TITLE: Test Location and Site Feature Plan
Rezoning Planning Proposal
Medhurst Road, Menangle

PROJ. #: 205817.05	
DRAWING No:	1
REVISION:	A

Legend

Slope Angles

- 0 - 10° (0 - 18%)
- 10° - 15° (18% - 27%)
- 15° - 20° (27% - 36%)
- 20° - 30° (36% - 58%)
- 30° - 40° (58% - 84%)
- >40° (>84%)

0 300 600 900 1,200 m

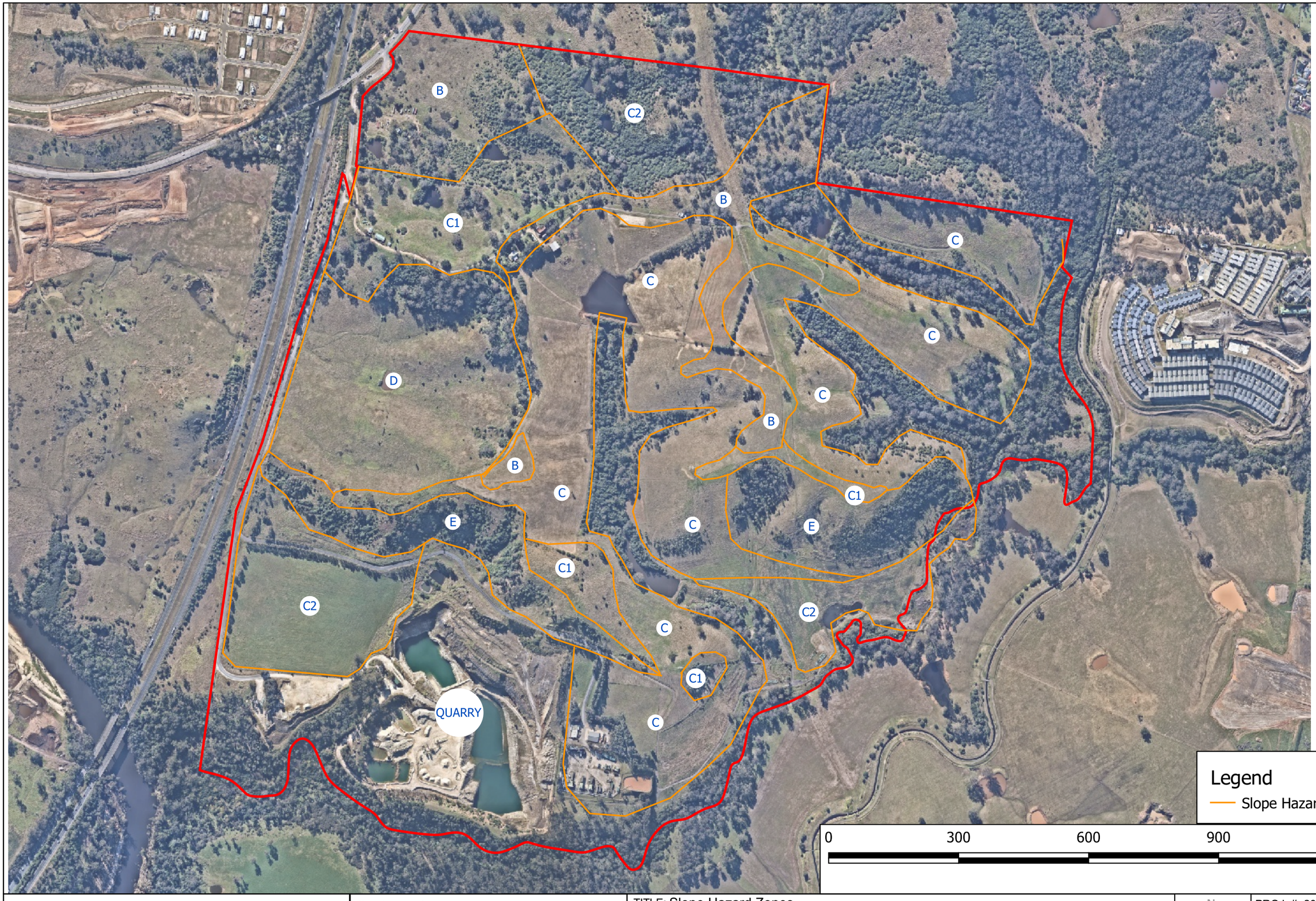
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: LEDA Holdings		
OFFICE: Macarthur	DRAWN BY: ECR	
SCALE: As shown	DATE: 9 August 2022	

TITLE: Slope Mapping
Rezoning Planning Proposal
Medhurst Road, Menangle

N
MGA

PROJ. #: 205817.05	
DRAWING No:	2
REVISION:	A



Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: LEDA Holdings		
OFFICE: Macarthur	DRAWN BY: ECR	
SCALE: As shown	DATE: 9 August 2022	

TITLE: Slope Hazard Zones
Rezoning Planning Proposal
Medhurst Road, Menangle

N
MGA

PROJ. #: 205817.05	
DRAWING No:	3
REVISION:	A

BOREHOLE LOG

CLIENT: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 160.6 mAHD
EASTING: 294022
NORTHING: 6223404
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 205817.00
DATE: 30/6/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
160	0.1	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, dark brown, with gravel, sand and rootlets, w>PL							A			
	0.7	FILL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with sand, trace gravel, w~PL							A			
	0.9	Silty CLAY CI-CH: medium to high plasticity, brown, trace rootlets, w<PL, apparently stiff, residual							A			
159	1	SANDSTONE: fine to medium grained, pale brown, very low strength with medium and high strength bands, extremely to slightly weathered, fractured, Bringelly Shale						1.16m: J, 60-80°, ir, clay vn 1.52m: B, 5°, pl, clay 2mm, fe 1.58m: B, 5°, pl, fe 1.85m: J, 45°, pl, clay 10mm 1.91m: B, 0°, pl, fe 1.92-2.03m: Ds, 90mm, fe 2.05m: J, 45°, pl 2.08-2.23: Bx5, 0-10°, pl	C	100	0	PL(A) = 1.62
158	2								C	100	0	
157	2.81	SANDSTONE: fine to medium grained, pale brown, medium to high strength with very high strength bands, moderately weathered then slightly weathered, fractured to slightly fractured, Bringelly Shale						2.27-2.52m: Ds, 250mm 2.55m: J, 45°, pl, clay 2mm 2.83m: B, 5°, pl, clay vn, fe 2.87m: B, 5°, pl, clay 2mm 3.32m: B, 10°, pl, fe 3.73m: B, 5°, pl, fe 4.01-4.09m: Bx4, 5-10°, fe, clay 1mm 4.09-4.10m: DS, 13mm, fe 4.18m: J, 80°, pl, fe, B, 10°, pl, fe 4.32-4.43m: Bx4, pl, clay 0-10mm, fe 4.62m: B, 10°, pl, fe 4.79m: J, 70-80°,pl, fe 4.86m: B, 10°, pl, fe 5.6m: J, 60°, pl, fe 5.66m: J, 80°, pl, fe 5.79-5.87m: Bx4, 0-10°, pl, clay 0-2mm 5.87-5.92m: Ds, 50mm 6.27m: J, 60°, pl, fe 6.44m: J, 45-60°, st, fe 6.49m: B, 10°, pl, fe 6.51m: J, 80°, ir, fe 6.76-6.87m: Bx2, 0-10°, pl, clay 1mm 6.98m: J, 60-85°, st, fe 7.16m: J, 30°, pl, fe 7.28m: J, 60°, pl, fe 7.37m: B, 15°, pl, fe 7.8m: J, 10° & 20°, st, fe	C	100	93	PL(A) = 0.44 PL(A) = 0.73 PL(A) = 3.83 PL(A) = 0.38 PL(A) = 2.42
156	4											
155	5											
154	6								C	100	88	PL(A) = 2.2 PL(A) = 1.69 PL(A) = 0.64 PL(A) = 1.95
153	7											
152	8											
151	8.02	Bore discontinued at 8.02m - limit of investigation										
	9											

RIG: Explorer **DRILLER:** Groundtest **LOGGED:** RB **CASING:** HQ to 0.9m

TYPE OF BORING: SFA to 1.0m, NMLC coring to 8.02m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 171.7 mAHD
EASTING: 294452
NORTHING: 6223238
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 205817.00
DATE: 30/6/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (XW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
171	0.1	TOPSOIL/Silty CLAY CI-CH: medium to high plasticity, red brown, trace gravel and rootlets, w~PL, residual							A			
	1	Silty CLAY CI-CH: medium to high plasticity, brown, trace ironstone gravel, w<PL, apparently stiff, residual - weathered rock below 1.2m							A			
170	1.77	SANDSTONE: fine to medium grained, pale brown, medium strength with very high strength fine grained sandstone layer, extremely weathered then moderately weathered, fractured, Bringelly Shale						1.77-2.28: Ds, 500mm, fe				
	2											
	2.35							2.28m: CORE LOSS: 70mm 2.41m: B, 5°, pl, fe 2.48m: Jx2, 60-90°, pl/cu, fe	C	97	49	PL(A) = 1.29
169	3							3.16-3.31m: Jx3, 60°, pl, fe 3.39m: J, 80-90°, ir, fe 3.55m: J, 45°, pl, fe, clay vn				PL(A) = 4.25
168	4							3.68-3.74m: Ds, 60mm, fe 3.81m: B, 10°, pl, clay 3mm, fe 3.95m: B, 10°, pl, cbs 1mm				PL(A) = 0.51
	4.05	SANDSTONE: fine to medium grained, pale brown, medium strength, moderately weathered, slightly fractured, Bringelly Shale						4.05m: B, 10°, pl, cbs 2mm	C	100	98	PL(A) = 0.93
167	5							5.10-5.11m: Ds, 10mm, cbs, fe				PL(A) = 1.18
166	6											
	6.0	SHALE: pale grey to brown, medium strength, moderately weathered then highly weathered then extremely weathered, fractured, Bringelly Shale						6.0-7.40m: Jx15, 45°, pl, clay vn, fe 6.14-7.30m: Bx9, 0-10°, clay 0-3mm, fe	C	100	12	PL(A) = 0.54
165	7											PL(A) = 0.58
	7.46	Bore discontinued at 7.46m - limit of investigation										
164	8											
163	9											
162												

RIG: Explorer **DRILLER:** Groundtest **LOGGED:** RB **CASING:** HQ to 1.6m

TYPE OF BORING: SFA to 1.2m, NMLC coring to 8.2m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 129.7 mAHD
EASTING: 294258
NORTHING: 6222780
DIP/AZIMUTH: 90°/--

BORE No: 206
PROJECT No: 205817.00
DATE: 30/6/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (XW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
129	0.2	FILL/Silty CLAY CI: medium plasticity, brown to dark brown, with siltstone gravel, trace rootlets, w>PL							A			
	0.9	Silty CLAY CI-CH: medium to high plasticity, red brown, trace ironstone gravel, w<PL, apparently stiff, residual							A			
128	1.27	SHALE: grey with brown, very low to medium strength with high strength band, moderately weathered, highly fractured to fractured, Ashfield Shale						1m: CORE LOSS: 270mm 1.27-1.44m: Jx2, 45°, pl, fe, clay 5mm 1.51-1.74m: Bx4, 0-10°, pl, fe, clay 1-4mm 1.78-1.82m: Ds, 40mm, fe	C	75	15	PL(A) = 0.32
127	2.23							1.85-1.91m: Bx2, 0-10°, pl, fe 1.96-2.0m: Ds, 40mm, fe 2.02-2.11m: Bx4, 0-10°, pl, clay 1-8mm 2.11m: CORE LOSS: 120mm 2.23-3.29m: Bx16, 0-10°, pl, clay 1-9mm, fe 2.44-2.48m: Cs, 40mm, fe 2.48-3.24m: Jx9, 30-70°, pl/st, clay 0-3mm, f 2.65-2.67m: Cs, 20mm, fe 2.69-2.71m: Cs, 20mm, fe 3.29m: J, 90°, pl 3.46m: B, 0°, pl, clay 2mm 3.52m: B, 0°, pl, clay vn 3.59-3.61m: Cs, 20mm, fe 3.64-4.21m: Bx16, 0-5°, pl, fe 3.74-4.13m: J, 70-90°, pl/ir, clay vn, fe 4.28-4.82m: Bx5, 0-10°, fe, clay vn 5.2m: J, 60°, pl, fe 5.51m: B, 0°, pl, fe 5.64-5.66m: Bx2, 0-10°, pl, fe	C	96	32	PL(A) = 1.46 PL(A) = 0.52 PL(A) = 0.48 PL(A) = 0.8
126	3.97	SANDSTONE: medium to fine grained, pale brown, medium to high strength with very low to low strength bands, moderately weathered, fractured to slightly fractured, Hawkesbury Sandstone										
125												
124									C	100	82	PL(A) = 2.68
123	5.95	Bore discontinued at 5.95m - limit of investigation										
122												
121												
120												

RIG: Explorer **DRILLER:** Groundtest **LOGGED:** RB **CASING:** HQ to 0.9m

TYPE OF BORING: SFA to 0.9m, rotary to 1.0m, NMLC coring to 5.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. 100% water loss at 5.0m

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 127.8 mAHD
EASTING: 294175
NORTHING: 6222425
DIP/AZIMUTH: 90°/--

BORE No: 208
PROJECT No: 205817.00
DATE: 30/6/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Type	Core Rec. %	RQD %	Test Results & Comments
127	0	FILL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with sand, trace gravel, w<PL	A			
		- becoming brown below 0.2m	A			
	1	- highly weathered Bringelly Shale band at 0.8m	A			
	1.2					
	1.4	Silty CLAY CI-CH: medium to high plasticity, red brown, trace ironstone gravel, residual	C	82	0	
126	2					
	2.0	SHALE: pale grey with brown, 10-20% fine grained sandstone laminations, medium strength with very low strength bands, highly weathered then moderately weathered bands, fractured, Ashfield Shale				
125	3					
	3.17		C	72	13	PL(A) = 0.53
124	4					
123	5					PL(A) = 0.67
122	5.81	SHALE: grey, 0-5% fine grained sandstone lamination, medium then medium to high strength, slightly weathered, fractured then slightly fractured, Ashfield Shale				PL(A) = 0.46
121	6		C	100	31	PL(A) = 0.98
120	7					PL(A) = 0.99
	8					
119	8.2	Bore discontinued at 8.2m - limit of investigation				
118	9					

Degree of Weathering: XW, HW, MW, SW, FS, FR
Graphic Log
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Water
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00

Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)

- 1.2m: CORE LOSS: 200mm
- 2m: J, 80°, pl
- 2.30-2.34m: Cs, 40mm
- 2.34m: CORE LOSS: 830mm
- 3.44m: J, 45°, pl, clay 1mm
- 3.54-3.75m: Bx5, 0-10°. clay 1-3mm
- 3.70-3.79m: Jx2, 30-45°, pl
- 3.83-3.93m: Jx2, 45°, pl
- 3.92m: B, 0°, pl, clay 2mm
- 4.09m: B, 0°, pl, clay 2mm
- 4.21-4.23m: Ds, 20mm fe
- 4.23-5.40m: Jx13, 45-90°, pl/st/ir, clay 0-2mm
- 4.23-5.84m: Bx23, 0-15°, pl/ir, fe, clay 0-8mm
- 4.4-4.42m: DS, 20mm, fe
- 5.45-5.48m: Ds, 30mm, fe
- 6.02m: B, 10°, pl, fe
- 6.07-6.49m: Jx5, 60-90°, pl, clay vn
- 6.24-6.53m: Bx4, 0-10°, clay 0-4mm
- 6.62-6.96m: Bx5, 0-5°, pl, clay 1mm, fe
- 7.08m: J, 45°, cu
- 7.15m: B, 5°, pl, clay 1mm
- 7.15-7.55m: Bx5, 0-10°, clay 0-2mm, fe
- 8.09m: B, 5°, pl
- 8.14m: B, 10°, pl, fe

RIG: Explorer **DRILLER:** Groundtest **LOGGED:** RB **CASING:** HQ to 1.2m

TYPE OF BORING: SFA to 1.2m, NMLC coring to 8.2m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 157.6 mAHD
EASTING: 293828
NORTHING: 6223301
DIP/AZIMUTH: 90°/--

BORE No: 209
PROJECT No: 205817.00
DATE: 15/7/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
157	0.3	FILL/Gravelly SAND: fine to coarse grained, pale brown, with clay and cobbles, moist, apparently well compacted							A			
		FILL/Sandy CLAY CL: low plasticity, brown, with sandstone and siltstone gravel, w<PL, apparently poorly compacted							A			
156	1								S			5,7,7 N = 14
	2								S			2,13,25 N = 38
155	3							2.6m: CORE LOSS: 750mm				
154	3.35	Sandy CLAY CL: low plasticity, pale brown and red brown, trace ironstone gravel, residual						3.35-3.70m: Ds 350mm, fe				
	3.7	SHALE: pale brown with grey, very low to low strength, highly weathered then moderately weathered, fractured, Bringelly Shale						3.7m: B, 10°, pl, fe, clay vn 3.74m: J, 60-70°, pl, fe 3.81m: B, 10°, pl, fe 3.88m: J, 45°, pl, fe 4.08-4.56m: Ds 480mm, fe 4.66-4.82m: Ds 160mm, fe 4.82m: J, 45°, pl, caly 2mm 5.05-5.07m: Bx3, 10°, pl, clay 0-5mm	C	75	18	PL(A) = 0.34
153	4											
152	5											
	6							5.20-5.34m: Ds 140mm, fe 5.34m: J, 80°, pl 5.52m: B, 5°, pl, clay 5mm 5.65m: J, 30°, pl, clay 1mm 5.74-5.76m: Cs 20mm 5.92m: J, 60°, pl, fe 6.18m: J, 20°, pl, clay vn 6.33-3.81m: Jx5, 60°, pl, clay 0-3mm, fe 6.97m: J, 80°, pl, fe 7.05-7.09m: Jx2, 45°, pl 7.42m: J, 20°, pl, fe 7.83m: B, 5°, pl, clay 2mm 8.26m: J, 20°, pl, fe 8.47-8.57m: Bx2, 0°, pl, clay 0-2mm 8.61m: J, 60°, pl, fe 8.67m: Cs 10mm, fe 8.75-8.91m: Bx3, 0-10°, pl, fe 9m: Cs 10mm 9.11m: B, 0°, pl, clay 4mm 9.17m: J, 70°, pl, fe 9.34m: B, 5°, pl, fe	C	100	5	PL(A) = 0.38
151	7											
150	8											
149	8.68	SHALE: pale brown then grey, low to medium strength with very low strength bands (sometimes carbonaceous), moderately weathered then slightly weathered, fractured, Bringelly Shale							C	100	59	PL(A) = 0.14 PL(A) = 0.35
148	9											

RIG: Hanjin 8D **DRILLER:** Rockwell **LOGGED:** RB **CASING:** HQ to 2.6m

TYPE OF BORING: SFA to 2.6m, rotary to 8.68m, NMLC coring to 13.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 157.6 mAHD
EASTING: 293828
NORTHING: 6223301
DIP/AZIMUTH: 90°/--

BORE No: 209
PROJECT No: 205817.00
DATE: 15/7/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (XW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
147	11	SHALE: pale brown then grey, low to medium strength with very low strength bands (sometimes carbonaceous), moderately weathered then slightly weathered, fractured, Bringelly Shale *(continued)*						9.48-9.91m: Bx4, 0-10°, pl, fe 9.57m: J, 20°, pl, fe 9.91m: J, 70°, pl, fe 10.0-10.02m: cbs 10.08m: B, 0-10°, pl, fe 10.54m: J, 30°, cu 10.96-11.03m: cbs 11.25-11.31m: Bx2, 0-10°, pl, fe 11.47-11.49m: Bx2, 0-15°. pl, fe 11.65m: B, 5°, pl, fe	C	100	59	PL(A) = 0.69 PL(A) = 0.37
146	11.1	SHALE: grey, with fine grained sandstone bands, medium strength then high strength, slightly weathered then fresh, slightly fractured, Bringelly Shale										
145	12								C	100	100	PL(A) = 0.61 PL(A) = 1.18 PL(A) = 1.16
144	13											
143	13.1	Bore discontinued at 13.1m - limit of investigation										
142	14											
141	15											
140	16											
139	17											
138	18											
	19											

RIG: Hanjin 8D **DRILLER:** Rockwell **LOGGED:** RB **CASING:** HQ to 2.6m

TYPE OF BORING: SFA to 2.6m, rotary to 8.68m, NMLC coring to 13.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 161.6 mAHD
EASTING: 294013
NORTHING: 6222962
DIP/AZIMUTH: 90°/--

BORE No: 210
PROJECT No: 205817.00
DATE: 15/7/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
161	0.25	TOPSOIL/Silty CLAY CI: medium plasticity, dark brown, trace sand and rootlets, w<PL, apparently firm, residual							A			
	0.55	Silty CLAY CI-CH: medium to high plasticity, red brown, trace sand, w<PL, apparently stiff, residual							A			
160	1	Sandy CLAY CL: low plasticity, pale brown, w<PL, hard, residual - carbonaceous bands between 1.5 - 2.1m							A S			12,20/70mm,-refusal
	2.1								S			25/100mm,-,-refusal
159		SANDSTONE: fine to medium grained, pale brown, with carbonaceous bands, medium strength with very low strength bands, moderately weathered with extremely weathered bands, fractured to slightly fractured, Bringelly Shale						2.35m: B, 0-10°, pl, clay 7mm 2.5m: J, 70°, pl, fe 2.56m: B, 5°, pl, fe 2.63-2.91m: Ds 280mm 3.09m: B, 10°, pl, clay 5mm 3.31m: B, 5°, pl, clay 2mm 3.52-3.54m: Ds 20mm 3.66-3.70m: Bx2, 10°, pl 3.99m: J, 45°, cu	C	100	46	PL(A) = 0.4
158	3.8	SANDSTONE: fine to medium grained, pale brown with grey, with carbonaceous bands, medium to high strength, fractured to slightly fractured, moderately weathered, Bringelly Shale						4.30-4.40m: Bx4, 0-10°, pl, cbs 4.31m: J, 50°, pl 4.57m: B, 0°, pl, cbs 5.33m: B, 0-10°, pl, cbs 5mm 5.59m: B, 10°, pl, cbs 5.7m: B, 10°, pl, cbs 3mm 5.84m: B, 10°, pl, cbs 5.93-5.94m: Bx2, 0-10°, pl 6.25m: B, 5°, pl, cbs, B, 0-10°, cbs, cu	C	100	83	PL(A) = 1.36 PL(A) = 0.41 PL(A) = 0.99 PL(A) = 2.82
157	6.02	SANDSTONE: fine to medium grained, blue-grey, high strength, fresh, slightly fractured, Bringelly Shale							C	100	100	PL(A) = 1.47 PL(A) = 1.02
153									C	100	100	PL(A) = 1.38 PL(A) = 1.56

RIG: Hanjin 8D **DRILLER:** Rockwell **LOGGED:** RB **CASING:** HQ to 2.2m

TYPE OF BORING: SFA to 2.17m, NMLC coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 161.6 mAHD
EASTING: 294013
NORTHING: 6222962
DIP/AZIMUTH: 90°/--

BORE No: 210
PROJECT No: 205817.00
DATE: 15/7/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (XW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
151	11	SANDSTONE: fine to medium grained, blue-grey, high strength, fresh, slightly fractured, Bringelly Shale *(continued)*						10.11m: J, 50°, pl 10.41m: J, 50°, pl	C	100	100	PL(A) = 2.47
150	12							11.28m: B, 10°, pl, fe 11.69m: B, 10°, pl, fe 11.72m: J, 35°, pl, fe, he 11.73m: J, 30°, pl, fe 11.74m: J, 35°, pl, fe, he 11.94m: J, 20°, pl, fe	C	100	100	PL(A) = 1.84 PL(A) = 2.82 PL(A) = 5.42
149	13 13.0	Bore discontinued at 13.0m - limit of investigation										
148	14											
147	15											
146	16											
145	17											
144	18											
143	19											
142												

RIG: Hanjin 8D **DRILLER:** Rockwell **LOGGED:** RB **CASING:** HQ to 2.2m

TYPE OF BORING: SFA to 2.17m, NMLC coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 153.6 mAHD
EASTING: 294131
NORTHING: 6222526
DIP/AZIMUTH: 90°/--

BORE No: 211
PROJECT No: 205817.00
DATE: 16/7/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
153	0.35	TOPSOIL/Silty CLAY CI-CH: medium to high plasticity, dark brown, with rootlets, w>PL, residual							A			
	0.6	Silty CLAY CI-CH: medium to high plasticity, brown, trace rootlets, w<PL, apparently stiff, residual							A			
	1	Sandy CLAY CL: low plasticity, pale brown, w<<PL, hard, residual							A S			15,25/70mm,- refusal
	1.22	SANDSTONE: fine to medium grained, pale brown, with fine to coarse grained siltstone gravel and bands, very low to low strength with high strength bands, highly weathered then moderately weathered, fractured, Bringelly Shale						1.3m: J, 30°, pl, clay 5mm, fe 1.43m: B, 0°, pl, clay 2mm, fe 1.54m: B, 0°, pl, fe 1.56m: J, 45°, pl, fe 1.88m: B, 0°, pl, clay 5mm 2.1m: J, 45°. pl, clay 5mm 2.25m: J, 45°, ir, clay vn, B, 0°, pl, cbs, clay vn 2.35m: J, 60°, pl, clay 3mm, fe 2.51m: CORE LOSS: 940mm	C	100	0	PL(A) = 0.02
152	2											
151	3											
	3.45							3.60-4.06m: Bx9, 0-10°, pl, clay 0-5mm, fe 3.68-3.71m: Ds 30mm, fe 3.82m: J, 70°, pl, fe 4m: J, 30°, pl, fe 4.21m: J, 45°, pl, fe 4.31m: B, 5°, pl, fe 4.56m: J, 45°, pl, fe 4.75m: J, 45°, pl, fe 4.97m: J, 45°, pl, fe 5.04-5.53m: Bx5, 0-10°, pl, clay 0-4mm, fe	C	70	29	PL(A) = 1.67 PL(A) = 0.05 PL(A) = 0.28 PL(A) = 1.14
150	4											
149	5											
148	5.76							5.58-5.60m: Cs 20mm 5.6m: CORE LOSS: 160mm 5.86-6.07m: Ds 210mm 6.13m: J, 30°, pl, clay 2mm, fe				
	6											PL(A) = 0.06
147	7							6.53m: J, 15°, pl, cbs 6.59m: J, 25°, pl, fe 6.69m: Cs 10mm, fe 6.76m: Jx2, 20° & 60°, pl, fe 6.9m: J, 30°, pl 7.03-7.15m: Jx3, 45-60°, pl, fe 7.24-7.76m: Bx4, 0-10°, clay 0-2mm, fe 7.96m: J, 45°, pl, fe	C	99	29	PL(A) = 0.09
146	8											
	8.3	SHALE: dark grey with orange, with carbonaceous bands, low to medium strength with extremely low and very low strength bands, moderately weathered, fractured to slightly fractured, Bringelly Shale - carbonaceous between 8.5 - 8.7m						8.38-8.48m: Bx2, 0-10°, clay 2-4mm, fe 8.58m: J, 60°, pl 8.7m: B, 10°, pl 9.04m: J, 0° & 30°, st 9.14m: J, 60°, pl 9.39m: B, 0°, pl, fe 9.55m: B, 0°, pl, fe				PL(A) = 0.06 PL(A) = 0.22 PL(A) = 0.13
145	9								C	100	86	
144												PL(A) = 0.61

RIG: Hanjin 8D **DRILLER:** Rockwell **LOGGED:** RB **CASING:** HQ to 1.25m

TYPE OF BORING: SFA to 1.22m, NMLC coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Leda Holdings Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Rosalind Park, Medhurst Road, Menangle, NSW

SURFACE LEVEL: 153.6 mAHD
EASTING: 294131
NORTHING: 6222526
DIP/AZIMUTH: 90°/--

BORE No: 211
PROJECT No: 205817.00
DATE: 16/7/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
143	10.65	SHALE: dark grey with orange, with carbonaceous bands, low to medium strength with extremely low and very low strength bands, moderately weathered, fractured to slightly fractured, Bringelly Shale						9.94m: B, 5°, pl, fe 10.05-10.09m: Ds 40mm 10.34-10.36m: Cs 20mm 10.38m: Cs 10mm 10.5-10.55m: Cs 50mm 10.59-10.63m: Cs 40mm 10.64m: Cs 10mm 10.84m: B, 5°, pl, fe 11.14m: J, 60°, pl, he 11.55-11.57m: Bx2, 0-10°, pl, fe 11.69-12.71m: Bx8, 0-10°, pl, clay 0-2mm, fe 12.51m: J, 45°, pl	C	100	86	PL(A) = 0.69
	11								C	100	80	PL(A) = 0.67 PL(A) = 0.84
142	12	LAMINITE: pale brown to red brown, with 20-30% fine sandstone lamination, medium strength with a very high strength band, moderately weathered, fractured to slightly fractured, Bringelly Shale							C	100	94.6	PL(A) = 3.29
141	13											PL(A) = 0.9
	13.0	Bore discontinued at 13.0m - limit of investigation										
140	14											
139	15											
138	16											
137	17											
136	18											
135	19											
134												

RIG: Hanjin 8D **DRILLER:** Rockwell **LOGGED:** RB **CASING:** HQ to 1.25m

TYPE OF BORING: SFA to 1.22m, NMLC coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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

TEST PIT LOG

CLIENT: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 157.9 mAHD
EASTING: 294222
NORTHING: 6223403

PIT No: 1
PROJECT No: 76649.01
DATE: 28/4/2016
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 mm)
157	0.15	TOPSOIL - grey and brown, friable, fissured, silty clay with abundant rootlets, humid (COLLUVIUM)							
	0.3	SILTY CLAY - hard, brown and grey, friable, slightly cobbly, silty clay with some coarse gravel (sandstone) and root fibres, humid (COLLUVIUM)		D	0.2		pp >600		
		CLAY - hard, light to mid orange brown, fissured, slightly silty, slightly sandy clay with some root fibres, humid		D	0.3				
	0.9				0.5		pp >600		
		SANDSTONE - very low strength, highly weathered, orange brown, fine to medium grained sandstone with some extremely low strength, extremely weathered bands		D	0.6				
156	1.4	Pit discontinued at 1.4m - refusal on medium strength sandstone			1.0				
					1.1				
155									
154									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: RJH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 145.2 mAHD
EASTING: 294823
NORTHING: 6226367

PIT No: 2
PROJECT No: 76649.01
DATE: 28/4/2016
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 mm)
145	0.15	TOPSOIL - grey and brown, friable, fissured, silty clay with abundant rootlets, humid							
		SILTY CLAY - hard, orange brown, fissured silty clay with trace rootlets, humid (RESIDUAL)		D	0.5		pp >600		
					0.6				
	0.9	SILTSTONE - low strength, moderately to slightly weathered, orange brown and grey sandy siltstone		D	1.0				
144	1				1.1				1
				D	1.5				
	1.6	Pit discontinued at 1.6m - limit of investigation			1.6				
	2								2
143									
	3								3
142									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 112.5 mAHD
EASTING: 293638
NORTHING: 6223097

PIT No: 3
PROJECT No: 76649.01
DATE: 28/4/2016
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 mm)
	0.15	TOPSOIL - grey and brown, friable, slightly silty clay with abundant rootlets, humid							
		SILTY CLAY - hard, red and grey, fissured, silty clay with some rootlets, humid (POSSIBLE COLLUVIUM)							
112		- with some fine gravel (ironstone) below 1.0m		D	0.5		pp >600		
					0.6				
	1			D	1.0		pp >600		1
					1.1				
111		- becoming red brown mottled light grey with trace rootlets below 1.4m		D	1.5		pp >600		
					1.6				
	2	- with randomly oriented fine to coarse ironstone, siltstone and sandstone at 2.0m (POSSIBLE SLIP PLANE)		D	2.0		pp >320-600		2
					2.1				
110	2.5	SILTY CLAY - stiff to hard, orange brown mottled light grey, friable, slightly sandy, silty clay with some extremely low to medium strength, extremely to highly weathered siltstone and sandstone bands (RESIDUAL)		D	2.5		pp >200-600		
					2.6				
	2.9	SILTSTONE - low to medium strength, highly to moderately weathered, orange brown and light grey siltstone							
	3			D	3.0				3
	3.1	Pit discontinued at 3.1m - limit of investigation			3.1				
109									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: RJH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 144.5 mAHD
EASTING: 294281
NORTHING: 6223130

PIT No: 4
PROJECT No: 76649.01
DATE: 28/4/2016
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 mm)
144	0.2	TOPSOIL - brown, friable, fissured, clayey silt, humid							
		SILTY CLAY - hard, red brown, fissured, silty clay with trace rootlets and fine to coarse gravel (ironstone), humid (RESIDUAL)		D	0.5		pp <600		
					0.6				
	1	- becoming orange brown below 0.9m		D	1.0		pp <600		1
		- becoming mottled black below 1.1m			1.1				
143	1.5	SANDSTONE - extremely low to very low strength, extremely to highly weathered, grey and brown sandstone		D	1.5		pp <600		
					1.6				
	2			D	2.0				2
	2.1	Pit discontinued at 2.1m - limit of investigation			2.1				
142	3								3
141									

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

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 153.9 mAHD
EASTING: 294644
NORTHING: 6223107

PIT No: 5
PROJECT No: 76649.01
DATE: 28/4/2016
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 mm)
153	0.2	TOPSOIL - brown, friable, fissured, silty clay with tabular sandstone boulders (800 x 600 x 50mm) and abundant rootlets, humid							
		SILTY CLAY - hard, red brown, fissured, silty clay with trace rootlets, humid (RESIDUAL)		D	0.5 0.6		pp >600		
	0.7	SANDSTONE - low to medium strength, moderately weathered, grey brown sandstone		D	1.0 1.1				
152	1.2	Pit discontinued at 1.2m - refusal on medium strength sandstone							
151									
150									

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1, 2, 3

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 161.5 mAHD
EASTING: 294007
NORTHING: 6222944

PIT No: 6
PROJECT No: 76649.01
DATE: 28/4/2016
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 mm)
161	0.15	TOPSOIL - brown, friable, silty clay with abundant rootlets, humid							
	0.4	SILTY CLAY - hard, dark red brown slightly friable, silty clay with some rootlets, humid (RESIDUAL)							
		SANDSTONE - very low to low strength, highly weathered, orange brown fine to medium grained sandstone with some rootlets in joints		D	0.5 0.6		pp >600		
160	1.0	Pit discontinued at 1.0m - limit of investigation							
159									
158									

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1, 2, 3

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 154.3 mAHD
EASTING: 294484
NORTHING: 6222817

PIT No: 7
PROJECT No: 76649.01
DATE: 28/4/2016
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)
154	0.15	TOPSOIL - brown, friable, fissured, clayey silt, humid			0.15		pp >600		
		SILTY CLAY - hard, orange brown, slightly friable, fissured, silty clay with trace rootlets, humid (RESIDUAL)		D	0.5		pp >600		
		- becoming yellow brown below 0.7m			0.6				
153	1.0	SILTSTONE - very low to low strength, moderately to highly weathered, red brow slightly sandy siltstone		D	1.0				
					1.11				
		- becoming low to medium strength, slightly to moderately weathered, grey below 1.5m		D	1.5				
					1.6				
				D	1.9				
152	2.0	Pit discontinued at 2.0m - limit of investigation			2.0				
151	3								

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 146.9 mAHD
EASTING: 294872
NORTHING: 6222871

PIT No: 8
PROJECT No: 76649.01
DATE: 28/4/2016
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 mm)
146	0	TOPSOIL - red brown, slightly friable, fissured, silty clay with abundant rootlets and trace ironstone gravel, humid							
	0.2	SILTY CLAY - hard, red, fissured, silty clay with trace rootlets, humid (RESIDUAL)		D	0.2				
					0.3				
		- becoming mottled grey brown, slightly friable below 0.6m		D	0.6		pp >600		
					0.7				
	0.8	SILTSTONE - low to medium strength, slightly weathered, grey siltstone							
	1			D	1.1				1
					1.2				
		- becoming low strength with extremely low to very low strength, extremely to highly weathered banding between 1.6 - 2.0m		D	1.6				
					1.7				
145	2	- becoming low to medium strength with extremely low to very low strength bands below 2.0m							2
				D	2.2				
					2.3				
		- becoming medium strength below 2.5m		D	2.5				
	2.6	Pit discontinued at 2.6m - limit of investigation			2.6				
144	3								3
143									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 88.3 mAHD
EASTING: 293387
NORTHING: 6222439

PIT No: 9
PROJECT No: 76649.01
DATE: 29/4/2016
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 mm)
88	0.1	TOPSOIL - light grey and brown, friable, fissured, silty clay, humid							
		SILTY CLAY - hard, light grey brown, friable, fissured, silty clay with trace rootlets, humid - becoming red mottled grey with trace gravel (sandstone to volcanic) below 0.3m (ALLUVIAL)		D	0.5 0.6		pp >600		
87	1.1	SILTSTONE - low to medium strength, slightly weathered, grey siltstone with extremely low strength, extremely weathered and very low strength, highly weathered bands - with slightly clayey silt bands (up to 40mm) below 1.3m		D	1.1 1.2		pp >600		
				D	1.7		pp = 310		
86	1.8	- becoming medium strength below 1.7m Pit discontinued at 1.8m - refusal on medium strength siltstone			1.8				
85									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 123.8 mAHD
EASTING: 293664
NORTHING: 6222687

PIT No: 10
PROJECT No: 76649.01
DATE: 29/4/2016
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 mm)
	0.1	TOPSOIL - light grey and brown, fissured, gravelly silty clay, humid		D	0.1		pp >60		
	0.2	SILTY CLAY - low strength, moderately to slightly weathered, dark grey siltstone with very low strength bands and clay infilled joints, humid (RESIDUAL)			0.2				
123		SILTSTONE - low strength, moderately to slightly weathered, dark grey siltstone with very low strength bands and clay infilled joints		D	0.5				
					0.6				
	1	- becoming low to medium strength below 1.0m		D	1.0		pp >600		1
					1.1				
		- becoming hard, grey mottled orange, fissured clay band angling ~30° downslope below 1.2m (SHEARED ZONE)							
		- becoming hard, grey mottled orange clay band, horizontal at 1.4m		D	1.4				
		- becoming medium strength below 1.5m			1.5				
				D	1.6				
	1.7	Pit discontinued at 1.7m			1.7				
122		- limit of investigation							2
	2								
121									
	3								3
120									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 147.7 mAHD
EASTING: 294063
NORTHING: 6222586

PIT No: 11
PROJECT No: 76649.01
DATE: 29/4/2016
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 mm)
	0.1	TOPSOIL - dark red brown, friable, fissured, silty clay with abundant rootlets, humid							
147		SILTY CLAY - hard, dark red brown, friable, fissured, silty clay with trace coarse gravel and rootlets, humid (RESIDUAL)		D	0.5 0.6		pp >600		
	0.9								
	1	SANDSTONE - low strength, moderately weathered, grey brown sandstone		D	1.0 1.1				1
	1.3	- becoming medium strength, slightly weathered below 1.2m							
146		Pit discontinued at 1.3m - refusal on medium strength sandstone							2
145									3
144									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 150.5 mAHD
EASTING: 294738
NORTHING: 6222743

PIT No: 12
PROJECT No: 76649.01
DATE: 29/4/2016
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 mm)
150	0.2	TOPSOIL - brown, friable, fissured, silty clay with abundant rootlets and some cobbles (ironstone), humid (COLLUVIUM)							
		SILTY CLAY - hard. red brown, fissured, silty clay with trace gravel (ironstone) and some rootlets, humid (RESIDUAL)		D	0.4		pp >600		
		- becoming light grey with trace rootlets below 0.5m			0.5				
	0.7	SILTSTONE - very low strength, moderately to slightly weathered, dark grey siltstone		D	0.9		pp >600		
	1				1.0				1
		- becoming light grey below 1.15m							
		- with shaly coal bands between 1.4 - 1.5m		D	1.4				
149		- becoming low to medium strength, slightly weathered, dark grey below 1.5m			1.5				
	2								2
				D	2.0				
					2.1				
	2.4	SANDSTONE - low to medium strength, moderately to slightly weathered, yellow brown and light grey fine to medium grained sandstone		D	2.4				
148	2.5	Pit discontinued at 2.5m - limit of investigation			2.5				
	3								3
147									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 108.6 mAHD
EASTING: 294811
NORTHING: 6222566

PIT No: 13
PROJECT No: 76649.01
DATE: 29/4/2016
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 mm)
	0.0	TOPSOIL - grey and brown, friable, fissured, silty clay with abundant rootlets and some fine to coarse gravel (ironstone), humid							
	0.2	SILTY CLAY - hard, orange brown grey, fissured, silty clay with trace fine gravel (ironstone), humid (RESIDUAL)							
108				D	0.5		pp >600		
					0.6				
	1	- becoming mid to dark orange brown and grey, slightly gravelly (dolerite) between 0.9 - 1.2m		D	1.0		pp >600		1
					1.1				
		- with some coarse gravel (sandstone) between 1.4 - 1.6m							
107		- becoming very stiff to hard, mottled grey below 1.5m		D	1.5		pp = 400		
					1.6				
	2	- becoming stiff to very stiff, red and orange mottled grey, friable below 2.0m		D	2.0		pp = 180-270		2
					2.1				
106		- becoming very stiff, red mottled grey below 2.5m		D	2.5		pp = 210-270		
					2.6				
	3	- becoming very stiff, orange mottled grey below 3.0m		D	3.0		pp = 310-350		3
					3.1				
				D	3.4				
	3.5	Pit discontinued at 3.5m - limit of investigation			3.5				
105									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Lend Lease Group
PROJECT: Due Diligence
LOCATION: Medhurst Road, Gilead, NSW

SURFACE LEVEL: 164.8 mAHD
EASTING: 294397
NORTHING: 6223177

PIT No: 14
PROJECT No: 76649.01
DATE: 28/4/2016
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 mm)
164	0.15	TOPSOIL - brown, fissured, silty clay, dry							
		SILTY CLAY - hard, yellow brown, fissured, silty clay with trace fine gravel (ironstone) and trace root fibres, humid (RESIDUAL)		D	0.5		pp >600		
	0.6	CLAY - hard, mid to dark grey, fissured, clay with some silt and trace root fibres, humid (RESIDUAL)			0.6				
163	1.0	SILTSTONE - low strength, moderately weathered, brown to grey siltstone		D	1.0		pp >570-600		
		- becoming medium strength below 1.1m			1.1				
				D	1.5				
	1.6	Pit discontinued at 1.6m			1.6				
		- refusal on medium strength siltstone							
162									
161									

RIG: JCB 4CX excavator - 450mm bucket

LOGGED: ECR

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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 BORE REPORT

BORE No: 1

CLIENT: CLEARY BROS (BOMBO) PTY LTD | PROJECT No: 20020 | DATE: 16–17 MAY 94

PROJECT: PROPOSED FACILITY | SURFACE LEVEL: 84.0 | SHEET 1 OF 2

LOCATION: MENANGLE PARK QUARRY | DIP OF HOLE: 90° | AZIMUTH:

Depth (m)	Description of Strata	Degree of Weathering (EW, HW, MW, SW, FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Discontinuities (B – Bedding, J – Joint, S – Shear, D – Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
0	FILLING – ripped sandstone filling									
1.0	CLAY – dark grey clay									
2.0	CLAY – light brown sandy gravelly clay									
3.5	SHALE – very low strength, highly weathered (drillers log)									
5.0	SANDSTONE – extremely low strength, extremely weathered grey and brown sandstone									
5.45	SANDSTONE – medium strength, moderately weathered, slightly fractured light brown medium grained sandstone, cross bedded				6.30m: B 0° Fe 6.35m: B 0° Fe 7.45m: possible B 7.70m: B 0° 7.75–7.90m: J subvertical undulating 8.60m: B 0° 8.80m: B 10° Fe		C	100		
							C	95		Water Pressure Test >100 Lugeons (8.5–12.1m) Water Pressure
8.95										
9.1										
9.15										
9.35							C	93		
10.0										

RIG: SCOUT II | DRILLER: KIERNAN | LOGGED: MCMORRAN | CASING: HQ TO 5.45m

TYPE OF BORING: SF AUGER TO 5.45m THEN NQ CORING TO 16.85m

WATER OBSERVATIONS: WATER AT 16.8m (26/5/94 & 16/8/94)

REMARKS: TOTAL WATER LOSS AT 7.8m

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_s (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED:

Initials:

Date: 16/8/94

D.J. Douglas & Partners

TEST BORE REPORT

BORE No: 1

CLIENT: CLEARY BROS (BOMBO) PTY LTD | PROJECT No: 20020 | DATE: 16–17 MAY 94

PROJECT: PROPOSED FACILITY | SURFACE LEVEL: 84.0 | SHEET 2 OF 2

LOCATION: MENANGLE PARK QUARRY | DIP OF HOLE: 90° | AZIMUTH:

Depth (m)	Description of Strata	Degree of Weathering (EW, HW, MW, SW, FS, FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Discontinuities (B – Bedding, J – Joint, S – Shear, D – Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
10	SANDSTONE – medium strength, moderately weathered, slightly fractured, light brown medium grained sandstone				10.18m: B 0°					
11					11.10m: B 0° 10mm very low strength sandstone 11.12m: B 0° Fe 11.45m: J 45° rough planar Fe 11.65m: B 20° 2mm clay		C	93		
12										
12.1										
12.2					11.70m: B 5° Fe 11.75m: B 15° Fe 11.83m: B 20° Fe 11.90m: J 30° 5mm clay 11.98m: B 5° Fe 12.03m: B 0° 12.45m: J 45° 2mm clay 12.70m: B 15° (shale intraclast) 13.20m: B 0° 13.35m: B 10° Fe					Test >100 Lugeons (12.1–16.95m)
13	13.2m: shale intraclast and quartz pebble layer						C	97		
14					14.40m: B 5° Fe					
15	14.75m: 30mm moderately weathered shale				14.75m: B 0°					
16					15.95m: B 0° Fe		C	81		
16.23					16.20m: J subvertical Fe					
16.43										
16.7					16.60m: J 45° Fe and J subvertical Fe					
16.85										
16.95	SHALE – low strength, moderately weathered grey shale, possibly intraclast BORE DISCONTINUED AT 16.95 METRES									
18										
19										
20										

RIG: SCOUT II | DRILLER: KIERNAN | LOGGED: MCMORRAN | CASING: HQ TO 5.45m

TYPE OF BORING: SF AUGER TO 5.45m THEN NQ CORING TO 16.95m

WATER OBSERVATIONS: WATER AT 16.8m (26/5/94 & 16/8/94)

REMARKS: TOTAL WATER LOSS AT 7.8m

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_s (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED:

Initials:

Date: 16/8/94

D.J. Douglas & Partners

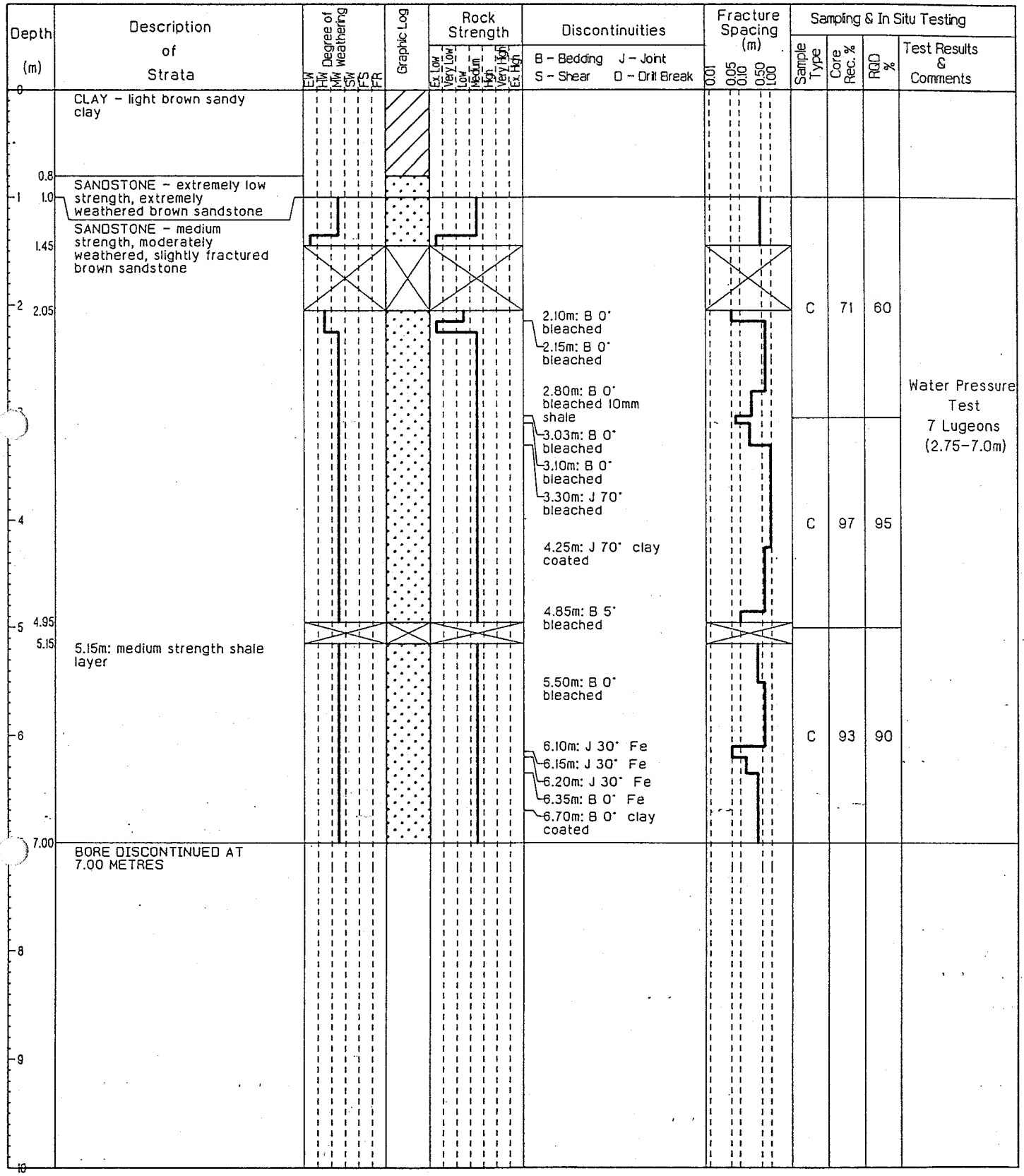
TEST BORE REPORT

BORE No: 2

CLIENT: CLEARY BROS (BOMBO) PTY LTD | PROJECT No: 20020 | DATE: 18 MAY 94

PROJECT: PROPOSED FACILITY | SURFACE LEVEL: 75.0 | SHEET 1 OF 1

LOCATION: MENANGLE PARK QUARRY | DIP OF HOLE: 90° | AZIMUTH:



RIG: SCOUT II | DRILLER: KIERNAN | LOGGED: MCMORRAN | CASING: HQ TO 1.00m

TYPE OF BORING: SF AUGER TO 1.00m THEN NQ CORING

WATER OBSERVATIONS: WET AT BASE 7.0m (26/5/94 & 16/8/94)

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_S (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED: Initials: Date: 16/8/94

D.J. Douglas & Partners

TEST BORE REPORT

BORE No: 3

CLIENT: CLEARY BROS (BOMBO) PTY LTD | PROJECT No: 20020 | DATE: 17–19 MAY 94

PROJECT: PROPOSED FACILITY | SURFACE LEVEL: 89.0 | SHEET 1 OF 2

LOCATION: MENANGLE PARK QUARRY | DIP OF HOLE: 90° | AZIMUTH:

Depth (m)	Description of Strata	Degree of weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex. High)	Discontinuities (B – Bedding, J – Joint, S – Shear, D – Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec.%	RQD %	Test Results & Comments
0	CLAY – light grey and brown sandy clay									
1.0	SANDSTONE – extremely low strength, extremely weathered grey and brown sandstone									
1.6	SANDSTONE – high strength, slightly weathered, slightly fractured, light grey fine grained sandstone with some dark grey shale laminations, ripple laminated				2.10m: B 0°		C	96	95	PL (A)=1.7 –Water Pressure Test 21 Lugeons (2.1–7.1m)
3.04										
3.10	SANDSTONE – medium strength, slightly weathered, slightly fractured, light grey and brown medium grained sandstone, cross bedded				3.20m: B 5° Fe 3.25m: B 0° Fe					
3.15										
3.43										
3.53					3.75m: J 45°		C	95	90	PL (A)=1.3MPa
6.20					6.20m: B 0°					
6.45	SANDSTONE – high strength, fresh, slightly fractured, light grey medium grained sandstone, crossbedded						C	100	100	PL (A)=1.1MPa –Water Pressure Test 0 Lugeons (7.1–12.1m)
10 10.0							C	100	100	

RIG: SCOUT II | DRILLER: KIERNAN | LOGGED: MCMORRAN | CASING: HQ TO 1.60m

TYPE OF BORING: SF AUGER TO 1.60m THEN NQ CORING

WATER OBSERVATIONS: WATER AT 13.1m (26/5/94) & 14.3m (16/8/94)

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_S (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED: Initials: Date: 26/9/94

D.J. Douglas & Partners

TEST BORE REPORT

BORE No: 3

CLIENT: CLEARY BROS (BOMBO) PTY LTD | PROJECT No: 20020 | DATE: 17–19 MAY 94

PROJECT: PROPOSED FACILITY | SURFACE LEVEL: 89.0 | SHEET 2 OF 2

LOCATION: MENANGLE PARK QUARRY | DIP OF HOLE: 90° | AZIMUTH:

Depth (m)	Description of Strata	Degree of weathering (EW, HW, MW, SW, FS, FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Discontinuities (B – Bedding, J – Joint, S – Shear, D – Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
10	SANDSTONE – high strength, fresh, slightly fractured, light grey medium grained sandstone, crossbedded						C	100	100	
11										
12										-Water Pressure Test 1 Lugeons (12.1–17.0m) PL (A)=1.6MPa PL (D)=1.2MPa
13							C	100	100	
14										
15					15.0–15.1m: compressive drilling breaks					
16	2mm thick coal layers at 16.10 and 16.15m						C	100	100	
17.0	BORE DISCONTINUED AT 17.00 METRES									
18										
19										
20										

RIG: SCOUT II | DRILLER: KIERNAN | LOGGED: MCMORRAN | CASING: HQ TO 1.60m

TYPE OF BORING: SF AUGER TO 1.60m THEN NQ CORING

WATER OBSERVATIONS: WATER AT 13.1m (26/5/94) & 14.3m (16/8/94)

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_s (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED: Initials: Date: 16/6/94

D.J. Douglas & Partners

TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
PROJECT: PROPOSED FACILITY
LOCATION: MENANGLE PARK QUARRY

DATE: 16 MAY 94
PROJECT No.: 20020
SURFACE LEVEL: 99.5

PIT No. 101
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – brown silty topsoil with abundant shale fragments to 150mm in lower 200mm (colluvium)	D	0.60	
0.40	CLAY – hard orange brown mottled grey clay. Slightly moist. Fine rootlets throughout. Grades to underlying			
0.8	MUDSTONE – extremely low strength, light orange grey mudstone with few fine rootlets. Slightly moist.			
1.0	MUDSTONE – low to medium strength, dark grey mudstone with few extremely low strength (10–30mm wide) bedding plane seams. Excavates on bedding planes spaced 10–30mm			
2.2	TEST PIT DISCONTINUED AT 2.20 METRES – slow excavation in medium strength mudstone			

RIG: CASE 580C

LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF SOUTHERN FACE

SAMPLING & TESTING

D disturbed sample — pp pocket penetrometer (kPa)
B bulk sample — Ux x mm dia. tube

CHECKED:
Initials:
Date: 26/5/94

D.J. Douglas & Partners

TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
DATE: 16 MAY 94
PIT No. 102
PROJECT: PROPOSED FACILITY
PROJECT No.: 20020
SHEET 1 OF 1
LOCATION: MENANGLE PARK QUARRY
SURFACE LEVEL: 100.0

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – orange brown clay topsoil. Slightly moist to dry			
0.40	CLAY – hard, orange brown clay with fine rootlets thoughout. Slightly moist			
0.75	CLAY – hard orange brownmottled black (ironstained) clay with some fine grained gravel (rock fragments) to 5mm. Iron cemented nodules included.	D	0.90	
1.40	CLAY – hard, orange mottled grey clay becoming orange red mottled grey with depth. Moist	D	2.10	
3.00	CLAY – hard orange red mottled grey clay with some fine to medium grained gravel to 10mm. (possible alluvium/colluvium)	D	3.50	
3.90	TEST PIT DISCONTINUED AT 3.90 METRES near limit of machine			

RIG: CASE 580C
LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF SOUTHERN FACE

SAMPLING & TESTING

D disturbed sample
B bulk sample
pp pocket penetrometer (kPa)
Ux x mm dia. tube

CHECKED:
Initials: GW
Date: 16/5/94

D.J. Douglas & Partners

TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
PROJECT: PROPOSED FACILITY
LOCATION: MENANGLE PARK QUARRY

DATE: 16 MAY 94
PROJECT No.: 20020
SURFACE LEVEL: 92.0

PIT No. 103
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – brown silty clay topsoil			
0.20	CLAY – hard, orange brown mottled black (ironstained) clay. Moist. Iron cemented nodules included.			
1.40	CLAY – hard grey mottled orange and orange red clay. Moist.			
2.40	MUDSTONE – extremely low and medium strength (bands) grey ironstained mudstone. Excavates in 10–20mm thick plates.			
2.60	PIT DISCONTINUED AT 2.60 METRES in banded very low to medium strength mudstone			

RIG: CASE 580C

LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF EASTERN FACE

SAMPLING & TESTING

D disturbed sample
B bulk sample
pp pocket penetrometer (kPa)
Ux x mm dia. tube

CHECKED:
Initials:
Date: 20/6/94

D.J. Douglas & Partners

TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
PROJECT: PROPOSED FACILITY
LOCATION: MENANGLE PARK QUARRY

DATE: 16 MAY 94
PROJECT No.: 20020
SURFACE LEVEL: 95.5

PIT No. 104
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – brown silty clay topsoil. Slightly moist.			
0.30	CLAY – hard, orange clay with some rock fragments to 30mm (colluvium) Grades to underlying unit. Slightly moist.			
0.65	MUDSTONE – extremely low, very low to medium strength, light to dark grey ironstained mudstone. Excavates in plates 10–30mm thick. Bedding (direction dip) at 254° /27°			
1.20	PIT DISCONTINUED AT 1.20 METRES in banded extremely low to medium strength mudstone			

RIG: CASE 580C

LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF NORTHERN PIT FACE

SAMPLING & TESTING

D disturbed sample
B bulk sample
pp pocket penetrometer (kPa)
Ux x mm dia. tube

CHECKED:
Initials: GRW
Date: 20/6/94

D.J. Douglas & Partners

TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
PROJECT: PROPOSED FACILITY
LOCATION: MENANGLE PARK QUARRY

DATE: 16 MAY 94
PROJECT No.: 20020
SURFACE LEVEL: 92.5

PIT No. 105
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – brown silty clay topsoil			
0.30	CLAY – hard, orange red becoming orange brown with depth. Fine rootlets throughout and with trace of rock fragments to 50mm.	D	0.60	
0.80	MUDSTONE – extremely low, very low to high strength, light grey to brown grey mudstone			
1.15	MUDSTONE – medium to high strength, brown grey mudstone with iron cemented joints. Excavates in 10–30mm slabs			
	PIT DISCONTINUED AT 1.15 METRES on medium to high strength sandstone			

RIG: CASE 580C

LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF NORTHERN PIT FACE

SAMPLING & TESTING

D disturbed sample
B bulk sample
pp pocket penetrometer (kPa)
Ux x mm dia. tube

CHECKED:
Initials: GHW
Date: 20/6/94

D.J. Douglas & Partners

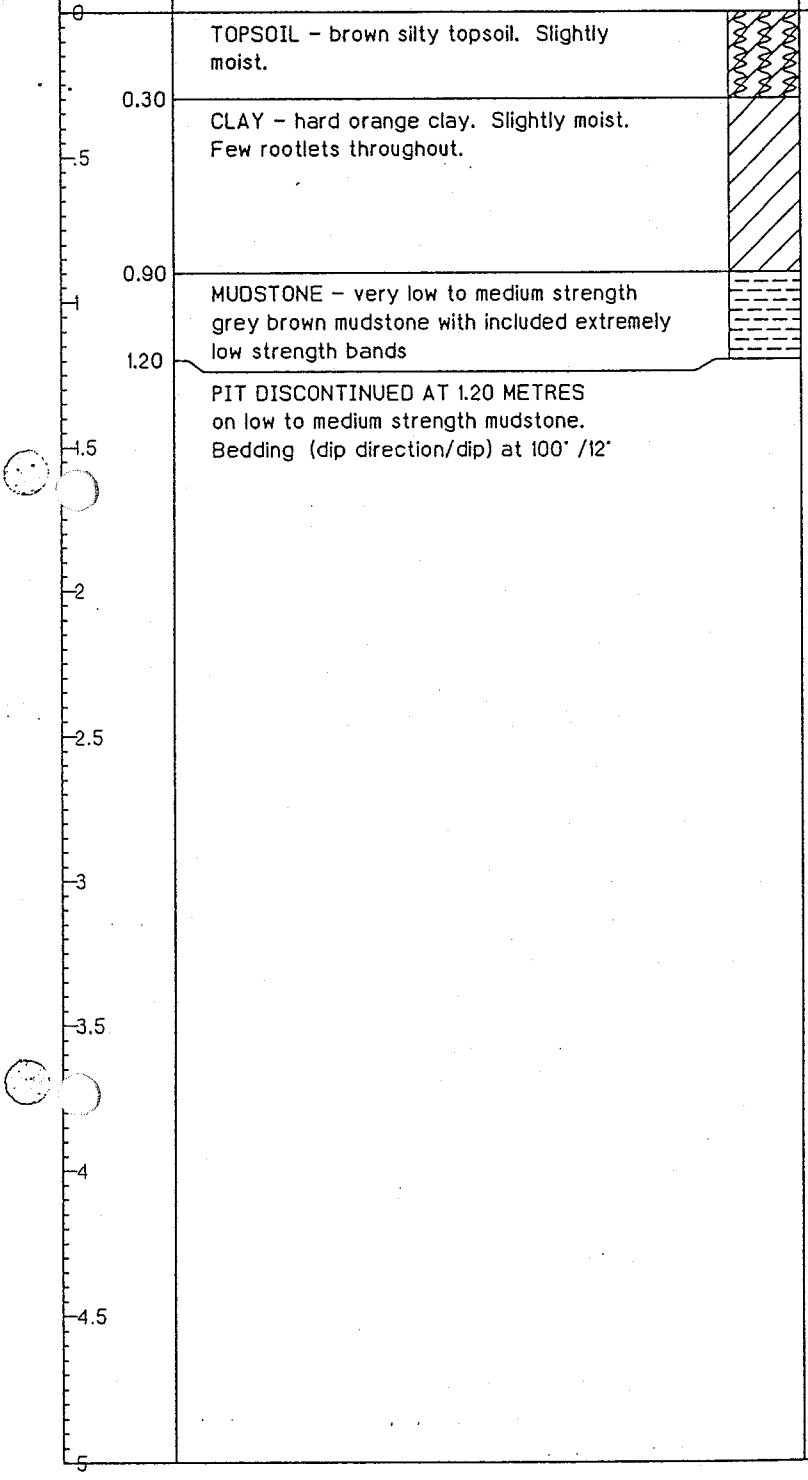
TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
PROJECT: PROPOSED FACILITY
LOCATION: MENANGLE PARK QUARRY

DATE: 16 MAY 94
PROJECT No.: 20020
SURFACE LEVEL: 90.5

PIT No. 106
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – brown silty topsoil. Slightly moist.			
0.30	CLAY – hard orange clay. Slightly moist. Few rootlets throughout.			
0.90	MUDSTONE – very low to medium strength grey brown mudstone with included extremely low strength bands			
1.20	PIT DISCONTINUED AT 1.20 METRES on low to medium strength mudstone. Bedding (dip direction/dip) at 100° /12°			



RIG: CASE 580C
LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF WESTERN PIT FACE

SAMPLING & TESTING

D disturbed sample
B bulk sample
pp pocket penetrometer (kPa)
Ux x mm dia. tube

CHECKED:
Initials:
Date: 20/6/94

D.J. Douglas & Partners

TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
PROJECT: PROPOSED FACILITY
LOCATION: MENANGLE PARK QUARRY

DATE: 16 MAY 94
PROJECT No.: 20020
SURFACE LEVEL: 87.0

PIT No. 107
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – light brown sandy clay topsoil			
0.20	SANDY CLAY – hard orange brown mottled light brown sandy clay. Moist. Roots included throughout. Grades to underlying unit (variable depth around test pit)			
0.90	SANDSTONE – extremely low to very low strength orange brown mottled grey medium grained sandstone. Moist.			
1.50	PIT DISCONTINUED AT 1.50 METRES Refusal on low to medium strength light orange cream medium grained sandstone			

RIG: CASE 580C

LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF SOUTHERN FACE

SAMPLING & TESTING

D disturbed sample
B bulk sample
pp pocket penetrometer (kPa)
Ux x mm dia. tube

CHECKED:
Initials:
Date: 20/6/94

D.J. Douglas & Partners

TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
PROJECT: PROPOSED FACILITY
LOCATION: MENANGLE PARK QUARRY

DATE: 16 MAY 94
PROJECT No.: 20020
SURFACE LEVEL: 73.0

PIT No. 108
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – brown clayey sand topsoil. Moist.			
0.40	SAND – dense brown to orange brown slightly clayey sand with trace of rock fragments to 50mm. Dry. Grades to underlying unit below 1.0m.			
1.10				
1.20	SANDSTONE – extremely low strength light orange sandstone			
	PIT DISCONTINUED AT 1.20 METRES Refusal on low to medium strength medium grained sandstone			

RIG: CASE 580C

LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF WESTERN FACE

SAMPLING & TESTING

D disturbed sample
B bulk sample
pp pocket penetrometer (kPa)
Ux x mm dia. tube

CHECKED:
Initials: GRW
Date: 20/6/94

D.J. Douglas & Partners

TEST PIT REPORT

CLIENT: CLEARY BROS (BOMBO) PTY LTD
PROJECT: PROPOSED FACILITY
LOCATION: MENANGLE PARK QUARRY

DATE: 16 MAY 94
PROJECT No.: 20020
SURFACE LEVEL: 87.5

PIT No. 109
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & Testing: Type	Depth (m)	Results
0	TOPSOIL – brown slightly clayey sand topsoil with included sandstone fragments			
0.20	CLAYEY SAND – dense fine grained brown clayey sand. Slightly moist.			
0.60				
0.70	SANDSTONE – extremely low strength grey sandstone. Moist.			
	PIT DISCONTINUED AT 0.70 METRES Refusal on medium to high strength medium grained sandstone			

RIG: CASE 580C

LOGGED: GW

GROUND WATER OBSERVATIONS: NO INFLOW OBSERVED

REMARKS: PHOTOGRAPH OF EASTERN FACE

SAMPLING & TESTING

D disturbed sample
B bulk sample
pp pocket penetrometer (kPa)
Ux x mm dia. tube

CHECKED:
Initials:
Date: 20/6/94

D.J. Douglas & Partners

Appendix C

Photo Plates 1 – 9

Photo 1: View looking southwest from Pit 1 (Project 76649.01).

Photo 2: View looking south east from Pit 1 (Project 76649.01).

Photo 3: View looking south from Pit 10 towards Pit 9 in the background (Project 76649.01).

Photo 4: View looking north from Pit 9 towards Pit 10 in the background (Project 76649.01).

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Leda Holdings Pty Ltd		**Site Photographs 1 to 4**	PROJECT No:	205817.05
	OFFICE: Macarthur	DRAWN BY: ECR	**Rezoning Planning Proposal**	PLATE No:	1
	SCALE: NTS	DATE: Various	**Medhurst Road, Menangle**	REVISION:	0

Photo 5: View looking east from Pit 6 (Project 76649.01).

Photo 6: View looking downslope of entrenched gully below Pit 12 (Project 76649.01).

Photo 7: View looking upslope at an entrenched gully and the toe of a slump in the south-eastern part of the site (Project 76649.01).

Photo 8: View looking upslope at the toe of slump in the south-eastern part of the site (Project 76649.01).

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Leda Holdings Pty Ltd		**Site Photographs 5 to 8**	PROJECT No: 205817.05
	OFFICE:	Macarthur	DRAWN BY: ECR	**Rezoning Planning Proposal**	PLATE No: 2
	SCALE:	NTS	DATE: Various	**Medhurst Road, Menangle**	REVISION: 0

Photo 9: View looking at back scarp in the very steep hillside at Pit 12 (Project 76649.01).

Photo 10: View looking at back scarp in the very steep hillside at Pit 12 (Project 76649.01).

Photo 11: View looking at back scarp in the very steep hillside at Pit 12 (Project 76649.01).

Photo 12: View looking at tree with downslope bow in the base of the track in the lower slope below Pit 12 (Project 76649.01).

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Leda Holdings Pty Ltd		**Site Photographs 9 to 12**	PROJECT No:	205817.05
	OFFICE: Macarthur	DRAWN BY: ECR	**Rezoning Planning Proposal**	PLATE No:	3
	SCALE: NTS	DATE: Various	**Medhurst Road, Menangle**	REVISION:	0

Photo 13: View looking west at break in the slope and trees leaning in various directions (Approximate Chainage 3860) (Project 76649.01).

Photo 14: View looking west at break in the slope and trees leaning in various directions (Approximate Chainage 3860) (Project 76649.01).

Photo 15: Sandstone slab at the surface near Pit 5, probably related to a sandstone ledge in the hillside (Project 76649.01).

Photo 16: Dolerite exposed in a small roadside quarry in the southern part of the site (Project 76649.01).

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Leda Holdings Pty Ltd		**Site Photographs 13 to 16**	PROJECT No:	205817.05
	OFFICE: Macarthur	DRAWN BY: ECR	**Rezoning Planning Proposal**	PLATE No:	4
	SCALE: NTS	DATE: Various	**Medhurst Road, Menangle**	REVISION:	0

Photo 17: View looking at dolerite boulder/corestone embedded in the surface of the hillside (Project 76649.01).

Photo 18: View looking at dolerite boulder/corestone embedded in the surface of the hillside (Project 76649.01).

Photo 19: View looking at erosion rills in over-steepened erosion gullies (Project 76649.01).

Photo 20: View looking at siltstone exposed in one erosion gully (Project 76649.01).

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Leda Holdings Pty Ltd		**Site Photographs 17 to 20**	PROJECT No: 205817.05
	OFFICE:	Macarthur	DRAWN BY: ECR	**Rezoning Planning Proposal**	PLATE No: 5
	SCALE:	NTS	DATE: Various	**Medhurst Road, Menangle**	REVISION: 0

Photo 21 - Eroded ground above Medhurst Road batter

Photo 22: Eroded ground on southern ridge line

Photo 23: Fill placed downslope of dam wall

Photo 24: Site vista looking east

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Leda Holdings Pty Ltd		**Site Photographs 21 - 24**	PROJECT No:	205817.05
	OFFICE: Macarthur	DRAWN BY: ECR	**Rezoning Planning Proposal**	PLATE No:	6
	SCALE: NTS	DATE: Various	**Medhurst Road, Menangle**	REVISION:	0

Photo 25: Vista looking northwest

Photo 26: Vista looking west

Photo 27: Seepage areas in midslope

Photo 28: Detailed view of seepage midslope

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT:	Leda Holdings Pty Ltd		**Site Photographs 25 - 28**	PROJECT No: 205817.05
	OFFICE:	Macarthur	DRAWN BY: ECR	**Rezoning Planning Proposal**	PLATE No: 7
	SCALE:	NTS	DATE: Various	**Medhurst Road, Menangle**	REVISION: 0

Photo 29: View looking North to dam

Photo 30: View looking south along ridge

Photo 31: View looking at dam wall

Photo 32: View looking south to abandonded dwelling

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OFFICE:	Macarthur	DRAWN BY:	ECR
SCALE:	NTS	DATE:	Various

Site Photographs 29 - 32
Rezoning Planning Proposal
Medhurst Road, Menangle

PROJECT No:	205817.05
PLATE No:	8
REVISION:	0

Photo 33: Sandstone at surface in midslope

Photo 34: Collapsed rabbit warren showing topsoil depths

Photo 35: High Voltage power line easement

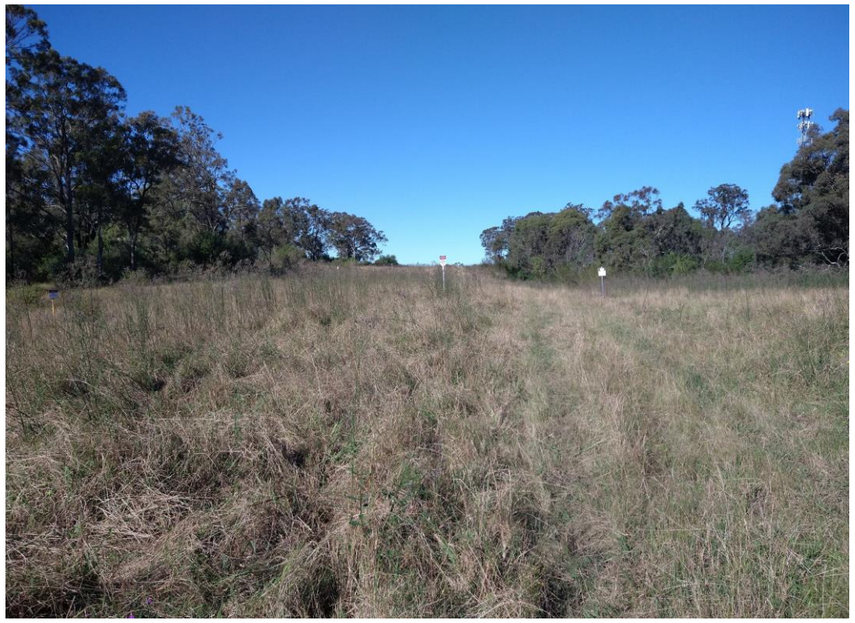

Photo 36: High pressure gas line easement

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Leda Holdings Pty Ltd		**Site Photographs 33 - 36**	PROJECT No:	205817.05
	OFFICE: Macarthur	DRAWN BY: ECR	**Rezoning Planning Proposal**	PLATE No:	9
	SCALE: NTS	DATE: Various	**Medhurst Road, Menangle**	REVISION:	0