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Report on
Geotechnical Investigation

Stage 2 Civil Works and Regional Stormwater Infrastructure Works

Bradfield City Centre
215 Badgerys Creek Road, Bradfield

Prepared for
Western Parkland City Authority

Project 222630.00
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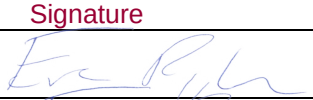
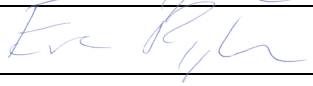
Author			19 January 2024
Reviewer		for KS	19 January 2024

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1. Introduction

This report presents the results of a geotechnical investigation undertaken for Bradfield City Centre Stage 2 Civil Works and Regional Stormwater Infrastructure Works. The works were commissioned by Western City Parkland Authority (WPCA) and were carried out in accordance with Douglas Partners Pty Ltd (DP) proposal P222630.00 dated 19 June 2023.

It is understood that the Bradfield City Centre Stage 2 Civil works include the construction of approximately 4200 m of flexible pavements and associated in-ground services. The Regional Stormwater Infrastructure works will include the partial realignment of a creek, construction of water quality basins and public spaces. Investigation was carried out to provide information on subsurface conditions underlying the site for design and planning purposes.

Civil design drawings prepared by SMEC showing the proposed road layouts, bulk earthworks and road long sections for Stage 2 were provided by the client for the investigation. No detailed drawings were provided for the Stormwater Infrastructure Corridor (SIC).

The investigation included the excavation of test pits, drilling of boreholes, installation of groundwater monitoring wells, laboratory testing of selected samples followed by engineering analysis and reporting. Details of the work undertaken and the results obtained are given in this report, together with comments relating to design and construction practice.

The investigation was carried out concurrently with a Salinity investigation and geotechnical investigation for the Advanced Manufacturing Research Facility Building 2 which have been reported separately.

2. Site Information

Bradfield City Centre is located to the south-east of the new Western Sydney International (Nancy-Bird Walton) Airport at the intersection of Badgerys Creek Road and The Northern Road in Bringelly (refer Figure 1).

The proposed Sydney Metro - Western Sydney Airport line runs through the site, providing connections from the key centre of St Marys through to stations at Orchard Hills, Luddenham, Airport Business Park, Airport Terminal and the Aerotropolis which is located within the site.

The street address for Bradfield City Centre is 215 Badgerys Creek Road, Bradfield (the Site) within the Liverpool Council Local Government Area (LGA). The site is legally described as Lot 3101, Deposited Plan (DP) 1282964 and has an area of 114.6 hectares, and is accessible from Badgerys Creek Road at

the north-western corner. The site includes land that is located within the Aerotropolis Core and Wianamatta-South Creek Precinct, of the Western Sydney Aerotropolis.

The site was previously a Royal Australian Air Force radio station. It is understood that there were a number of radio towers and staff base buildings which have been decommissioned and removed from site however some of the tower anchors, grounding and wiring have been left in ground.

Site Address	215 Badgerys Creek Road, Bradfield NSW
Legal Description	Lot 3101 on Deposited Plan (D.P.) 1282964
Approximate area	114.6 ha (Whole Bradfield City Centre Site) 38.7 ha (Stage 2 Civil Site) 17.6 ha (Stormwater Corridor excluding event space)
Local Council Area	Liverpool City Council
Current Land Use	Mixed use, Enterprise and ENZ Environment and Recreation
Surrounding Uses	North – Rural, grazing East – Riparian and Mixed use residential South – Riparian and Mixed use residential West – Mixed Use residential

The site location and layout are shown on Drawing 1 (Appendix A) and Figure 1 below.

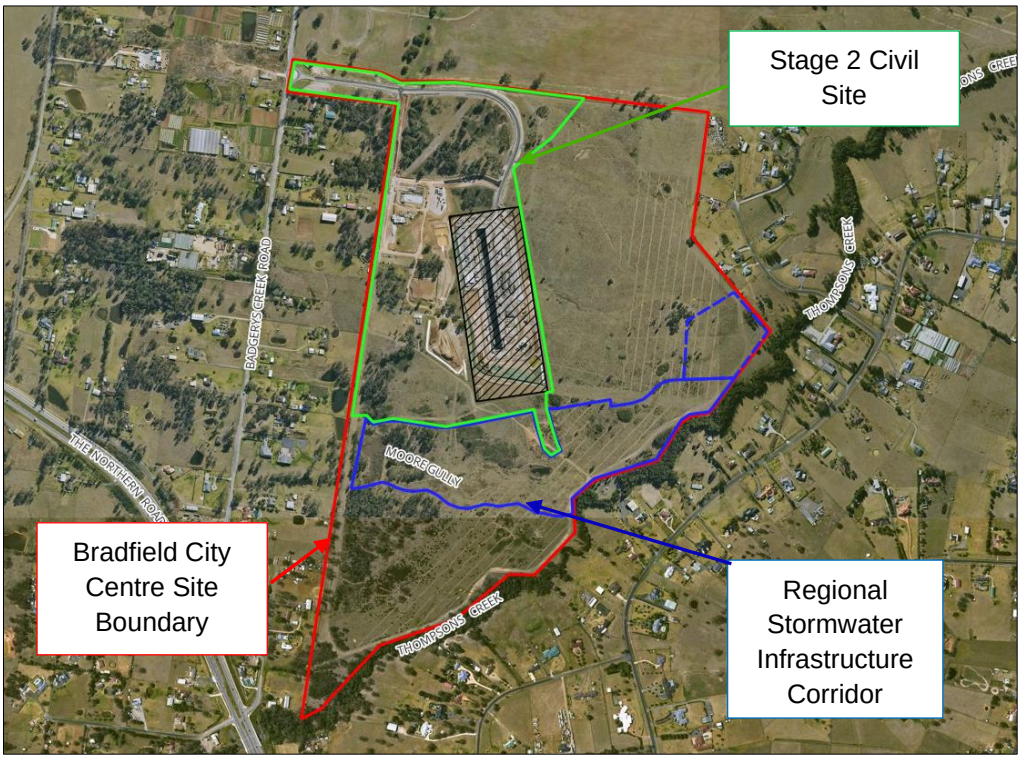

Figure 1: Site Location

2.1 Stage 2 Site

Stage 2 is approximately 38.7 ha located in the north-west corner of the site. At the time of the investigation, the Stage 1 site was occupied by the construction sites for the Aerotropolis Metro Station and Advanced Manufacturing Research Facility Building 1 (AMRF1). The construction of the AMRF1 building included civil works for the area surrounding the actual building. The Civil works included some bulk earthworks, road construction and temporary onsite detention basins and drainage swales. The Metro Station site was excluded from the scope of this report. The areas to the north and south of the construction areas were mostly grass-covered with some areas of thick shrubs and trees.

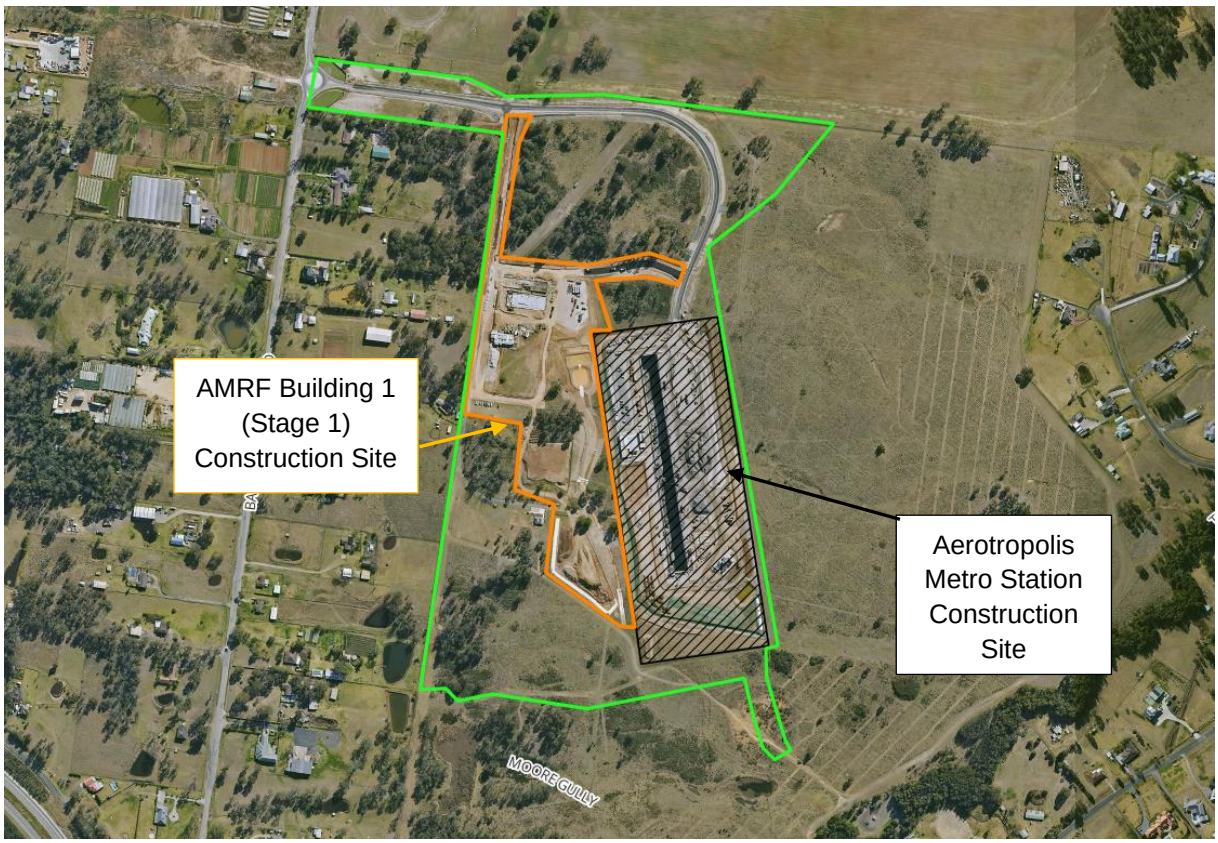

Figure 2: Stage 2 Site showing site conditions at the time of the investigation

2.2 Regional Stormwater Infrastructure Corridor

The regional stormwater infrastructure corridor (SIC) is approximately 18.8 ha within the central portion of the site. The site generally surrounds the existing creek line of Moore Gully in the west and then the flat adjacent to Thompsons Creek in the east. At the time of the investigation, the site was mostly grass-covered with some areas of thick shrubs and trees.

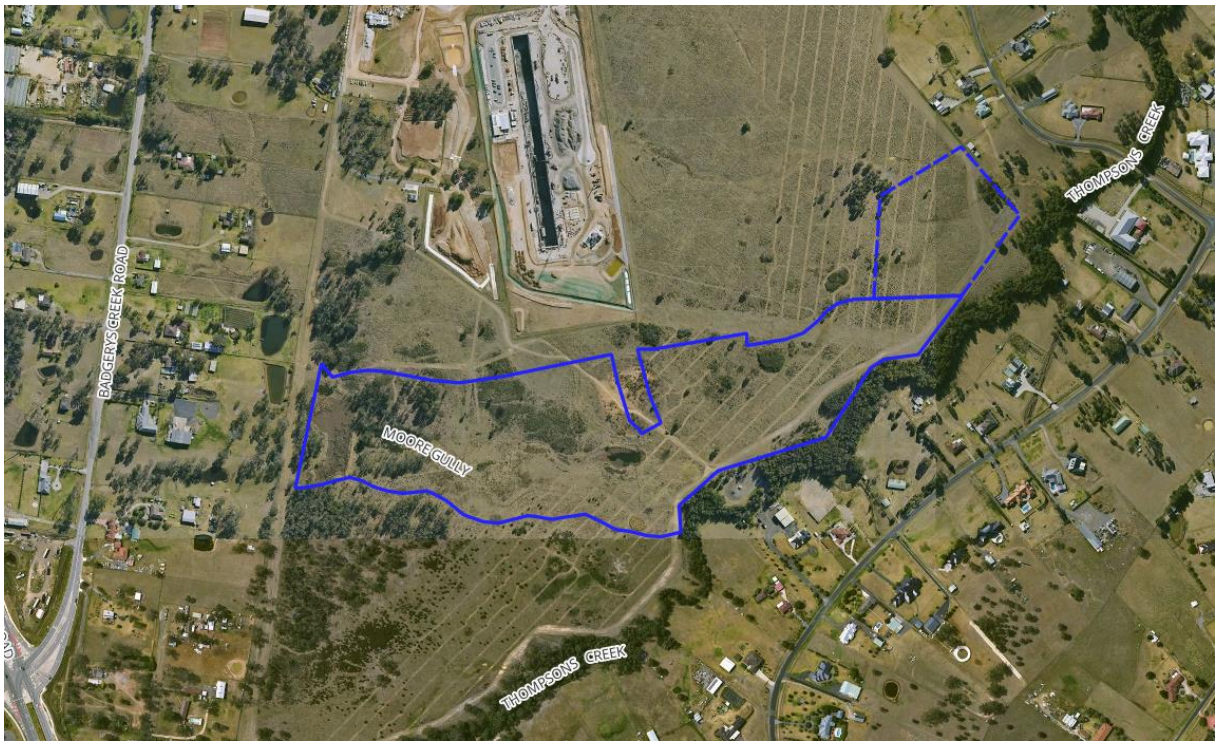

Figure 3: Regional Stormwater Infrastructure site

3. Geological Setting

3.1 Topography

The Stage 2 site typically traverses gently undulating terrain with an overall relief of approximately 10 m from the highest part of the site (approx. RL 80, relative to Australian height datum – AHD) in the north west corner of the site to the lowest part of the site (approx. RL 70) at the southern boundary along Thompsons Creek. Ground surface slopes within the site are typically less than five degrees.

The SIC site topography is characterised by a mostly flat floodplain along Moore Gully and Thompsons Creek. Moore Gully drains west to east into Thompsons Creek in the central part of the site. There are two farm dams on Moore Gully: one near the western boundary of the site is about 6000 m^2 and one closer to the joining of Thompsons Creek in the east is about 1500 m^2. Drainage is typically poor within the corridor due to the relative flatness of the terrain and appears to stay water logged most of the time.

3.2 Geology and Soils

Reference to the New South Wales Department of Minerals and Energy, *Geology of the Penrith 1:100,000 Sheet 9030, New South Wales Geological Survey, Sydney,* dated 1991, (DME, 1991) indicates that the Stage 2 site is underlain by the Bringelly Shale Formation (refer Figure 4, below). This unit typically comprises shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, with rare coal and tuff layers.

The Luddenham Dyke is mapped to the north west of the site. The Luddenham Dyke is a Jurassic igneous intrusion comprising olivine basalt, analcite, augite, feldspar and magnetite which is typically up to 6 m wide (DME, 1991). Whilst mapping indicates that the dyke does not extend into the site, our investigation encountered material consistent with the dyke material near the central western part of the site.

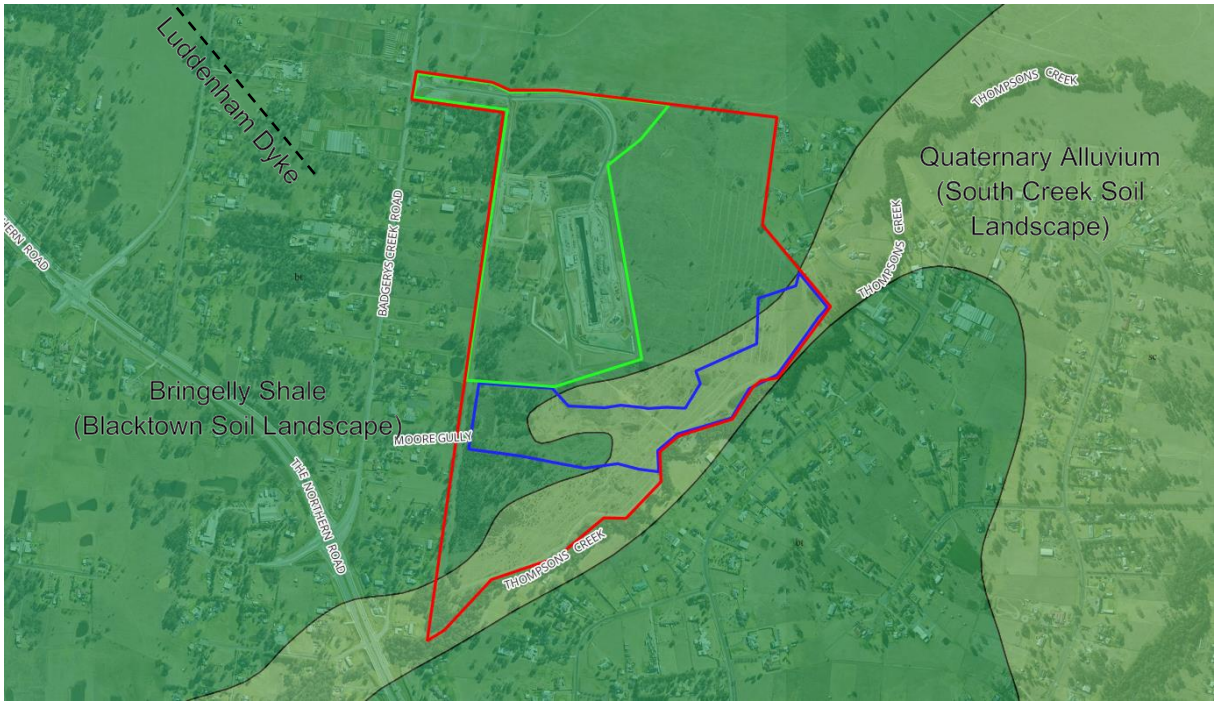

Figure 4: Geology and Soils Landscape Mapping

Along Thompsons Creek and a small portion of Moore Gully, the Bringelly Shale is overlain by alluvial deposits comprising fine-grained sand, silt and clay.

Reference to the Bannerman, S.M. and Hazelton, P.A., *Soil Landscapes of the Penrith 1:100 000 Sheet, Soil Conservation Service of NSW,* dated 1990, indicates that the site includes two soil landscape groups, including the Blacktown Soils (dark green) and South Creek (light green) soil landscapes. The approximate soil landscape boundaries match the corresponding underlying geology boundaries, as shown on Figure 4.

The northern and western portions of the site comprise soils of the Blacktown soil landscape, which is characterised by gently undulating rises, slopes usually less than 5%. This is a residual soil landscape, which the mapping indicates comprises multiple soil horizons that range from shallow red-brown podzolic soils comprising mostly clayey soils on crests and upper slopes, to deep brown to yellow clay soils on mid to lower slopes and in areas of poor drainage. These soils are typically of low fertility, are moderately reactive, highly plastic and generally have a low wet strength.

The floodplain of Thompsons Creek and the eastern part of Moore Gully is mapped as the South Creek soil landscape, which is characterised by floodplains, valley flats and drainage depressions of the channels, usually flat with incised channels that are mainly cleared. This is an alluvial soil landscape, which mapping indicates comprises multiple soil horizons, including red and yellow podzolic soils, most

common on terraces, and yellow solodic soils. These soils are often very deep layered sediments over bedrock or relict soils, present an erosional hazard and experience frequent flooding.

Australian Soil Resource Information System managed by CSIRO Land and Water maps the site as extremely low probability of Acid Sulfate Soil occurrence.

According to NSW Department of Infrastructure, Planning and Natural Resources, *Map of Salinity Potential in Western Sydney*, 2002, the site has known salinity along Thompsons Creek and Moore Gully with moderate salinity potential in the remainder of the site. Refer to Figure 5 below.

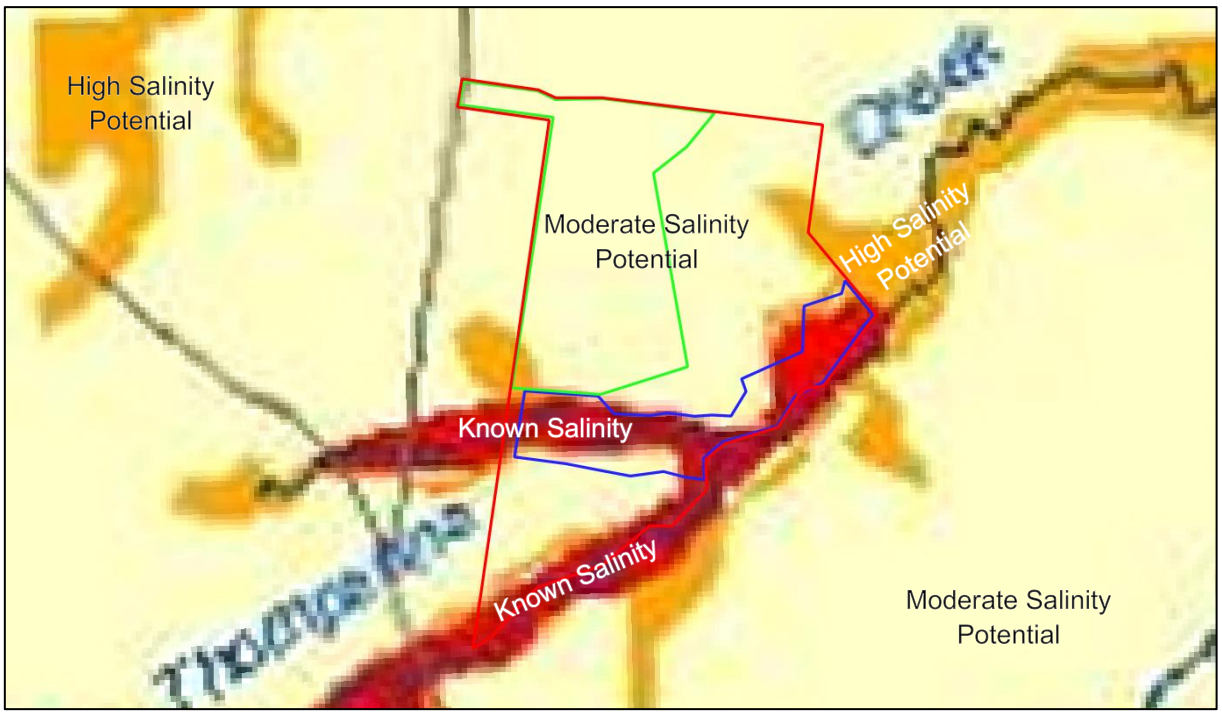

Figure 5: Regional Salinity Mapping

3.3 Surface Water and Groundwater

Surface water is found on the site in Thompsons Creek and Moore Gully which flow to the east and north to eventually join South Creek. Moore Gully has two small dams along the alignment and there is another small farm dam in the north eastern part of the site. Based on review of surface drainage it is anticipated that groundwater would primarily also flow towards the north east.

Unweathered Bringelly Shale has very low hydraulic conductivity and the few bores drilled into the unweathered shales in the Sydney area are generally dry or yielding small flows of saline groundwater, typically with total dissolved salts (TDS) contents of 10 000 mg / L to 30 000 mg / L (Old, 1942; McNally, 2004). Groundwater flow is likely to be dominated by fracture flow with resultant low yields (typically <1 L / s) in bores.

A search of the NSW Department of Planning, Industry and Environment groundwater bore database indicated that there are five exploration bores on the site drilled to depths of 6 – 12.2 m however no groundwater levels were available.

4. Field Work

4.1 Methods

The field work for the Stage 2 site comprised the excavation of 21 test pits (Pits 101, 103 – 110, 113, 116 – 118, 121 – 128) to depths of up to 3 m using a JCB 4CX Eco backhoe fitted with a 450 mm bucket. Additional test pit locations were originally proposed within the roadways surrounding the AMRF1 however due to the in-progress construction of these roads, these test pits were not carried out.

Field work for the SIC included the following:

- the drilling of five boreholes (Bores 201, 203, 204, 206, 207) using a truck-mounted drill rig fitted with 110 mm continuous solid flight augers and a tungsten-carbide (TC) bit. Bore 7 is not within the SIC but was drilled away from the site for additional groundwater measurements;
- excavation of two test pits (Pits 202 and 205) to depths of 1.5 m and 3.5 m respectively using a JCB 4CX Eco backhoe fitted with a 450 mm bucket.
- Standpipe piezometers were installed in Bores 201, 204, and 207 to enable monitoring of groundwater levels post-drilling. Details of the piezometer installation are given on the borehole logs.

The test pits and boreholes were logged on site by a geotechnical engineer, who collected representative disturbed samples to assist in strata identification and for laboratory testing.

Standard penetration testing (AS 1289.6.3.1) was carried out in the boreholes drilled with the drilling rig whilst augering. The standard penetration test (SPT) procedure is given in the notes accompanying the logs and the penetration 'N' values are shown on the borehole logs in Appendix C. Dynamic cone penetrometer (DCP) tests were carried out to depths of up to 1.2 m at each test pit location to assess the penetration resistance of the near-surface soils.

The test locations were nominated by DP and located on site prior to the investigation using a differential GPS unit with a nominal accuracy of ±0.1 m. The test locations are shown in Drawings 2 and 3 (Appendix B) and test pit and borehole logs are provided in Appendix C.

All field measurements and mapping for this project have been carried out using the Geodetic Datum of Australia 2020 (GDA2020) and the Map Grid of Australia 2020 (MGA2020), Zone 56. All reduced levels are given in relation to Australian Height Datum (AHD).

4.2 Results

The subsurface conditions encountered during the field investigation are shown on the test pit and borehole logs in Appendix B, together with notes defining classification methods and the descriptive terms used.

4.2.1 Stage 2

The typical succession of strata encountered within the Stage 2 test pits is summarised as follows:

TOPSOIL	Silty clay topsoil encountered to depths in the range 0.1 – 0.2 m in all test pits;
CLAY: (Residual)	Silty clay, typically stiff to very stiff, encountered to depths in the range 0.5 – 2.4 m in all test pits;
SHALE BEDROCK: (Bringelly Shale)	Shale bedrock, typically very low and low strength on first contact and increasing to low to medium strength with depth, encountered from depths in the range 0.5 – 2.4 m and continuing to the limit of investigation depth of 3.3 m in Pit 108 and to refusal depths of 1.3 – 2.8 m in all other Pits with the exception of Pit 123;
BASALT (Luddenham Dyke)	Basalt, high strength, encountered from a depth of 0.8 m in Pit 123. The basalt was highly fractured on first contact and caused refusal of the excavator bucket at a depth of 0.9 m

No free groundwater was observed in any of the test pits during excavation. It is noted that the test pits were immediately backfilled following excavation which precluded longer term monitoring of groundwater levels. It should be noted that groundwater levels are affected by factors such as preceding climatic conditions and soil permeability and can therefore fluctuate with time.

4.3 Regional Stormwater Infrastructure Corridor

The typical succession of strata encountered within the Stormwater Corridor test locations is summarised as follows:

TOPSOIL	Silty clay topsoil encountered to depths in the range 0.1 – 0.3 m in all test pits and boreholes;
CLAY: (Residual)	Silty clay, stiff to hard, encountered to depths in the range 1.4 – 2.6 m in Bores 201 and 207 and Pit 202;
CLAY: (Alluvial)	Silty clay, typically stiff to very stiff, encountered to depths of 4.5 and 4.8 m in Bores 203 and 206 respectively and to the limit of investigation depths of 3.5 – 5 m in Bore 204 and Pit 205;
SHALE BEDROCK: (Bringelly Shale)	Shale bedrock, typically very low and low strength on first contact and increasing to low to medium strength with depth, encountered from depths in the range 1.4 – 4.8 m and continuing to the limit of investigation depths of 3.5 – 10 m in Bores 201, 203, 206 and 207. Pit 202 was terminated on refusal in medium strength shale at a depth of 1.7 m;

Free groundwater was observed at depths of 3.5 m and 4.1 m in Pit 205 and Bore 206 respectively. Free groundwater was not observed whilst drilling or excavating in any of the other locations. Groundwater wells were installed in Bores 201, 203, 204, 206 and 207 for long term monitoring of groundwater levels. Well construction details are included on the borehole logs.

A summary of groundwater observations and measurements within the wells is presented Table 1. It is noted that groundwater levels will fluctuate over time in response to climatic variations or anthropogenic influences.

Table 1: Results of Groundwater Well Monitoring

Bore No.	Date	Groundwater Depth (m bgl)	Groundwater RL (m AHD)
201 Surface RL: 68.1 Well Depth: 5.0 m	24 August 2023	2.05	66
	14 September 2023	2.17	65.9
	26 September 2023	2.22	65.9
203 Surface RL: 64.2 Well Depth 5.0 m	24 August 2023	3.0	61.2
	14 September 2023	2.7	61.5
	26 September 2023	2.7	61.5
204 Surface RL: 62.3 Well Depth: 5.0 m	24 August 2023	2.8	59.6
	14 September 2023	2.9	59.5
	26 September 2023	2.9	59.4
206 Surface RL: 59.3 Well Depth: 5.0 m	24 August 2023	1.7	57.7
	14 September 2023	1.8	57.5
	26 September 2023	1.8	57.5
207* Surface RL: 69.5 Well Depth: 10.0	24 August 2023	4	65.4
	14 September 2023	5.2	64.2
	26 September 2023	5.3	64.2

Note" * Bore 207 is not within the SIC

The boreholes were drilled to the north of the water logged areas surrounding the Moore Gully water course. The groundwater levels generally match the levels of the low points of Moore Gully in the west and Thompsons Creek in the east.

5. Laboratory Testing

5.1 California Bearing Ratio

Bulk samples from the Stage 2 test pits were tested in the laboratory for measurement of field moisture content (FMC), compaction properties (maximum dry density – MDD, optimum moisture content – OMC) and California bearing ratio (CBR). The detailed laboratory test report sheets are included in Appendix C, with the results summarised in Table 2.

Table 2: Results of Laboratory Testing

Pit No	Depth (m)	FMC (%)	OMC (%)	MDD (t/m^3)	Swell (%)	CBR (%)	Material
101	0.5	16.2	16.5	1.78	2.5	3.0	Clay
103	0.3	15.3	19.5	1.72	1.5	4.5	Clay
104	0.5	16.4	19.0	1.71	2.0	4.0	Clay
105	1.0	14.7	18.5	1.74	3.0	2.0	Clay
106	1.0	14.0	17.0	1.73	5.0	1.5	Clay
107	1.1	6.3	9.0	1.84	0.5	12	Clay
108	1.0	12.1	14.5	1.83	3.0	3.0	Clay
109	0.5	16.7	15.5	1.91	0.5	1.5	Clay
110	1.0	17.6	17.5	1.73	3.0	2.5	Clay
113	0.5	18.0	17.0	1.76	2.5	4.0	Clay
116	0.5	21.1	20.0	1.71	1.0	8	Clay
118	1.0	19.3	19.5	1.69	3.0	2.5	Clay
121	0.5	14.0	15.5	1.71	5.0	1.5	Clay
123	0.5	13.5	18.0	1.69	0.5	7	Clay
124	0.5	13.8	17.5	1.72	2.5	4.0	Clay
125	1.5	17.6	15.5	1.81	1.0	3.0	Clay
127	1.0	23.0	22.5	1.63	2.5	2.5	Clay
128	1.0	14.5	13.5	1.88	1.0	6	Clay
126	1.0	16.4	18.5	1.69	3.0	2.0	Clay

The CBR tests were carried out on samples compacted to approximately 100% dry density ratio relative to standard compaction at standard optimum moisture content. The samples were then soaked for four days under surcharge loadings of 4.5 kg. The results of the field moisture content tests (at the time of the sampling) listed in Table 1 indicate the proposed subgrade soils were in the range 4.5% dry to 4.3% wet of OMC.

5.2 Lime Demand

Five residual clay samples from the Stage 2 test pits were tested in the laboratory for measurement of lime demand (RMS T144 Method). The testing was carried out using hydrated lime with a Calcium Hydroxide content of 72%. The detailed laboratory test report sheets are included in Appendix C, with the results summarised in Table 3.

Table 3: Results of Laboratory Testing – Lime Demand

Pit No.	Depth (m)	Percentage of lime required to saturate the sample (by weight)
103	0.6	4.0
110	0.5	5.0
117	1.0	5.0
122	0.5	5.0
125	0.5	4.0

The results of the lime demand testing indicate that 4 – 5% hydrated lime (by weight) must be added to the samples to become fully saturated.

5.3 Atterberg Limits

Selected samples from the test pits and boreholes were tested in the laboratory for measurement of field moisture content, plasticity and Shrink-swell index. The detailed laboratory test report sheets are presented in Appendix D, with the results summarised in Table 4.

Table 4: Results of Laboratory Testing – Atterberg Limits

Pit or Bore No.	Depth (m)	FMC (%)	LL (%)	PL (%)	PI (%)	LS (%)	Material
101	0.5	19.0	60	20	40	13.0	Silty CLAY
105	0.5	14.8	55	20	35	15.0	Silty CLAY
110	0.5	21.6	60	21	39	13.0	Silty CLAY
113	0.5	19.3	56	19	37	13.0	Silty CLAY
123	0.5	15.6	45	21	24	11.5	Silty CLAY
126	0.5	16.0	57	22	35	11.5	Silty CLAY
127	0.5	27.3	72	23	49	17.5	Silty CLAY
202	1.0	21.3	66	25	41	13.0	Silty CLAY
203	1.0	17.1	52	17	35	12.0	Silty CLAY
205	1.0	19.5	51	17	34	13.0	Silty CLAY

Where FMC = Field moisture content; PL = Plastic limit; LL = Liquid limit; PI = Plasticity Index; LS = Linear shrinkage

The plasticity results indicate the soils tested are of variable (medium to high) plasticity and would be susceptible to shrink-swell movements with changes in soil moisture content.

5.4 Dispersibility Testing

Selected samples from the test pits and boreholes were tested in the laboratory for measurement of Emerson Class. The detailed laboratory test report sheets are presented in Appendix D, with the results summarised in Table 5.

Table 5: Results of Laboratory Testing - Emerson Class

Pit or Bore No	Depth (m)	Description	Emerson Class No
106	0.5 m	Silty Clay	2
127	0.5 m	Silty Clay	2
128	0.5 m	Silty Clay	2
202	1.0 m	Silty Clay	2
204	1.5 m	Silty Clay	2

Notes to table
Emerson Class No (AS 1289.3.8.1)

The results indicate the soils tested are all Class 2 (partial dispersion) and would have a high potential for erosion.

5.5 Particle Size Distribution

Selected samples from the test pits and boreholes were tested in the laboratory for measurement of Particle Size Distribution (PSD). The detailed laboratory test report sheets are presented in Appendix D, with the results summarised in Table 6.

Table 6: Results of Laboratory Testing - Gradings

Pit No	Depth (m)	Description	Gravel (%)	Sand (%)	Silt and clay (%)
202	0.5	Silty Clay	0	8	92
205	0.5	Silty Clay	0	4	96

The results of the PSD testing indicates that the samples tested are silty clays with trace sand content

5.6 Permeability Testing

Selected samples from the test pits and boreholes in the SIC were tested in the laboratory for measurement of permeability using the constant head permeability test. The samples were remoulded and compacted to 98% relative to standard compaction at optimum moisture content. The detailed laboratory test report sheets are presented in Appendix D, with the results summarised in Table 7.

Table 7: Results of Laboratory Testing - Gradings

Pit No	Depth (m)	Description	Coefficient of Permeability (m/s)
202	0.5	Silty Clay (residual)	5×10^{-10}
203	0.2 – 1.0	Silty Clay (alluvial)	9×10^{-11}
205	0.5	Silty Clay (alluvial)	5×10^{-10}

The results of the permeability testing indicate that the soils tested are very low permeability.

5.7 Aggressivity and Salinity

Aggressivity and salinity testing was carried out for the greater Bradfield City Centre site and has been reported separately. Reference should be made to "Report on Salinity Assessment, Proposed Urban Development, Bradfield City Centre" (DP Project 222630.00.R.003) for results and recommendations salinity testing.

6. Proposed Development

6.1 Stage 2

Based on the "Road Hierarchy Plan" prepared by SMEC, some 4200 m of flexible roadways are proposed including a dual carriageway arterial road and single carriageway collector and local roads. Cut and fill earthworks up to 4 m will be required to achieve the design levels.

It is understood that the roads surrounding the AMRF Building 1 site (Stage 1) have already been designed and are in construction are the time of this report (parts of Road 03, Road 06 and Road 02).

Service drawings indicate that proposed wastewater mains will approximately follow the road alignments with various lot connections however long sections were not available.

6.2 Stormwater Infrastructure Corridor

Concept drawings indicate that the proposed development will include the realignment of the Moore Gully creek line, a series of water quality basins and wetland landscaping, swimming hole and a gathering ground public space. Fill will be placed to raise surface levels above flood levels.

7. Comments

7.1 General

This report provides general comments regarding subsurface conditions, subgrade preparation measures, pavement design, excavation conditions, retention systems and design parameters together for the proposed infrastructure.

Considering that detailed design of the SIC has not been completed, our comments must be considered preliminary in nature.

7.2 Stage 2 Civil Site

7.2.1 Geotechnical Model

Based on the subsurface conditions encountered the geotechnical model underlying the Stage 2 site comprises:

- Topsoil comprising silty clay or clayey silt typically to depths of 0.1 – 0.2 m; overlying
- Residual silty clay of stiff to hard consistency; grading into
- Weathered shale bedrock, initially of very low to low strength which increases with depth.
- A high strength basaltic dyke intrudes the site in the south west corner. Based on published data the dyke is a near vertical structure up to 6 m wide though its width was not confirmed.

Groundwater was not encountered within the limits of investigation depths of 3 m within the Stage 2 area. The regional groundwater is typically expected to be well within the bedrock profile, although seepage along the clay/rock interface and through joints in the bedrock would be expected, particularly during and following inclement weather. Groundwater levels are transient and will fluctuate with time.

7.2.2 Pavement Design

The following comments are based on the drawings provided, results of surface and subsurface conditions encountered at the time of the investigation and the results of laboratory testing. Given the low strength of the natural clays (CBR values of 1.5 – 2%) and the resultant low strength in those areas where excavated soils have been placed as fill, subgrade improvement is recommended for the clay and proposed clay fill subgrades. Subgrade improvement could be either replacement with a material such as durable crushed sandstone (CBR at least 15%) or lime stabilisation. Subgrade improvement will improve constructability and strength of the subgrade which will be reflected in reduced pavement thickness. Discussion on earthworks, subgrade preparation and pavement thickness design is given in the following sections.

7.2.3 Site Preparation

To prepare subgrades for the proposed new pavements, the following subgrade preparation procedure is recommended:

- Strip all organic topsoils and other deleterious materials from the subgrade areas. These materials will not be suitable for reuse as fill. Topsoil or other organic soils can however be stockpiled and used in future landscaped areas;
- Inspect stripped surfaces by a geotechnical engineer to confirm that no remaining topsoil or unsuitable material (such as uncontrolled fill or similar) are encountered at strip level;
- Where cut and fill is required to achieve the design levels, refer Section 7.3.2 and 7.3.3 for excavation conditions and earthworks requirements;
- Inspect the exposed subgrade prior to stabilisation and test roll the subgrade with a smooth drum roller of at least 12 tonnes static deadweight capacity. Soft or weak areas should be rectified as directed by the geotechnical consultant;
- Carry out subgrade improvement within clay and clay fill subgrades to a depth of 300 mm with either replacement with a durable crushed rock (CBR at least 15%) or lime stabilisation with 5% lime by weight. Stabilise the existing subgrades using 5% lime to a depth of 300 mm. Subgrade improvement should not be carried out on rock subgrades. Previous experience in similar materials in the Western Sydney area has indicated that premature failure of such pavements can occur, but that the risk can be minimised by:
  - subgrade stabilisation being carried out by specialist contractors experienced in stabilising clay subgrades;
  - careful detailing of subsurface drainage to mitigate the effects of potential moisture ingress as a result of the permeability differences between the stabilised and unstabilised zones;
  - stabilisation and re-compaction techniques are employed that do not result in a zone of uncompacted material below the interface of the stabilised zone and underlying subgrade.
- Density testing of the filling, subgrade and pavement layers should be carried out at Level 2 responsibility as outlined in Council design guideline and RMS QA Specification R44 (Ref 5).

Prevailing weather conditions at the time of construction and the control that can be exercised over construction traffic will be critical in achieving satisfactory subgrade performance. If pavement construction does not immediately follow subgrade preparation (thus exposing the subgrade to weather and traffic), subgrade deterioration would be expected, thus requiring rectification. In conjunction with subgrade preparation procedures, consideration should also be given to installing temporary drainage systems prior to construction of the final works.

All earthworks should be undertaken under close supervision and consultation with the geotechnical consultant in order to avoid any unnecessary over-excavation.

7.2.4 Earthworks Conditions

Long sections were only available for Roads 01 – 05 and part of Road 06 however the bulk earthworks plan indicates cut and fill to depths of up to 4 m. Table 8 summarises the expected excavation conditions along the proposed road alignments.

Table 8: Expected Excavation Conditions

Road	Chainage	Relevant Test Pit No	Comment
01	0 - 60	104, 110	Cut up to 1 m through very stiff clays and extremely weathered shale
	60 - 120	104, 110	Minor fill
	610 - 826	128	Fill up to 2 m
02	0 - 250	-	Fill up to 1 m Property outside Stage 2 Boundary
	250 - 560	101, 103	Cut up to 1.6 m through very stiff clays to depths of 0.7 – 1.5 m then low to medium strength shale
	560 - 670	104, 108	Fill up to 1 m
	670 - 770	108	Cut up to 0.6 m through hard clays
	770 - 860	109	Fill up to 1.8 m
03	0 – 100	-	Under construction by others
	100 – 180	-	Cut up to 0.6 m through hard clays
04	0 - 170	116, 118	Near Grade/ cut up to 0.5 m
	170 - 210	-	Minor fill
	210 - 340	-	Cut up to 3 m, within existing basin and swale. Excavation likely to be through residual clays then low to medium strength shale
	340 - 485	121	Fill up to 1 m
05	0 - 160	-	Cut up to 1 m, likely though clays and extremely weathered shale. Property outside Stage 2 Boundary
	160 - 360	125	Fill up to 1m
	360 - 460	125, 126	Cut up to 1.5 m through hard clays to depths of 0.7 m then low to medium strength shale
	460 - 800	122, 127	Fill up to 1.6 m
06	0 - 208	-	Under construction by others
	208 - 350	113, 116	Near Grade / fill less than 0.5 m
	350 - 630	116, 117, 123, 124, 125	Near grade / Cut and fill less than 0.5 m. Noted that high strength Basalt Dyke was encountered at 0.8 m depth at about Chainage 490
07	-	-	Fill up to 4 m, Property outside Stage 2 Boundary
08	-	-	Cut up to 1 m, likely through hard clays and extremely weathered shale
09	-	118, 126	Cut up to 4 m, likely through hard clays to depths of 0.7 – 1.5 m then through low to medium strength shale
10	-	-	Cut up to 4 m, likely through hard clays to depths of 0.7 – 1.5 m then through low to medium strength shale
11	-	-	Within Metro Site
12	-	-	Within Metro Site
13	-	104, 105, 107	Cut up to 1 m through very stiff clays
14	-	105, 106	Cut up to 1.5 m through very stiff clays to 1.1m then low to medium strength shale

Note: *Long sections and chainages not provided for Roads 07 – 14, earthworks depths have been estimated from the bulk earthworks plans

A summary of stratum types and the corresponding generalised bulk and localised excavation methods required to remove the encountered and anticipated overburden are summarised in Table 9.

Table 9: Generalised Excavatability Methods

Soil/Rock Type	Bulk Excavation	Localised Excavation
Clay and Extremely Weathered Shale	Conventional earthmoving equipment such as excavators and scrapers	
Very Low – Low Strength Shale	Light to medium ripping (small bulldozers)	Excavator, hydraulic hammer or trenching machines
Medium Strength Shale	Heavy ripping (medium to large bulldozers)	Hydraulic hammer or trenching machines
High or Greater Strength Rock	Very heavy ripping	Hydraulic hammer, diamond saws, blasting

Deeper excavations such as found along Road 09 and 10 and for service trenches will encounter low to medium strength, or stronger, rock which will require the use of heavy ripping. It is noted that our test pits were excavated using a 9 tonne backhoe fitted with a 450 mm wide toothed bucket which refused in low to medium strength rock. Excavatability of the rock may be easier than noted above where the rock is highly weathered and fractured.

Test Pit 123 encountered high strength basalt at a depth of 0.8 m which is likely part of the Luddenham Dyke. The dyke is understood to typically be up to 6 m wide but localised excavations of the dyke material will require very heavy ripping, hydraulic hammers, diamond saws or blasting.

It is noted that plant required for rock removal has been based on our experience on similar, nearby sites and is to be used as a guide only. Removal of rock must be based on the earthworks contractors' own assessment of the subsurface conditions and excavation trials are highly recommended in this regard. For detailed information on rock types and strength, reference must be made to the individual logs. The rock depths measured are accurate only at the test locations and may vary widely elsewhere, however site conditions are noted to be relatively consistent.

The use of vibratory equipment is not expected to be of major concern. However, if the use of percussive equipment encroaches within 40 m of any vibration sensitive structures, further assessment will be required, and vibration monitoring should be undertaken. If the monitoring indicates unacceptable levels of vibration, then the use of non-percussive (i.e. rock sawing and ripping) excavation methods will be needed. This requirement, however, will need to be determined on site once design levels are finalised and the details of the proposed excavation equipment are known.

Reference to the test pit logs (Appendix B) will provide guidance to the earthworks contractor on the materials that can be expected to be encountered. The plant required must be based on the earthworks contractor's assessment of the test pit logs and if necessary, the results of additional borehole drilling or test pit excavation by the contractor.

Notwithstanding the above, inspection of all subgrades will be required to allow for variations in subsurface conditions between test pits (where encountered) to be accommodated within the design

prior to pavement construction. Many of the road alignments were not included in the investigation due to changing designs, property access and construction works in progress.

7.2.5 Earthworks

Where overbreak in the rock occurs during cutting or road boxing to design subgrade levels, allowance should be made for subgrade replacement to a nominal thickness to ensure that a subgrade of acceptable quality and uniform strength is attained. Suitable replacement materials would comprise quarry overburden or roadbase gravels with a soaked CBR of more than 15%, compacted as recommended above.

Where fill is required to obtain design subgrade levels, it should be placed in near-horizontal layers at a maximum 250 mm loose thickness. The layers should be compacted to at least 98% Standard compaction to within 0.5 m of the finished subgrade level. The upper 0.5 m thickness should be compacted to achieve at least 100% Standard DDR, with placement moisture contents as nominated above. Moisture contents should be maintained within 2% of optimum moisture content (OMC)

The fill material should have a nominal maximum particle size of 100 mm and should be suitably graded to facilitate compaction. Generally the soils and very low strength bedrock encountered will be suitable for reuse as engineered fill within the site.

It is expected that bedrock of very low strength or less should readily break down beneath the action of the rollers. Rock of low to medium strength or higher may need mechanical crushing as it is not expected to break down under the action of compactors during filling works. Rock crushing can add significant expense and time to typical bulk earthwork programmes.

Geotechnical testing should be carried out in accordance with AS 3798 – 2007 *'Guidelines on Earthworks for Commercial and Residential Developments – Appendix B* (Ref. 6). As a minimum, placement of filling where structures are proposed must be to a Level 1 standard as described in AS 3798 (Ref 6). Level 2 control is considered appropriate for pavement construction and backfilling of service trenches, unless otherwise specified by the designer. It is also recommended that the Geotechnical Inspection and Testing Authority (GITA) is engaged directly on behalf of the principal and not by the earthworks contractor.

7.2.6 Design Traffic Loadings

Based on the traffic hierarchy plan prepared by SMEC and Liverpool City Council engineering guidelines, the design traffic loadings adopted for pavement design purposes are summarised in Table 10. It is noted that Liverpool Council does not provide indicative traffic loadings for Arterial Roads. For the purposes of this pavement design, a traffic loading of 1×10^7 ESA has been adopted however this should be reviewed by the client and updated with traffic estimates if possible. All the traffic loadings adopted must be confirmed by the client and Council prior to construction.

Table 10: Design Traffic Loadings

Road	Road Category	Design Traffic Loading (ESA)
01	"Transit Boulevard", likely equivalent to Sub-arterial	8×10^6
02	Arterial Road	1×10^7
03	Collector Road	2×10^6
04	Local Road	3×10^5
05	Collector Road	2×10^6
06	Collector Road	2×10^6
07	Local Road	3×10^5
08	Local Road	3×10^5
09	Local Road	3×10^5
10	Local Road	3×10^5
11	Local Road	3×10^5
12	Local Road	3×10^5
13	Local Road	3×10^5
14	Local Road	3×10^5

Where ESA = Equivalent standard axles

7.2.7 Design Subgrade CBR

It is noted that many roads have not been investigated due to revisions to road layouts, roads being outside of the WPCA property boundaries and construction works in progress on the site. It is noted that design CBR values in the areas yet to be filled will be dependent on fill quality. However, for the purposes of providing indicative pavement thicknesses, it is assumed that site-won soils will be used in the fill areas. Additional investigation will be required when access is available to the remaining areas and additional sampling and laboratory testing will be required as construction progresses to confirm the adopted design CBR values and adjust the design as necessary.

Based on the results of the laboratory testing, the clay soils have variable and low CBR values (1.5 – 2%). As a result, subgrade improvement is recommended for all clay and clay fill subgrades. Following either lime stabilisation (5% lime by weight) or subgrade replacement (durable material with CBR at least 15%) to a depth of 300 mm, a design subgrade CBR of 5% is recommended. Subgrade improvement is not required for areas where the subgrade comprises weathered shale.

7.2.8 Pavement Thickness Design

The pavement thickness designs given in Table 6 are based on the requirements of Liverpool City Council, AUSTROADS (2017) and the design parameters detailed in Sections 7.3.4 and 7.3.5. The pavement material quality and compaction requirements are given in Table11.

Table 11: Pavement Thickness Design

Road	Design CBR (%)	Traffic Loading[1]	Total Pavement Thickness (mm)	Pavement Profile (mm)		
				Wearing Course	Base Course	Sub-base Course
01	5.0[2]	8×10^6	530	50AC[3]	165	315
02		1×10^7	545	50AC	170	325
03		2×10^6	480	50AC	150	280
04		3×10^5	390	50AC	120	220
05		2×10^6	480	50AC	150	280
06		2×10^6	480	50AC	150	280
07		3×10^5	390	50AC	120	220
08		3×10^5	390	50AC	120	220
09		3×10^5	390	50AC	120	220
10		3×10^5	390	50AC	120	220
11		3×10^5	390	50AC	120	220
12		3×10^5	390	50AC	120	220
13		3×10^5	390	50AC	120	220
14		3×10^5	390	50AC	120	220

Notes: (1) To be confirmed by Council prior to construction;
(2) Based on subgrade improvement to a minimum depth of 300 mm resulting in an effective CBR value of 5%, and allowing for some variability in untreated subgrade strength;
(3) Wearing course for roundabouts to use polymer modified asphalt

In accordance with Liverpool City Council requirements, the wearing course should be 50 mm comprising a dense graded asphaltic concrete mix. Wearing course for roundabouts should use polymer modified asphalt and the asphalt binder must comply with Grade A10E requirements.

Our experience indicates that a 50 mm AC layer will act as a structural element and over time will be subject to fatigue. Notwithstanding this, it must be accepted that fatigue will occur regardless of the pavement type and allowance must be made within the maintenance scheduling for periodic sealing of cracks and re-sheeting to ensure ingress of water into the pavement gravel is minimised.

7.2.9 Materials and Compaction

The pavement base and sub-base should be placed and compacted in layers no thicker than 150 mm, with control exercised over placement moisture contents. If layer thicknesses greater than 150 mm are proposed, then it may be necessary to test the top and bottom of the layer to ensure that the minimum level of compaction has been achieved through the layer.

The suggested minimum material quality and compaction requirements are given in Table 12.

Table 12: Pavement Material Quality and Compaction

Layer	Material Quality	Minimum Compaction
Wearing Course	To conform to Council requirements	To conform to Council requirements
Base Course	To conform to Council requirements Soaked CBR ≥ 80%, PI ≤ 6%	Minimum dry density ratio of 98% Modified (AS 1289 Test 5.2.1)
Sub-base Course	To conform to Council requirements Soaked CBR ≥ 50%, PI ≤ 12%	Minimum dry density ratio of 98% Modified (AS 1289 Test 5.2.1)
Subgrade Replacement (where required)	Durable crushed rock Soaked CBR ≥ 15%	Minimum dry density ratio of 100% Standard (AS 1289 Test 5.1.1)
Subgrade	-	Minimum dry density ratio of 100% Standard (AS 1289 Test 5.1.1)

Where PI = plasticity index
Note 1: Council requirements included in Appendix F.

Whilst the use of lesser quality pavement materials than that detailed in Table 12 may be feasible, some compromise in either performance and/or pavement life must be anticipated and accepted. It is also suggested that advice be sought from Council if lesser quality pavement materials are proposed.

7.2.10 Drainage

Surface and subsurface drainage must be installed and maintained to protect the pavement and subgrade. The subsurface drains should be located at a minimum of 0.5 m depth below the excavation level. Guidelines on the arrangement of subsurface drainage are given on Page 20 of ARRB – SR41 (1989). It should be noted that if the sub-base is of low permeability relative to the base layer, then the subsurface drain is required to intersect all pavement layers as shown in ARRB – SR41 (1989).

It is suggested that subsurface drainage be provided for on the cut sides of the road pavement. It should be noted that such drainage could be integral with other drainage works proposed, such as bedding for stormwater lines. However, to facilitate drainage of the bedding layer, inlets to the pits via, say, a 3 m length of slotted pipe, will need to be incorporated into the works.

7.2.11 Salinity Considerations

Damage to pavements as a result of salinity is predominantly due to the presence of saline water tables which transfer salts to the pavement gravels. As such, mitigation of the effects of salinity is predominantly controlled by the inclusion of surface and subsurface drainage, as discussed in Section 7.2.10, which is aimed at protecting the pavement and subgrade from moisture ingress. Similarly, the incorporation of a primer seal immediately following placement and compaction of the base course followed by installation of the final seal soon after will minimise the risk of moisture infiltration during inclement weather.

The performance of pavements is also dependent on material quality and in this regard, it is considered that the use of gravels which satisfy the requirements of RMS Form 3051 (1994) for unbound gravels, in addition to Council's specification will provide pavements constructed to industry-accepted practice.

7.3 Services

Detailed design for proposed services was not available at the time of investigation. Concept designs indicate that services will roughly follow the road alignments with depths in the range 1 – 2 m. The following comments are generalised based on the subsurface profiles encountered. Excavation conditions and methodologies were given in 7.2.4.

7.3.1 Groundwater Inflow into Excavation

No groundwater was encountered within the limits of the investigation within Stage 2. There is the potential for localised perched groundwater and seepage, which could be expected along the soil/rock interface. Deeper excavations may encounter groundwater however the permeability in the clays and shale bedrock is typically very low and control of water encountered would be expected to be controlled using conventional sump and pump methods. It is noted that the extent of groundwater inflows would be dependent on the preceding climatic conditions.

Prolonged presence of ponded water within trenches may also potentially destabilise the trench excavations or soften the base of the trench which would require dewatering and over-excavation to rectify.

7.3.2 Batter Slopes and Excavation Support

It is expected that trenched excavation methods will be adopted for the shallow services within Stage 2, as such battered, benched or shored excavation to the invert depths will be required.

In general, excavation support for structural pits and trenches could either be in the form of temporary batter slopes and/or benches (above the groundwater table), or alternatively retaining structures, such as trench boxes.

Where space permits, temporary batter slopes (or benched excavation) could be used for excavations of up to say 4 m depth in soils, above the groundwater table. Maximum recommended temporary batter slopes for trench excavations (above the groundwater table only) should be no greater than 1.5(H):1(V).

Where batter slopes cannot be accommodated due to space restrictions and/or where excavations are below the groundwater table, the use of propped shoring boxes will be required to support the excavation. If high seepage rates are observed, propped shoring boxes will need to be installed immediately and progressively during excavation in conjunction with continuous dewatering.

For propped shoring with lateral support, the shoring walls may be designed based on a rectangular earth pressure distribution. Where no movement sensitive structures are located within a horizontal distance of 2H (where H is the vertical height of the retained zone) of the rear of the wall, lateral earth pressure distribution of 5H kPa (where H is the height of the retained soils) can be adopted. If there is a need for movement to be limited, then a higher lateral earth pressure distribution of 8H kPa should be used.

All slopes should be inspected by a geotechnical engineer at depth intervals of no greater than 1.5 m prior to excavation continuing. In all cases, surface encumbrances such as large equipment, heavy materials or stockpiles should be excluded from the zone of influence of the excavation which is

generally taken to be within a 45° (i.e.: 1 horizontal:1 vertical) line extending from the base of the trench or retaining wall to the ground surface.

Notwithstanding the above comments on trench stability, the contractor must comply with all statutory requirements for excavation support.

7.3.3 Erosion Potential

Soils of the Blacktown soil landscapes are typically of moderate to high erodibility which was confirmed by Emerson Crumb testing. The more sodic soils can have a high to very high erodibility and the erosion hazard for this landscape is high.

It is considered that the erosion hazard within the areas proposed for development would be within usually accepted limits and could be managed by good engineering and land management practices. Conventional soil and sediment control measures are to be implemented by the installing contractor.

7.3.4 Service Structure Foundations

Based on the results of the investigation and information provided, and site preparation in accordance with Section 8.4, controlled fill, natural soils or weathered rock are expected to be exposed at founding depths for service structures (such as manholes, service pits etc).

Allowable bearing pressures of 100 kPa are considered appropriate for stiff or stronger clays and controlled fill. An allowable bearing pressure of 500 kPa could be adopted for foundation design within weathered bedrock of at least very low strength. Bearing pressures in excess of those given above may be feasible with further investigation once design has progressed. The finalised designs should be subject to geotechnical review and inspection prior to construction.

All foundations must be inspected by a geotechnical engineer prior to the placement of steel and/or pouring of concrete to ensure that adequate founding conditions have been achieved.

7.4 Regional Stormwater Infrastructure Corridor

Detailed design for the SIC was not available at the time of investigation. It is understood that the development will include the realignment of the Moore Gully creek line, a series of water quality basins and wetland landscaping, swimming hole and gathering ground public space. The main constraints to development in this are the shallow groundwater and water logging potential. Considering detailed design has not been carried out, the general comments given in the following sections must be considered preliminary in nature.

7.4.1 Geotechnical Model

Based on the subsurface conditions encountered the geotechnical model underlying the SIC comprises:

- Topsoil comprising silty clay or clayey silt typically to depths of up to 0.3 m; overlying
- Residual silty clay of stiff to hard consistency in the west and alluvial clays of stiff to very stiff consistency in the east; overlying

- Weathered shale bedrock, initially of very low to low strength which increases with depth.

Groundwater levels were measured at depths of 1.8 – 3 m below ground level (approximately RL 66 in the west falling to approximately RL 57 in the east). Groundwater levels are transient and will fluctuate with time.

7.4.2 Groundwater

Bores 201 – 203 were drilled to the north of the water logged areas surrounding the Moore Gully water course and Bores 204 – 206 were drilled to the north of Thompsons Creek. The groundwater levels recorded in the wells installed generally match the levels and are likely controlled by the surface water levels of Moore Gully in the west and Thompsons Creek in the east.

On 26 September 2023, water levels were recorded at approximately RL 66.0 m AHD in Bore 201 to the west which drop at a steady gradient to approximately RL 57.5 m AHD in Bore 206 to the east.

Permeability testing carried out in the SIC indicate the residual and alluvial clays are of very low permeability.

7.4.3 Water Quality Basins

It is expected that the series of water quality basins proposed will be “offline” from the Moore Gully and Thompsons Creek waterways. The basins should utilise a clay or impermeable plastic liner to prevent localised raising of the groundwater levels. The base levels of the basins should be above the groundwater levels which are dictated by the water levels in Moore Gully and Thompsons Creek.

7.4.4 Creek Realignment and Earthworks

7.4.4.1 Earthworks

The water logged areas surrounding Moore Gully will form a constraint to earthworks. It is suggested that deep drainage channels are excavated at the commencement of earthworks to allow construction traffic to access the lower areas of the SIC. When the site has been suitably drained, the following methodology are suggest for fill placement: Strip vegetation and organic topsoils (to expected depths of 0.3 m) and separately stockpile for use in landscaping or remove off site;

- Strip uncontrolled fill and unsuitable material within the footprint of the proposed structures. Allow for inspection of the stripped surface by a geotechnical engineer;
- Compact the exposed surface with at least 8 passes of a 12 tonne (minimum deadweight) roller, followed by test rolling in the presence of a geotechnical engineer. Where soft spots are identified, they should be excavated and then backfilled using a suitable granular material.
- Fill should be placed in 250 mm (loose thickness) layers and compacted to achieve 98 – 102% dry density ratio relative to standard compaction. Placement moisture contents should be within 2% of OMC (as determined in the standard compaction test).

Highly reactive clay fill should be avoided due to the likelihood of drastic changes in moisture which will cause significant surface cracking. Surface drainage should be maintained at all times by adopting appropriate cross-falls across the site. Surface drainage should be installed as soon as is practicable in order to capture and remove surface flows to prevent erosion and softening of the exposed surface.

Site observations and laboratory test results have indicated the presence of high plasticity silty clays which are also highly erodible. Whilst these soils are typically of a stiff to very stiff consistency when dry, they can rapidly lose strength when wet and exposed and result in difficult trafficability conditions. It is recommended that all filling be placed and compacted in accordance with Level 1 requirements (AS 3798 – 2007).

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

7.4.5 Excavation

The earthworks plans have not been finalized at the time of preparing this report. The bulk excavations are expected to be limited to the new channel of the realigned Moore Gully which are expected to be within natural soils. All topsoil, natural soils should be readily removed using a conventional earthmoving equipment such as excavators and scrapers.

For information on soil types and consistency, reference must be made to the individual logs which are included in Appendix B. Tenderers must make their own assessment of excavation condition, with the information given on the test pit logs provided as preliminary information only.

7.4.6 Batter Slopes

While cut slopes within the clays may often stand vertically and unsupported (provided no nearby structures are present) for short periods of time, they will rapidly lose strength upon exposure to weather. Where above the groundwater levels, a maximum batter slope of 1.5(H):1(V) is recommended for unsurcharged temporary slopes in stiff clays. Where the slopes are to be vegetated to prevent erosion, a maximum final batter slope of 3(H):1(V) is recommended. Where batters are proposed below groundwater levels, specific investigation and design analysis will be required.

Where batters are formed in controlled fill, similar parameters to those recommended for cut slopes can be adopted. However, it is recommended that whilst the slope is being formed the batters should be over-filled in near-horizontal lifts and cut back to form the design grades.

If permanent batters are proposed for the proposed realignment of the Moore Gully creek line, they will need to be appropriately protected from erosion.

7.4.7 Retaining Walls

Where engineer-designed retaining walls are proposed, the following measures should be incorporated into the design:

- For horizontal backfill or retained soils, design based on an average bulk unit weight for retained material of 20 kN/m^3 and on a triangular earth pressure distribution based on an active earth pressure coefficient of (K_a) 0.3 for compacted filling and natural clay where no movement sensitive structures are located within a horizontal distance of 2H (where H is the vertical height of the retained zone) of the rear of the wall;
- Where there are movement sensitive structures located within the abovementioned critical zone, an at rest pressure coefficient (K_0) of 0.6 should be adopted;

- If hydrostatic pressures are allowed, soil densities could be reduced to the buoyant values.
- Backfilling of the void between the wall and the slope using imported, free draining granular material connected into a drainage pipe at the base of the wall;
- Capping of the backfill (where exposed) with compacted clay or concrete to prevent surface runoff entering the backfill;
- Provision of an open drain to collect and divert surface runoff from ponding above the wall.

If a drainage medium is not provided behind the retaining wall, then hydrostatic pressures must be incorporated within the design with soil parameters reduced to their buoyant values.

7.4.8 Footings

High level footings founded in very stiff to hard clays could be adopted for lightly loaded structures. Footings could be proportioned based on an allowable bearing pressure of 100 kPa in the stiff clays or controlled fill.

Considering the depth of high plasticity clays with significant potential of movement due to moisture variations, likelihood of water level fluctuations and seeping through the foundation excavation, cased bored piers could be a viable option for heavier structures. Further specific investigation is recommended for any major structures proposed.

8. Recommended Further Investigation

The geotechnical investigation undertaken to date has indicated that most of the site will be suitable for the proposed developments, with comments given on geotechnical limitations, development guidelines, indicative pavement thicknesses. Conceptual comments on design and construction aspects are also given in the report. Further 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):

- Further investigation for the specific basin and water quality structures proposed in the SIC;
- Additional pavement design test locations and CBR confirmation in areas where access was not permitted such as the properties to the west of Stage 2 and in the AMRF1 construction area. Confirmation CBR testing will also be required in filled areas during construction.
- Routine inspections and earthworks monitoring during construction;
- Detailed geotechnical investigations for the sewer services once detailed design progresses.

9. References

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10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Badgerys Creek Road, Bradfield in accordance with DP's proposal dated 19 June 2023 and acceptance received from WPCA on 13 July 2023. The work was carried out under NSW Government General Conditions of Agreement. This report is provided for the exclusive use of Western Parkland City Authority 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 sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

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

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Appendix A

About This Report

About this Report

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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 Methods

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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.

Description and Classification Methods

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

Soil Types

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

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

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

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

Definitions of grading terms used are:

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

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

In fine grained soils (>35% fines)

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

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

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

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

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

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

Soil Descriptions

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Origin

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

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

Moisture Condition – Coarse Grained Soils

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

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

Moisture Condition – Fine Grained Soils

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

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

Rock Strength

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

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

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

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

Degree of Weathering

The degree of weathering of rock is classified as follows:

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

Rock Descriptions

Degree of Fracturing

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

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

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

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Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

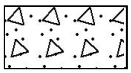
Symbols & Abbreviations

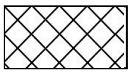
Graphic Symbols for Soil and Rock

General

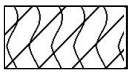

Asphalt

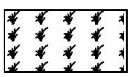

Road base

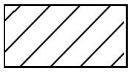

Concrete

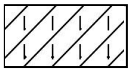

Filling

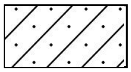
Soils


Topsoil

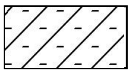

Peat

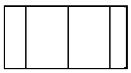

Clay

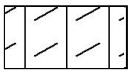

Silty clay

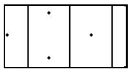

Sandy clay

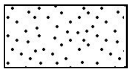

Gravelly clay

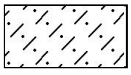

Shaly clay

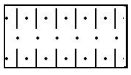

Silt


Clayey silt


Sandy silt

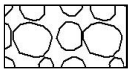

Sand

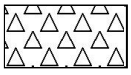

Clayey sand


Silty sand


Gravel

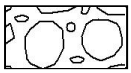

Sandy gravel


Cobbles, boulders

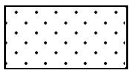

Talus

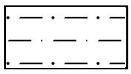
Sedimentary Rocks

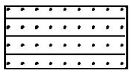

Boulder conglomerate

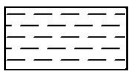

Conglomerate


Conglomeratic sandstone

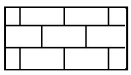

Sandstone


Siltstone

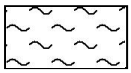

Laminite

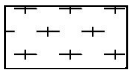

Mudstone, claystone, shale

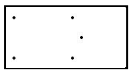

Coal


Limestone

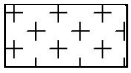
Metamorphic Rocks

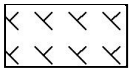

Slate, phyllite, schist

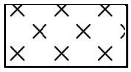

Gneiss

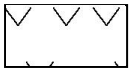

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite

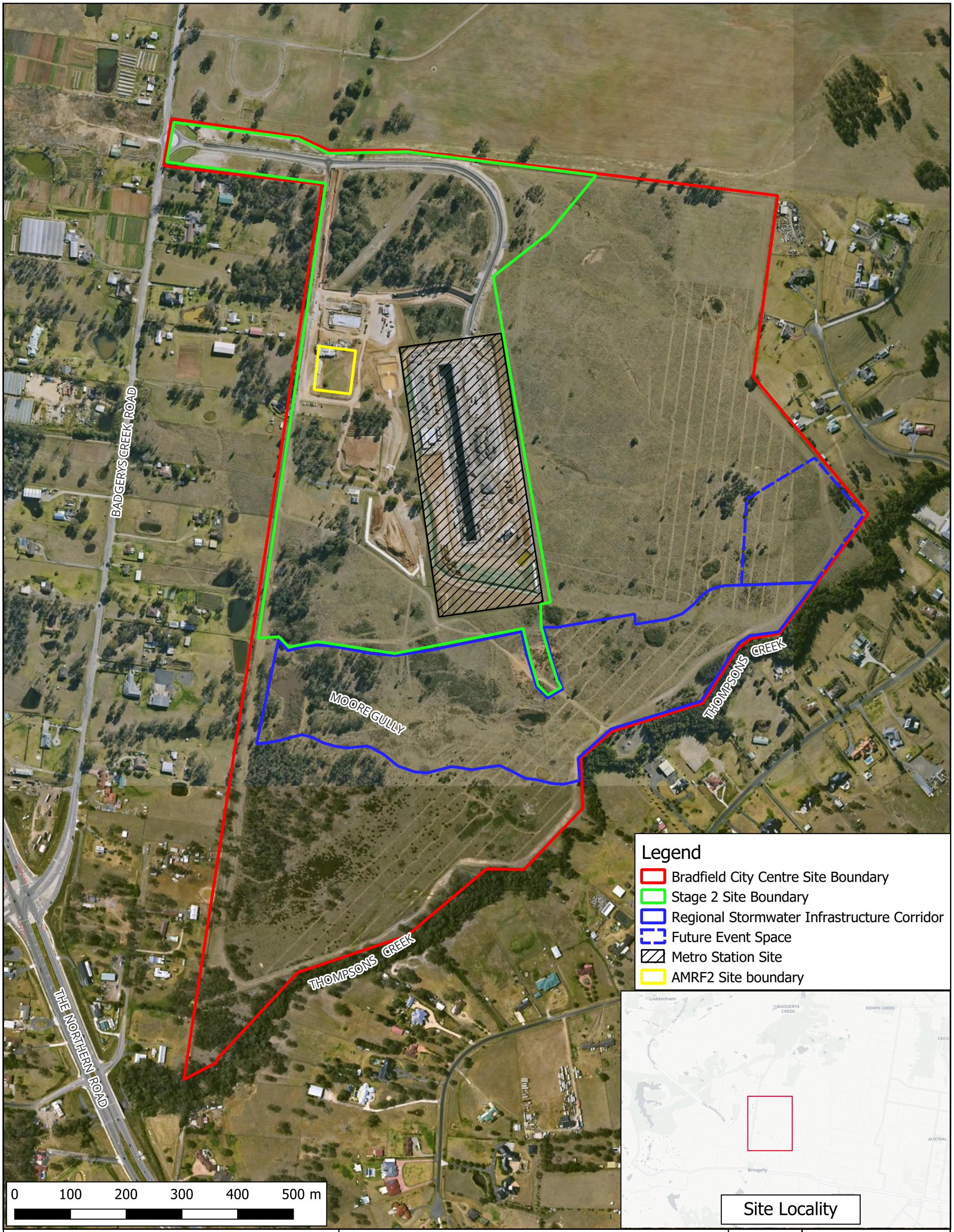

Dacite, epidote


Tuff, breccia


Porphyry

Appendix B

Drawings 1 – 4



Douglas Partners
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Site Location Plan
Proposed Urban Development
Stage 2, Bradfield City Centre
Badgerys Creek Road, Bradfield

N
MGA

CLIENT: Western Parkland City Authority	PROJ. #: 222630.00	DRAWING No: 1	REVISION: 2	SCALE: As Shown

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 18.01.2024

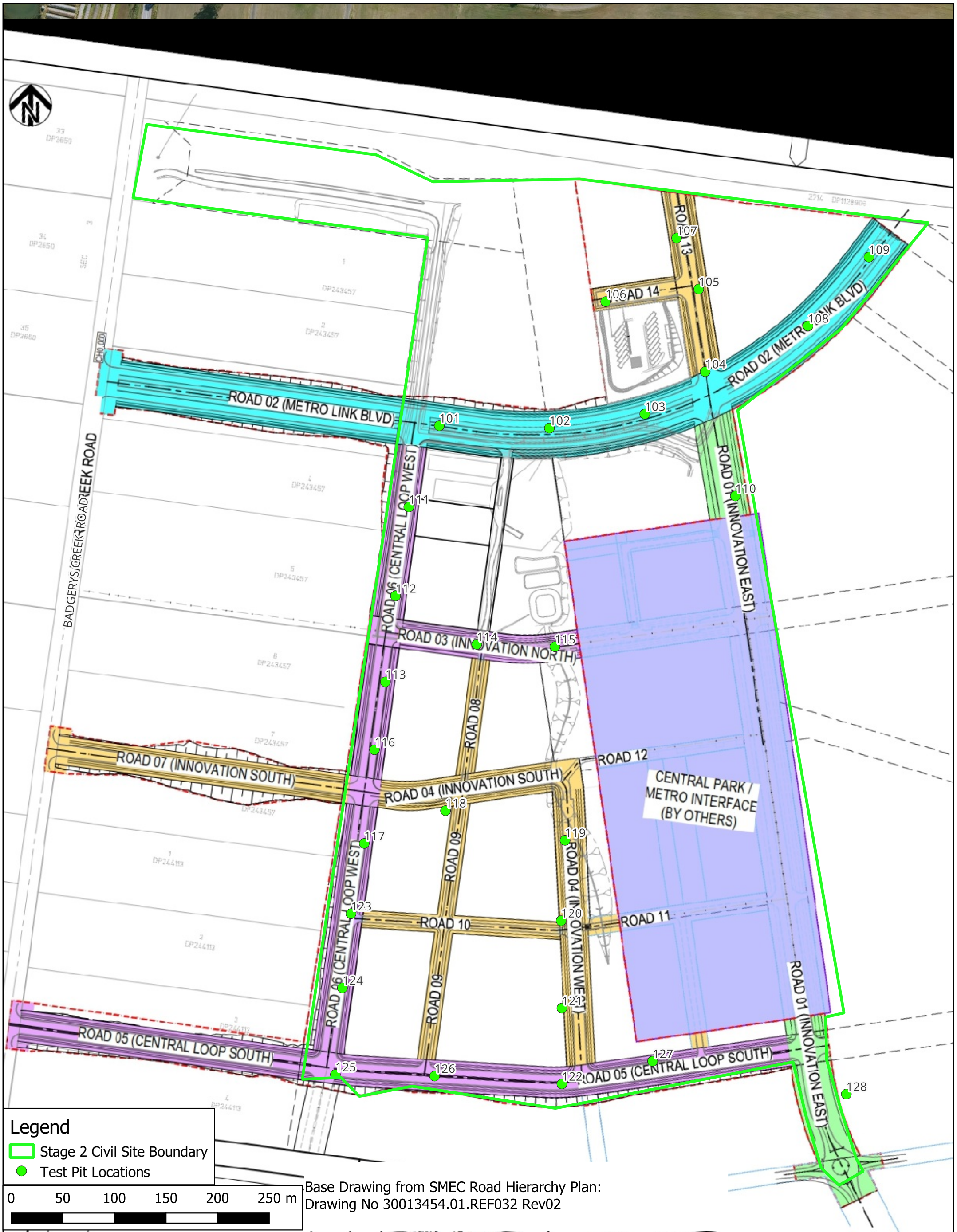
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Test Pit Location Plan**
Stage 2 Civil Works Area
215 Badgerys Creek Road, Bradfield

N
MGA

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 18.01.2023

CLIENT: Western Parkland City Authority
PROJ. #: 222630.00
DRAWING No: 2
REVISION: 2
SCALE: As Shown



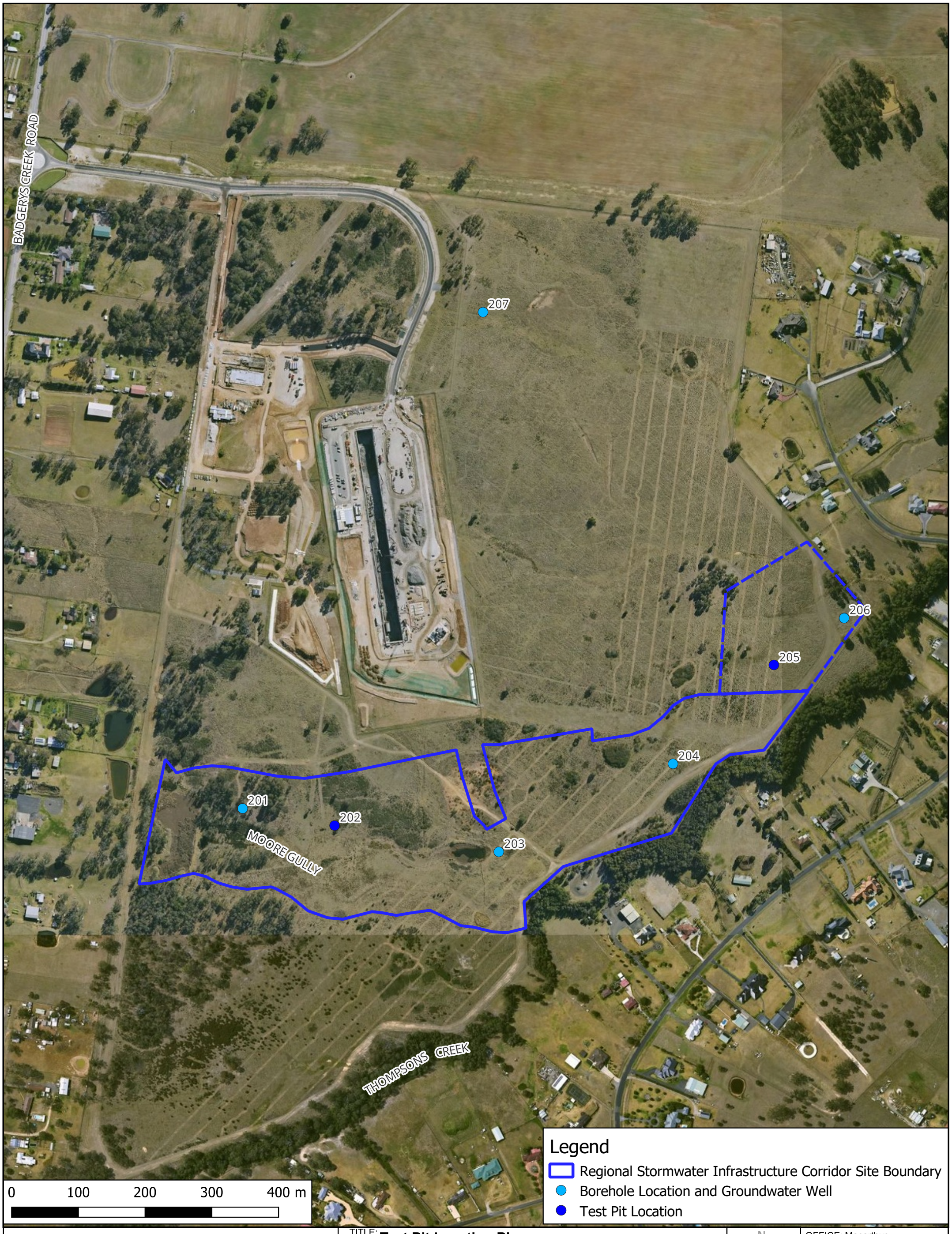
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Test Pit Location Plan with Road Layout**
Stage 2 Civil Works Area
215 Badgerys Creek Road, Bradfield

N
MGA

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 18.01.2024

CLIENT: Western Parkland City Authority
PROJ. #: 222630.00
DRAWING No: 3
REVISION: 2
SCALE: As Shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Test Pit Location Plan**
Regional Stormwater Infrastructure
215 Badgerys Creek Road, Bradfield

N
MGA

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 18.01.2024

CLIENT: Western Parkland City Authority
PROJ. #: 222630.00
DRAWING No: 4
REVISION: 0
SCALE: As Shown

Appendix C

Test Pit and Borehole Logs

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 81.3 mAHD
EASTING: 290469
NORTHING: 6244334

PIT No: 101
PROJECT No: 222630.00
DATE: 8/8/2023
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)
81	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual		D	0.5				
80	1	Below 0.9m: grading into extremely weathered shale, very stiff, with highly weathered low strength bands		D	1.0				
	1.5	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale		D	1.5				
79	2			D	2.0				
	2.5	Pit discontinued at 2.5m - refusal on low to medium strength shale							
78	3								
77	4								
76	5								
75	6								
74	7								
73	8								
72	9								
71	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 76.2 mAHD
EASTING: 290664
NORTHING: 6244342

PIT No: 103
PROJECT No: 222630.00
DATE: 10/8/2023
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)
76	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<<PL		D/B	0.3				
		Silty CLAY CI-CH: medium to high plasticity, red-brown, w<PL, very stiff, residual		D/B	0.6				
	0.7	Below 0.4m: grading to pale grey, very stiff							
75	1	Below 0.6m: grading into extremely weathered shale, very stiff, with low strength, highly weathered bands							
	1.3	SHALE: red-brown, low to medium strength, highly weathered, Bringelly Shale			1.3				
		Pit discontinued at 1.3m - refusal on low to medium strength shale							
74	2								
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 73.0 mAHD
EASTING: 290725
NORTHING: 6244384

PIT No: 104
PROJECT No: 222630.00
DATE: 10/8/2023
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)
73	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<<PL		D/B	0.5				
72	1	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual Below 0.8m: trace ironstone, very stiff		D	1.0				
		Below 1.4m: grading to pale grey, with extremely weathered shale bands		D	1.5				
71	2	Below 1.9m: with low strength, highly weathered shale bands							
	2.2	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
		Pit discontinued at 2.2m - refusal on low to medium strength shale							
70	3								
69	4								
68	5								
67	6								
66	7								
65	8								
64	9								
63	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 76.1 mAHD
EASTING: 290716
NORTHING: 6244460

PIT No: 105
PROJECT No: 222630.00
DATE: 8/8/2023
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)
76	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium strength, dark brown mottled red, with rootlets, trace fine to coarse gravel, w<PL		D	0.1				
		Silty CLAY CL-CI: low to medium plasticity, red-brown mottled grey, trace rootlets, w<PL, residual		D	0.5				
75	1	Below 0.8m: grading to pale grey mottled red, with extremely weathered shale bands		D	1.0				
	1.5	Below 1.3m: grading to pale grey, with low strength, highly weathered shale bands		D	1.5				
74	2	SHALE: pale brown, very low to low strength, Bringelly Shale		D	2.0				
	2.8	Pit discontinued at 2.8m - refusal on low to medium strength shale		D	2.8				
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 79.7 mAHD
EASTING: 290625
NORTHING: 6244450

PIT No: 106
PROJECT No: 222630.00
DATE: 8/8/2023
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)
79	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual		D	0.5				
	1	Below 0.9m: grading into extremely weathered, hard, with		B	1.0				
	1.1	low strength, highly weathered bands		D					
78		SHALE: pale red-brown, low to medium strength, Bringelly Shale		D	1.5				
	1.9			D	1.9				
	2	Pit discontinued at 1.9m - refusal on low to medium strength shale							
77	3								
76	4								
75	5								
74	6								
73	7								
72	8								
71	9								
70	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 76.2 mAHD
EASTING: 290697
NORTHING: 6244517

PIT No: 107
PROJECT No: 222630.00
DATE: 8/8/2023
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)
76	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown mottled red, with fine gravel and rootlets, w<<PL		D	0.1				
	0.5	Silty CLAY CI-CH: medium to high plasticity, red and pale brown, trace rootlets, with extremely weathered shale, very stiff and low strength, highly weathered bands, residual		D	0.5				
75	1.1	SHALE: pale brown, medium strength, Bringelly Shale		D/B	1.1				
		Pit discontinued at 1.1m - refusal on medium strength shale							
74	2								
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 71.6 mAHD
EASTING: 290828
NORTHING: 6244423

PIT No: 108
PROJECT No: 222630.00
DATE: 8/8/2023
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)
71	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, w<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled grey, trace fine to coarse gravel and rootlets, w<PL, very stiff to hard, residual		D	0.5				
	1	Below 0.9m: extremely weathered shale bands, very stiff to hard		D/B	1.0				
70									
	2	Below 1.8m: grading to pale grey, with low strength, highly weathered shale band		D	2.0		pp = 440-450		
	2.1	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
69	3								
	3.3	Pit discontinued at 3.3m - target depth reached		D	3.3				
68	4								
67	5								
66	6								
65	7								
64	8								
63	9								
62	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 69.1 mAHD
EASTING: 290880
NORTHING: 6244496

PIT No: 109
PROJECT No: 222630.00
DATE: 8/8/2023
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)
69	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale brown, trace rootlets, w<PL, firm to stiff, residual		D	0.5				
68	1	Below 0.8m: grading to red-brown, trace fine to coarse ironstone gravel, stiff		D	1.0				
		Below 1.3m: grading to pale grey mottled red		D	1.5		pp = 190-200		
67	2	Below 1.9m: grading to pale grey, extremely weathered shale, with very low strength, highly weathered bands		D	2.0		pp = 230-260		
	2.3			D	2.3				
	2.5	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
		Pit discontinued at 2.5m - target depth reached							
66	3								
65	4								
64	5								
63	6								
62	7								
61	8								
60	9								
59	10								

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 73.0 mAHD
EASTING: 290765
NORTHING: 6244281

PIT No: 110
PROJECT No: 222630.00
DATE: 10/8/2023
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)
73	0.3	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity dark and pale brown, with fine to coarse gravel and rootlets, w<<PL		D/B	0.5				
72	1	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual Below 0.8m: grading to pale grey, with extremely weathered shale, very stiff, with low strength, highly weathered shale bands		D/B	1.0				
	1.5			D	1.5		pp = 390		
71	2	SHALE: red and pale brown, low to medium strength, highly weathered, Bringelly Shale		D	2.0		pp = 290		
	2.3	Pit discontinued at 2.3m - refusal on low to medium strength shale		D	2.3				
70	3								
69	4								
68	5								
67	6								
66	7								
65	8								
64	9								
63	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 82.1 mAHD
EASTING: 290412
NORTHING: 6244084

PIT No: 113
PROJECT No: 222630.00
DATE: 10/8/2023
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)
82	0.15	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual		D/B	0.5				
81	1	Below 0.7m: grading to pale grey mottled red, with extremely weathered shale bands, stiff, with low strength, highly weathered shale bands		D	1.0				
	1.8								
80	1.81 2	SHALE: red-brown, low to medium strength, highly weathered, Bringelly Shale Pit discontinued at 1.81m - refusal on low to medium strength shale							
79	3								
78	4								
77	5								
76	6								
75	7								
74	8								
73	9								
72	10								

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface, test pit moved east (offset 3m)

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 77.3 mAHD
EASTING: 290396
NORTHING: 6243981

PIT No: 116
PROJECT No: 222630.00
DATE: 10/8/2023
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)
77	0.3	TOPSOIL/Silty CLAY CI-CH: medium to high plasticity, dark brown, with fine to coarse gravel and rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual		D/B	0.5				
	0.9			D	0.9				
76	1.0	Below 0.7m: extremely weathered shale bands, stiff to very stiff							
		SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
		Pit discontinued at 1.0m - refusal on medium strength shale							

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface, test pit near Telstra service (offset 10m)

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 75.5 mAHD
EASTING: 290392
NORTHING: 6243926

PIT No: 117
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
75	0.2	TOPSOIL/Silty CLAY CI-CH: medium to high plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, firm to stiff, residual		D/B	0.5				
	1	Below 0.9m: grading to pale brown mottled grey, extremely weathered shale, hard		D	1.0				
74		Below 1.3m: grading to pale grey, with low strength, highly weathered shale bands		D	1.5				
	2	SHALE: pale grey, low to medium strength, highly weathered, Bringelly Shale							
	2.2	Pit discontinued at 2.2m - refusal on medium strength shale		D	2.2				
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Heavy grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 77.5 mAHD
EASTING: 290470
NORTHING: 6243959

PIT No: 118
PROJECT No: 222630.00
DATE: 8/8/2023
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)
77	0.2	FILL/TOPSOIL: Silty CLAY CL-CI, low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse ironstone gravel and rootlets, w<PL, very stiff, residual		D/B	0.5				
	1	Below 0.8m: grading to pale grey mottled red, stiff		D	1.0				
76		Below 1.3m: with extremely weathered shale bands, very stiff		D	1.5		pp = 290-310		
	1.7	SHALE: red-brown, low to medium strength, highly weathered, Bringelly Shale							
	1.9	Pit discontinued at 1.9m - refusal on low to medium strength shale							
75	2								
	3								
74									
	4								
73									
	5								
72									
	6								
71									
	7								
70									
	8								
69									
	9								
68									
	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 71.3 mAHD
EASTING: 290578
NORTHING: 6243750

PIT No: 121
PROJECT No: 222630.00
DATE: 9/8/2023
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)
71	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, red-brown, with fine to coarse ironstone gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale grey mottled red, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual		D/B	0.5				
	1			D/B	1.0				
70		Below 1.4m: with extremely weathered shale, with low strength, highly weathered shale		D	1.5				
	1.9								
	2	SHALE: pale brown, very low to low strength, highly weathered, Bringelly Shale		D	2.0				
69	2.3			D	2.3				
		Pit discontinued at 2.3m - refusal on medium strength shale							
	3								
68									
	4								
67									
	5								
66									
	6								
65									
	7								
64									
	8								
63									
	9								
62									
	10								
61									

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 69.1 mAHD
EASTING: 290581
NORTHING: 6243691

PIT No: 122
PROJECT No: 222630.00
DATE: 9/8/2023
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)
69	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled grey, trace fine to coarse gravel and rootlets, w<PL, stiff to very stiff, residual		D/B	0.5				
68	1	Below 0.7m: grading to pale grey mottled red, firm to stiff		D	1.0				
		Below 1.4m: grading to grey, with extremely weathered shale bands, stiff to very stiff		D	1.5				
67	2			D	2.0		pp = 250-300		
					2.5		pp = 200-210		
	2.8			D	2.8				
66	2.9 3	SHALE: pale brown, low to medium strength, highly weathered, with very stiff clay bands, Bringelly Shale							
		Pit discontinued at 2.9m - refusal on low strength shale							
65	4								
64	5								
63	6								
62	7								
61	8								
60	9								
59	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover, slightly moist on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 74.4 mAHD
EASTING: 290373
NORTHING: 6243854

PIT No: 123
PROJECT No: 222630.00
DATE: 9/8/2023
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)
74	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, brown, trace ironstone gravel and rootlets, w<PL, very stiff, residual		D	0.5				
	0.8			B					
73	0.91	BASALT: dark brown and black, high strength, fractured		D	0.9				
		Pit discontinued at 0.91m - refusal on high strength igneous rock							
72	2								
71	3								
70	4								
69	5								
68	6								
67	7								
66	8								
65	9								
64	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover, slightly moist on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 73.1 mAHD
EASTING: 290368
NORTHING: 6243789

PIT No: 124
PROJECT No: 222630.00
DATE: 9/8/2023
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)
73	0.1	TOPSOIL/Silty CLAY CI: medium plasticity, pale and dark brown, with fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse ironstone gravel and rootlets, w<PL, very stiff, residual		D	0.5				
				B					
72	1	Below 0.8m: grading to pale grey, hard		D	1.0				
		Below 1.3m: extremely weathered shale bands, with low strength, highly weathered shale bands		D	1.3				
				D	1.5				
	1.6	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
71	1.9	Pit discontinued at 1.9m - refusal on medium strength shale							
70	3								
69	4								
68	5								
67	6								
66	7								
65	8								
64	9								
63	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover, slightly wet on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 68.4 mAHD
EASTING: 290362
NORTHING: 6243702

PIT No: 125
PROJECT No: 222630.00
DATE: 9/8/2023
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)
68	0.4	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, pale and dark brown, with fine to coarse gravel and rootlets, w<<PL		D/B	0.5				
		Silty CLAY CI-CH: medium to high plasticity, pale brown mottled red, trace ironstone gravel and rootlets, w<PL, stiff, residual		D	1.0				
67				D/B	1.5				
		Below 1.8m: grading to grey mottled red							
66	3.0	Below 2.9m: trace ironstone cobbles							
		Pit discontinued at 3.0m - limit of investigation							
65									
64									
63									
62									
61									
60									
59									
58									

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Heavy grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 72.8 mAHD
EASTING: 290459
NORTHING: 6243698

PIT No: 126
PROJECT No: 222630.00
DATE: 9/8/2023
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)
72	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, red-brown, with fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace fine to coarse gravel and rootlets, with highly weathered shale band, w<pl, stiff to very stiff, residual		D/B	0.5				
	0.7								
	0.9	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale		D	0.9				
		Pit discontinued at 0.9m - refusal on medium strength shale							

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 69.4 mAHD
EASTING: 290652
NORTHING: 6243715

PIT No: 127
PROJECT No: 222630.00
DATE: 9/8/2023
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)
69	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown mottled red-brown, with rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale grey, trace rootlets, w<PL, stiff, residual		D	0.5				
68	1	Below 0.9m: grading to pale grey, firm to stiff		D/B	1.0				
				D	1.5		pp = 190-200		
	2	Below 1.9m: with low strength, highly weathered shale bands		D	2.0		pp = 250		
67	2.4	SHALE: pale grey, low to medium strength, extremely weathered, Bringelly Shale		D	2.5				
	2.8	Pit discontinued at 2.8m - refusal on low to medium strength shale		D	2.8				
66	3								
65	4								
64	5								
63	6								
62	7								
61	8								
60	9								
59	10								

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Trace grass on surface, surrounded by metal pipes sticking out of the ground

☐ 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 65.0 mAHD
EASTING: 290860
NORTHING: 6243681

PIT No: 128
PROJECT No: 222630.00
DATE: 9/8/2023
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)
65	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, red-brown, trace fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace ironstone gravel and rootlets, w<PL, stiff, residual		D	0.5				
64	1			B	1.0				
		Below 1.4m: grading to pale grey mottled pale brown		D	1.5				
63	2			D	1.9				
		Below 2.1m: with extremely weathered shale bands							
	2.4	Pit discontinued at 2.4m - refusal on very low to low strength shale		D	2.4				
62	3								
61	4								
60	5								
59	6								
58	7								
57	8								
56	9								
55	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Trace grass on surface, surrounded by metal pipes sticking out of the ground

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 68.1 mAHD
EASTING: 290482
NORTHING: 6243623
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 222630.00
DATE: 11/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details: stick-up
68	0.1	TOPSOIL/Silty CLAY CL: low plasticity, brown, trace gravel and rootlets, w<PL		D	0.1				backfill
		Silty CLAY CI: medium plasticity, brown, trace gravel, w<PL, hard, residual		D	0.5				casing
				B					
67	1			D	1.0		10,17,18 N = 35		bentonite
				S					
				D	1.45 1.5				
		Below 1.6m: grading to pale grey							
66	2								
	2.0	SHALE: pale grey, very low to low strength							
65	3	Below 3.0m: grading to low to medium strength							sand
64	4								screen
63	5								
	5.0	Bore discontinued at 5.0m - limit of investigation							
62	6								
61	7								
60	8								
59	9								
58	10								

RIG: Explora 140 **DRILLER:** W C Excavations (Will) **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 5.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA20 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

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 65.5 mAHD
EASTING: 290620
NORTHING: 6243597

PIT No: 202
PROJECT No: 222630.00
DATE: 10/8/2023
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)
65	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown and red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual		D/B	0.5				
	1	Below 0.7m: grading to pale brown, very stiff		D	1.0				
		Below 1.1m: with extremely weathered shale bands, hard, with low strength, highly weathered band							
64	1.4	SHALE: pale brown, low to medium strength, extremely weathered, Bringelly Shale							
	1.7	Pit discontinued at 1.7m - refusal on medium strength shale		D	1.7				
63	2								
	3								
62									
	4								
61									
	5								
60									
	6								
59									
	7								
58									
	8								
57									
	9								
56									
	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface, next to a swamp (offset ~20-30m)

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 64.2 mAHD
EASTING: 290868
NORTHING: 6243556
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 222630.00
DATE: 11/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details: stick-up
64	0.2	TOPSOIL/Silty CLAY CL: low plasticity, orange-brown, trace gravel and rootlets, w<PL		D	0.1 0.2				backfill
		Silty CLAY CI-CH: medium to high plasticity, brown mottled pale grey, trace gravel, w<PL, stiff, alluvial		D B	0.5				casing
63	1			D S	1.0		4,6,9 N = 15		bentonite
		Below 1.5m: grading to red-brown			1.45				
62	2				2.5				
		Below 2.5m: grading to orange mottled pale grey, very stiff		S			5,8,13 N = 21		
61	3				2.95				sand
60	4			S	4.0		4,10,23 N = 33		screen
	4.5	SHALE: brown, very low strength			4.45				
59	5	5.0 Bore discontinued at 5.0m - limit of investigation							
58	6								
57	7								
56	8								
55	9								
54	10								

RIG: Explora 140 **DRILLER:** W C Excavations (Will) **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 5.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA20 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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 62.3 mAHD
EASTING: 291129
NORTHING: 6243689
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 222630.00
DATE: 11/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
62	0.3	TOPSOIL/Silty CLAY CL: low plasticity, brown, trace gravel and rootlets, w<PL		D	0.1				stick-up
		Silty CLAY CL-CI: low to medium plasticity, pale brown mottled orange and red, trace gravel, w<PL, alluvial		D	0.5				backfill
61	1			D	1.0				casing
				S			3,4,8 N = 12		bentonite
				D	1.45 1.5				
60	2								
		Below 2.5m: becoming dark orange mottled dark brown, very stiff			2.5				
				S			6,8,10 N = 18		
	3				2.95				
59		Below 3.2m: grading to dark brown							sand
	4				4.0				screen
58				S			8,9,25 N = 34		
					4.45				
57	5	5.0 Bore discontinued at 5.0m - limit of investigation							
56	6								
55	7								
54	8								
53	9								
52	10								

RIG: Explora 140 **DRILLER:** W C Excavations (Will) **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 5.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA20 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

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 60.1 mAHD
EASTING: 291281
NORTHING: 6243837

PIT No: 205
PROJECT No: 222630.00
DATE: 10/8/2023
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)
60	0.3	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, pale brown, with fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace gravel and rootlets, w<PL, stiff, alluvial		D/B	0.5				
59	1	Below 0.9m: grading to red-brown mottled pale brown, trace ironstone, firm to stiff		D	1.0				
		Below 1.3m: grading to pale grey mottled pale brown		D	1.5		pp = 410		
58	2			D	2.0		pp = 290-310		
					2.5		pp = 110-130		
57	3								
	3.5	Below 3.3m: with heavily iron indurated cobbles		D	3.5			▽	
		Pit discontinued at 3.5m - limit of investigation							
56	4								
55	5								
54	6								
53	7								
52	8								
51	9								
50	10								

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

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: Seepage observed at 3.5-3.8m

REMARKS: Grass cover on surface

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 59.3 mAHD
EASTING: 291385
NORTHING: 6243906
DIP/AZIMUTH: 90°/--

BORE No: 206
PROJECT No: 222630.00
DATE: 23/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
59	0.2	TOPSOIL/Silty CLAY CL: low plasticity, brown, trace gravel and rootlets, w<PL							stickup
		Silty CLAY CI-CH: medium to high plasticity, brown-grey, trace gravel, w~PL, stiff, alluvial		D/B	0.5				bentonite
58	1			D/B	1.0		pp = 200		1 casing
				S			4,6,8 N = 14		
				D/B	1.45 1.5		pp = 200-250		
57	2	Below 2.0m: grading to pale brown and pale grey, w~PL		D	2.0				2
				D	2.5				
				S			4,4,6 N = 10		
56	3			D	2.95 3.0				3 sand
					3.5				screen
55	4	Below 4.1m: w>PL			4.0			23-08-23	4
				S			5,5,5 N = 10 pp = 100		
					4.45 4.5				
	4.8	SHALE: brown, very low strength, extremely weathered							
54	5 5.0	Bore discontinued at 5.0m - limit of investigation							5
53	6								6
52	7								7
51	8								8
50	9								9
49	10								10

RIG: Explora 140 **DRILLER:** Steve **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 5.0m

WATER OBSERVATIONS: Free groundwater encountered whilst augering at 4.1m

REMARKS: Location coordinates are in MGA94 Zone 20. Well installed: 1m stickup, bentonite 0-1.0m, sand 1.0-5.0m; casing 0-2.0m, screen 2.0-5.0m

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: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 69.5 mAHD
EASTING: 290843
NORTHING: 6244364
DIP/AZIMUTH: 90°/--

BORE No: 207
PROJECT No: 222630.00
DATE: 23/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
69	0.3	Silty CLAY CL: low plasticity, dark brown, trace gravel, w<PL							stickup
		Silty CLAY CI: brown, trace gravel, w<PL, stiff, residual		D	0.5				
	1			D	1.0				backfill
				S			3,5,8 N = 13		
68		Below 1.3m: grading to brown and pale grey		D	1.45 1.5		pp = 300-350		casing
	2			D	2.0				bentonite
67		Below 2.3m: grading to pale brown and pale grey			2.5				
	2.6	SHALE: grey, very low strength, extremely weathered		S	2.6		pp >600 8,18,17 N = 35		
	3			D	2.95 3.0				
66	3.5	SHALE: brown, very low to low strength, extremely weathered							
	4								
65									
	5								
64		Below 5.5m: grading to dark grey, very low to medium strength							
	6								sand
63									
	7								screen
62									
	8								
61									
	9								
60									
	10	10.0 Bore discontinued at 10.0m - limit of investigation							

RIG: Explora 140 **DRILLER:** Steve **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 20. Well installed: 1m stickup, backfill 0-1.8m, bentonite 1.8-2.6m, sand 2.6-10m; casing 0-4.0m, screen 4.0-10.0m

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

Appendix D

Results of Laboratory Testing

Material Test Report

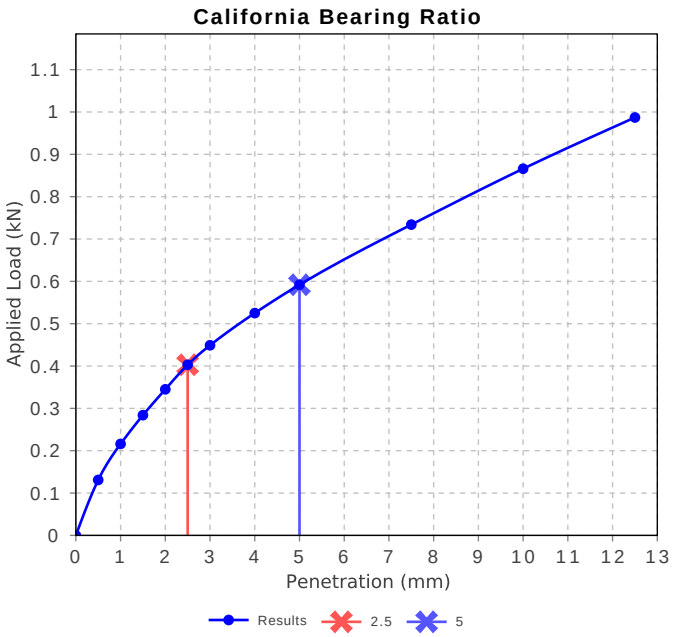
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: alex.crowe@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Alex Crowe
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955A
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 11/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**101, Depth: 0.5m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.78		
Optimum Moisture Content (%)	16.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m^3)	1.73		
Field Moisture Content (%)	16.2		
Moisture Content at Placement (%)	16.9		
Moisture Content Top 30mm (%)	24.0		
Moisture Content Rest of Sample (%)	18.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	74.1		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	13.9		



Material Test Report

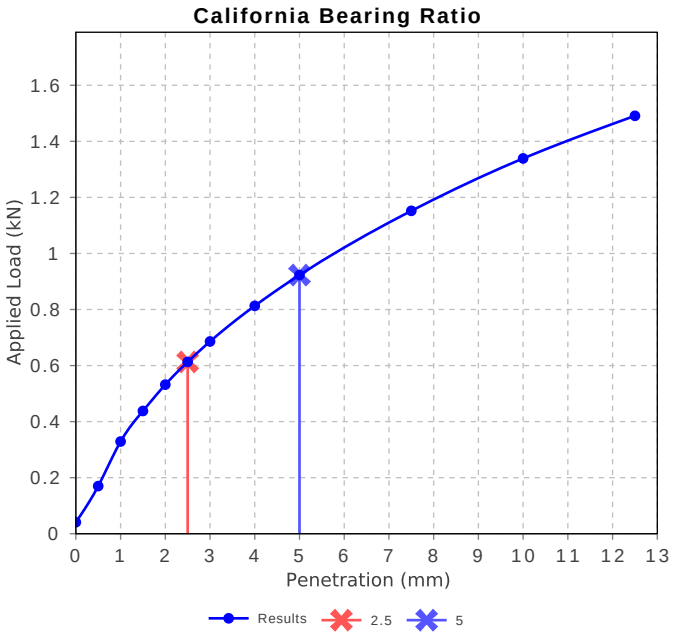
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: alex.crowe@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Alex Crowe
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955B
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 12/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**103, Depth: 0.3m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown, w<PL, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	19.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.70		
Field Moisture Content (%)	15.3		
Moisture Content at Placement (%)	19.4		
Moisture Content Top 30mm (%)	22.7		
Moisture Content Rest of Sample (%)	19.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.1		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Douglas Partners
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18 Waler Crescent Smeaton Grange NSW 2567
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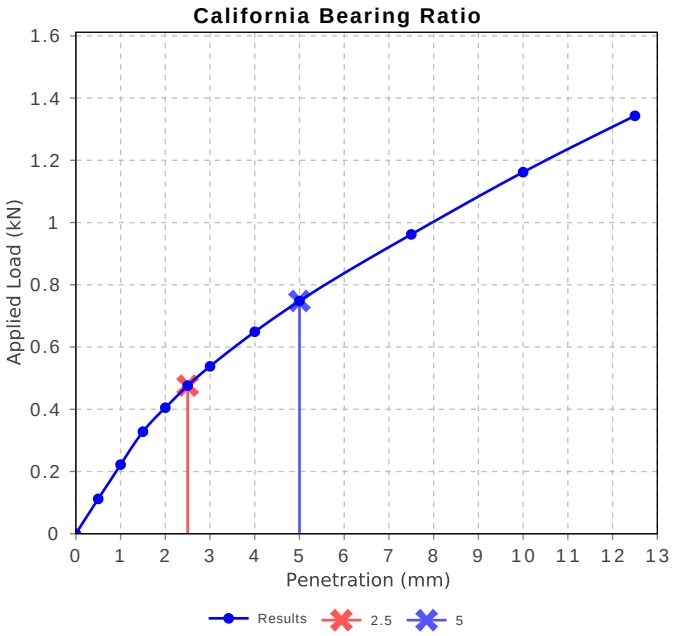
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Alex Crowe
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **222630.00-2**
Issue Number: 3 - *This version supersedes all previous issues*
Reissue Reason: *Split Report*
Date Issued: 10/10/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 10955
Sample Number: MA-10955D
Date Sampled: 10/08/2023
Dates Tested: 17/08/2023 - 12/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **104, Depth: 0.5m**
Material: Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.71		
Optimum Moisture Content (%)	19.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m^3)	1.67		
Field Moisture Content (%)	16.4		
Moisture Content at Placement (%)	19.2		
Moisture Content Top 30mm (%)	24.9		
Moisture Content Rest of Sample (%)	21.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.3		
Swell (%)	2.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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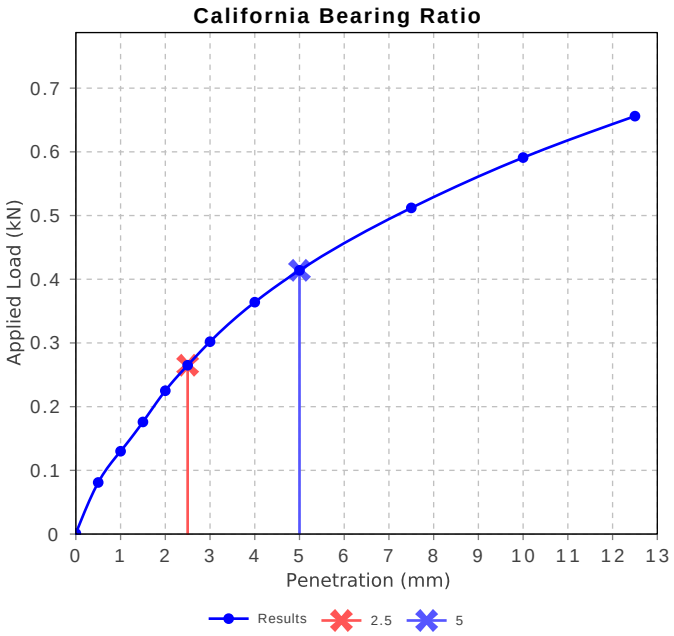
Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955E
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**105, Depth: 1.0m**
Material:	Silty CLAY CL-CI: low to medium plasticity, red-brown mottled grey, trace rootlets, w<PL, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.74		
Optimum Moisture Content (%)	18.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	102.5		
Dry Density after Soaking (t/m^3)	1.69		
Field Moisture Content (%)	14.7		
Moisture Content at Placement (%)	18.8		
Moisture Content Top 30mm (%)	25.8		
Moisture Content Rest of Sample (%)	21.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	98.5		
Swell (%)	3.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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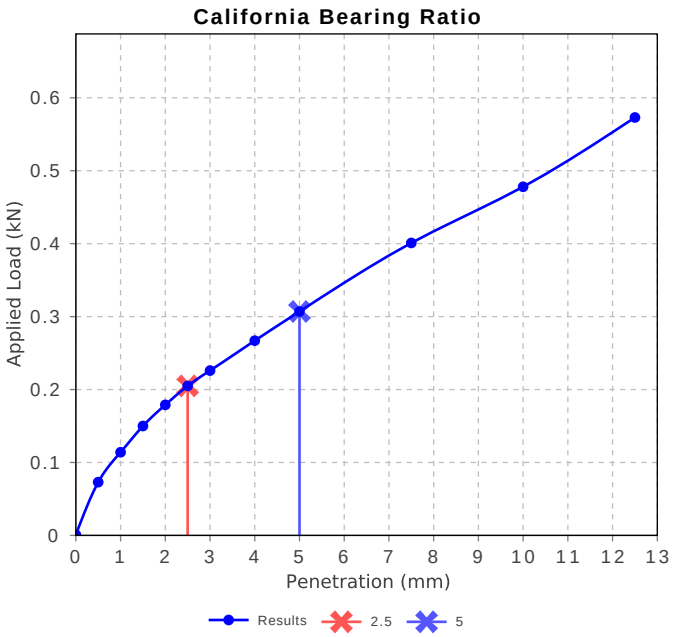
Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955F
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**106, Depth: 1.0m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**1.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.73		
Optimum Moisture Content (%)	17.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.66		
Field Moisture Content (%)	14.0		
Moisture Content at Placement (%)	17.3		
Moisture Content Top 30mm (%)	26.3		
Moisture Content Rest of Sample (%)	19.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.6		
Swell (%)	5.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	4.0		



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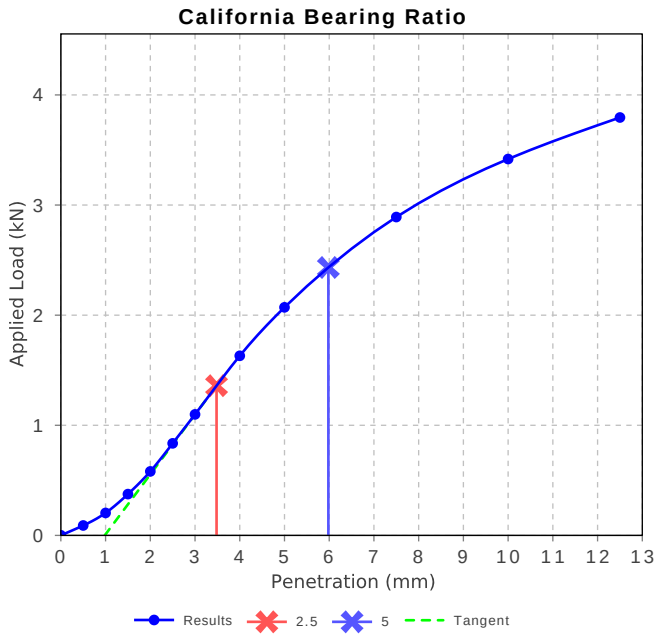
Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955G
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**107, Depth: 1.1m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red and pale brown, extremely weathered shale bands, trace rootlets, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**12**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.84		
Optimum Moisture Content (%)	9.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	103.0		
Dry Density after Soaking (t/m^3)	1.82		
Field Moisture Content (%)	6.3		
Moisture Content at Placement (%)	9.4		
Moisture Content Top 30mm (%)	15.8		
Moisture Content Rest of Sample (%)	12.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	97.2		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	15.6		



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Report Number:	**222630.00-2**
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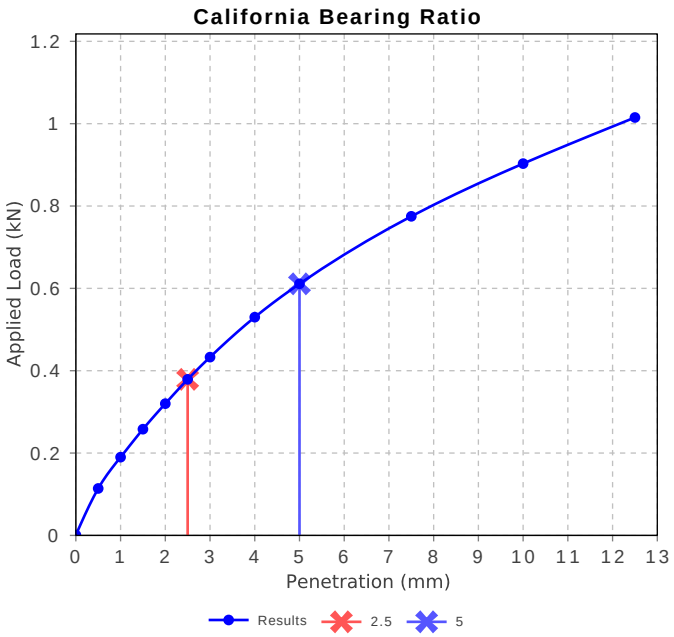
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955H
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**108, Depth: 1.0m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown mottled grey, trace fine to coarse gravel and rootlets, w<PL, very stiff to hard, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.83		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m^3)	1.77		
Field Moisture Content (%)	12.1		
Moisture Content at Placement (%)	14.5		
Moisture Content Top 30mm (%)	20.9		
Moisture Content Rest of Sample (%)	17.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.8		
Swell (%)	3.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.4		



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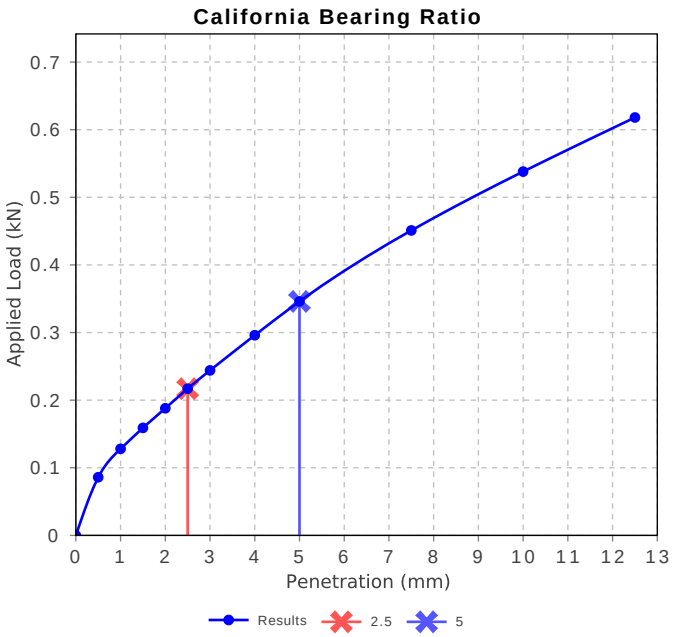
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955I
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 11/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**109, Depth: 0.5m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale brown, trace rootlets, w<PL, firm to stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**1.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.91		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.90		
Field Moisture Content (%)	16.7		
Moisture Content at Placement (%)	15.6		
Moisture Content Top 30mm (%)	19.1		
Moisture Content Rest of Sample (%)	15.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	74.5		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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Report Number:	**222630.00-2**
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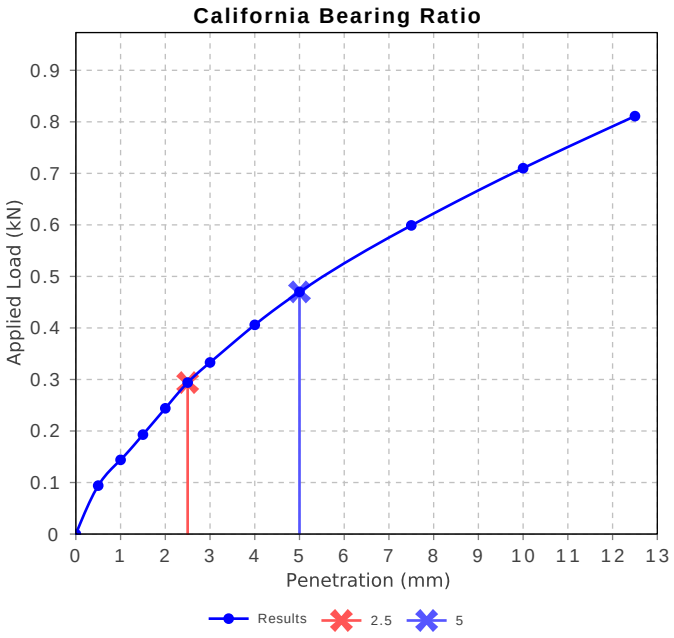
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955K
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 12/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**110, Depth: 1.0m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.73		
Optimum Moisture Content (%)	17.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m^3)	1.68		
Field Moisture Content (%)	17.6		
Moisture Content at Placement (%)	17.8		
Moisture Content Top 30mm (%)	25.7		
Moisture Content Rest of Sample (%)	19.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	194.9		
Swell (%)	3.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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Report Number:	**222630.00-2**
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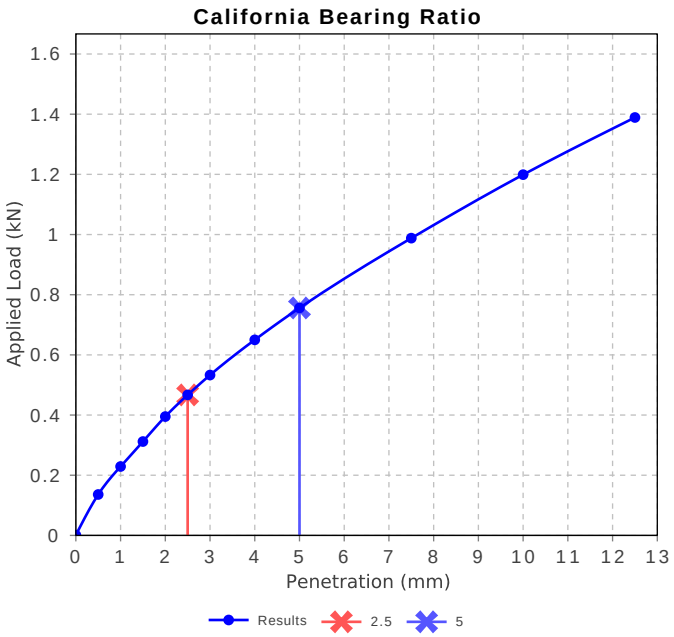
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955L
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 11/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**113, Depth: 0.5m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.76		
Optimum Moisture Content (%)	17.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.71		
Field Moisture Content (%)	18.0		
Moisture Content at Placement (%)	17.4		
Moisture Content Top 30mm (%)	23.9		
Moisture Content Rest of Sample (%)	18.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.4		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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Report Number:	**222630.00-2**
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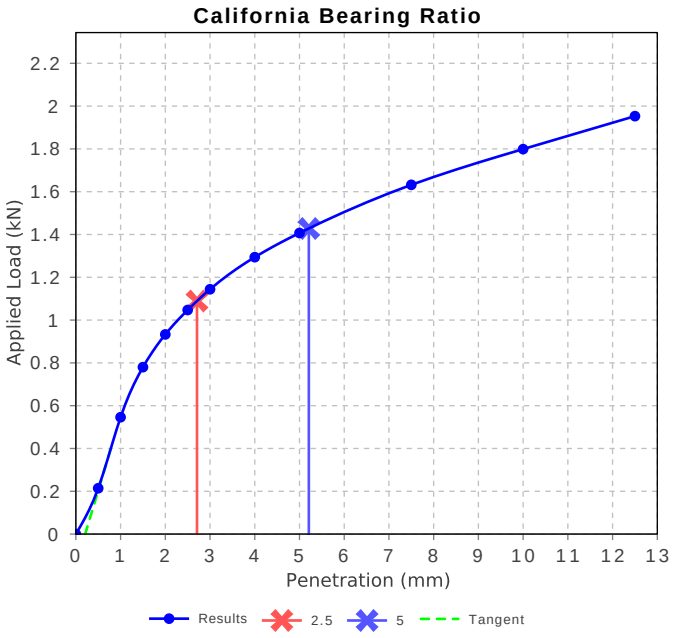
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955M
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 11/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**116, Depth: 0.5m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**8**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.71		
Optimum Moisture Content (%)	20.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m^3)	1.69		
Field Moisture Content (%)	21.1		
Moisture Content at Placement (%)	20.2		
Moisture Content Top 30mm (%)	23.2		
Moisture Content Rest of Sample (%)	19.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.3		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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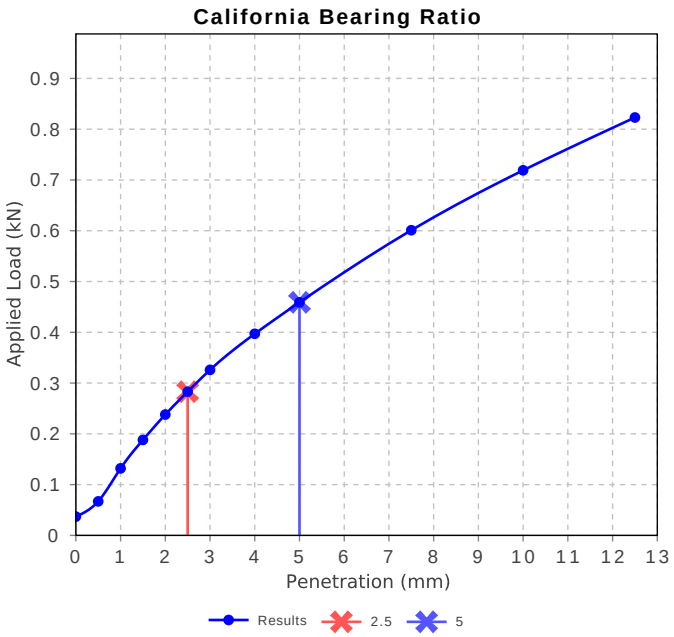
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Alex Crowe
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955O
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 12/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**118, Depth: 1.0m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse ironstone gravel and rootlets, w<PL, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.69		
Optimum Moisture Content (%)	19.5		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	98.0		
Dry Density after Soaking (t/m^3)	1.65		
Field Moisture Content (%)	19.3		
Moisture Content at Placement (%)	18.9		
Moisture Content Top 30mm (%)	26.8		
Moisture Content Rest of Sample (%)	22.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	191.6		
Swell (%)	3.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

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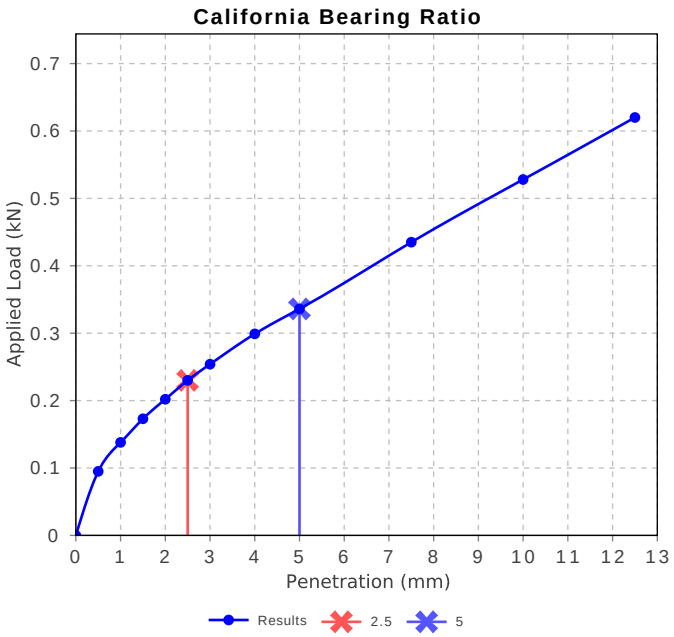
Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955P
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**121, Depth: 0.5m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale grey mottled red, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**1.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.71		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	103.0		
Dry Density after Soaking (t/m^3)	1.63		
Field Moisture Content (%)	14.0		
Moisture Content at Placement (%)	15.8		
Moisture Content Top 30mm (%)	28.3		
Moisture Content Rest of Sample (%)	21.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	117.8		
Swell (%)	5.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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Approved Signatory: Alex Crowe
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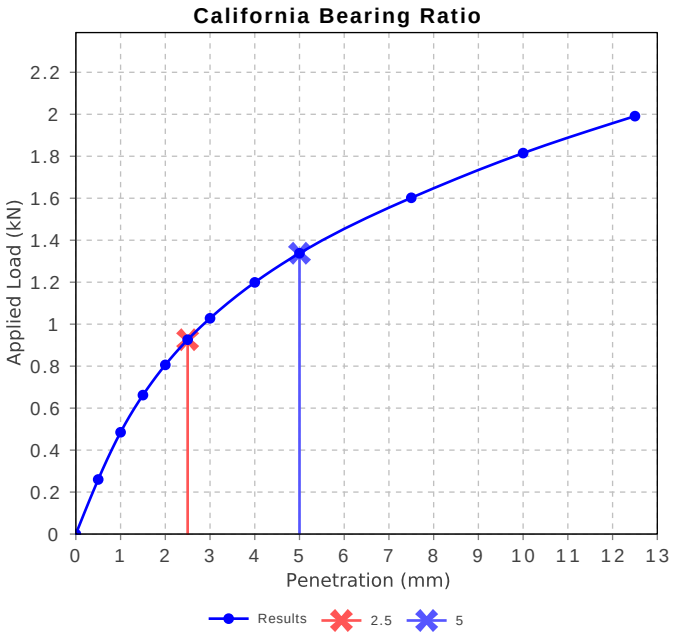
Laboratory Accreditation Number: 828

Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955S
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**123, Depth: 0.5m**
Material:	Silty CLAY CI-CH: medium to high plasticity, brown, trace ironstone gravel and rootlets, w<PL, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**7**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.69		
Optimum Moisture Content (%)	18.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.68		
Field Moisture Content (%)	13.5		
Moisture Content at Placement (%)	18.1		
Moisture Content Top 30mm (%)	23.1		
Moisture Content Rest of Sample (%)	21.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.8		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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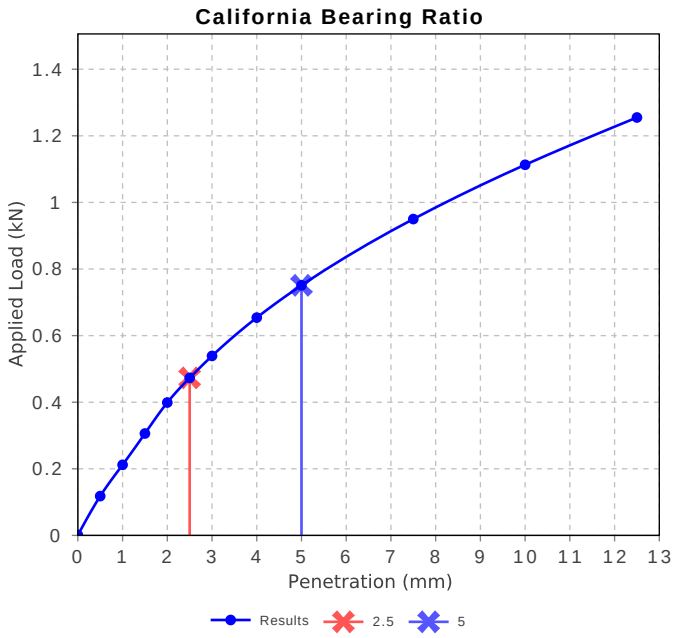
Approved Signatory: Alex Crowe
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955T
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**124, Depth: 0.5m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse ironstone gravel and rootlets, w<PL, very stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	17.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m^3)	1.68		
Field Moisture Content (%)	13.8		
Moisture Content at Placement (%)	17.6		
Moisture Content Top 30mm (%)	24.2		
Moisture Content Rest of Sample (%)	20.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.3		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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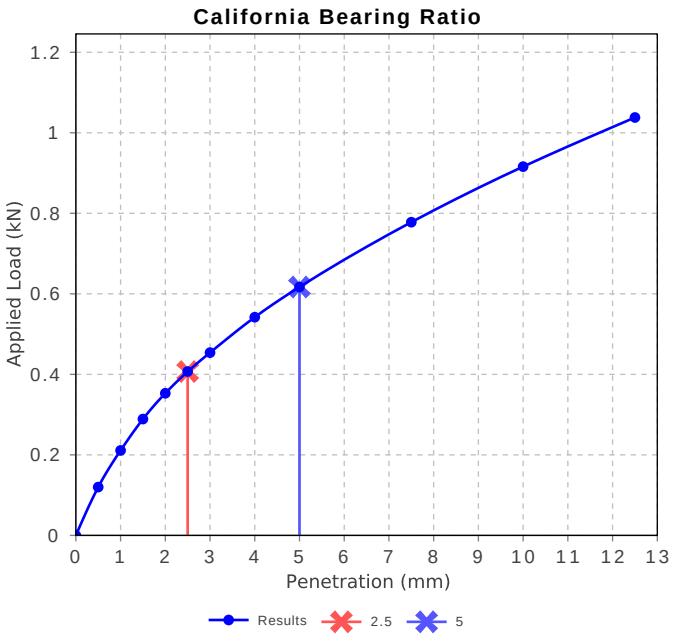
Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955V
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**125, Depth: 1.5m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale brown mottled red, trace ironstone gravel and rootlets, w<PL, stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.81		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	103.0		
Dry Density after Soaking (t/m^3)	1.78		
Field Moisture Content (%)	17.6		
Moisture Content at Placement (%)	16.2		
Moisture Content Top 30mm (%)	21.8		
Moisture Content Rest of Sample (%)	18.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	143.4		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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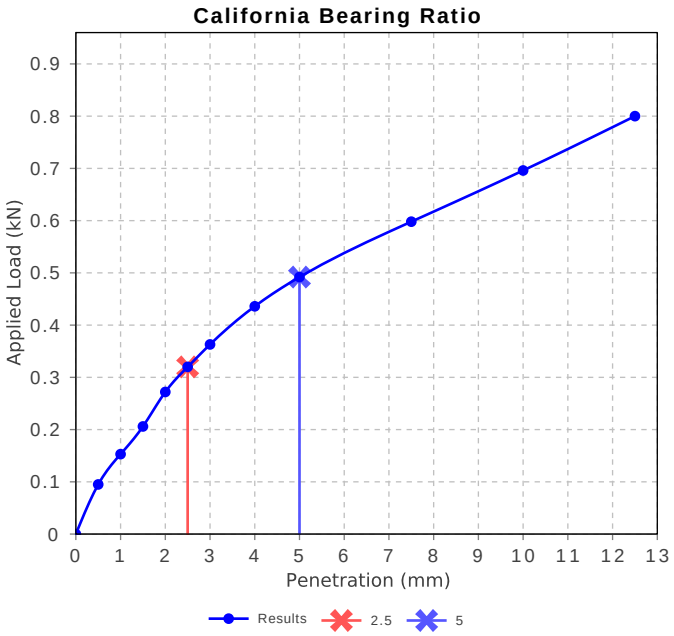
Report Number:	**222630.00-2**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Split Report*
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955W
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 12/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**127, Depth: 1.0m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale grey, trace rootlets, w<PL, stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.63		
Optimum Moisture Content (%)	22.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.59		
Field Moisture Content (%)	23.0		
Moisture Content at Placement (%)	22.8		
Moisture Content Top 30mm (%)	26.9		
Moisture Content Rest of Sample (%)	23.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	50.4		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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Report Number:	**222630.00-2**
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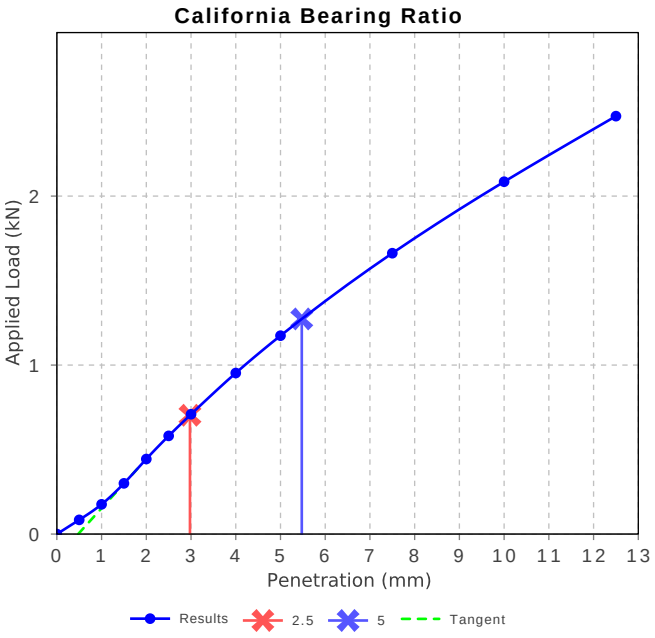
Date Issued:	10/10/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955X
Date Sampled:	10/08/2023
Dates Tested:	17/08/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**128, Depth: 1.0m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale brown, trace ironstone gravel and rootlets, w<PL, stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**6**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.88		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.86		
Field Moisture Content (%)	14.5		
Moisture Content at Placement (%)	13.8		
Moisture Content Top 30mm (%)	19.4		
Moisture Content Rest of Sample (%)	15.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	137.9		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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Laboratory Accreditation Number: 828

Report Number:	**222630.00-2**
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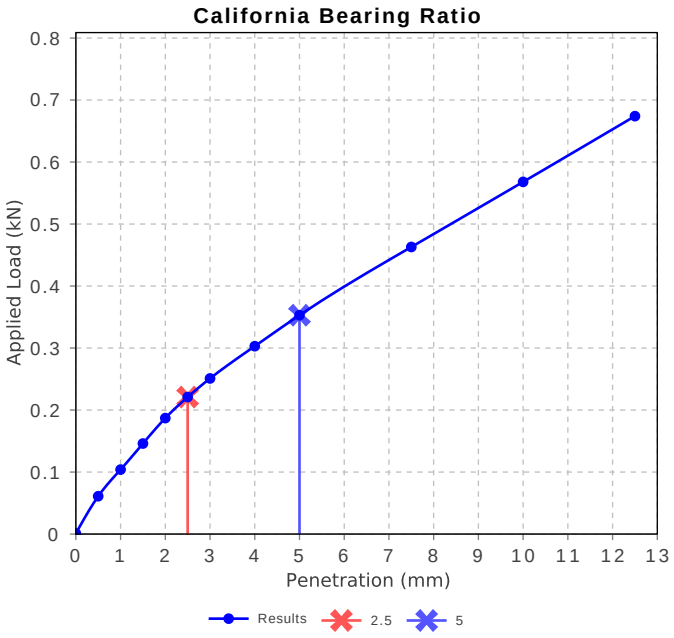
Date Issued:	10/10/2023
Client:	Western Parkland City Authority Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	10955
Sample Number:	MA-10955Y
Date Sampled:	14/09/2023
Dates Tested:	14/09/2023 - 15/09/2023
Sampling Method:	AS 1289.1.2.1 6.4 (b) - Sampling from layers in earthworks or pavement - compacted
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**126, Depth: 1.0m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale grey, trace rootlets, w<PL, stiff, residual

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.69		
Optimum Moisture Content (%)	18.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m^3)	1.63		
Field Moisture Content (%)	16.4		
Moisture Content at Placement (%)	18.6		
Moisture Content Top 30mm (%)	29.7		
Moisture Content Rest of Sample (%)	21.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	118.5		
Swell (%)	3.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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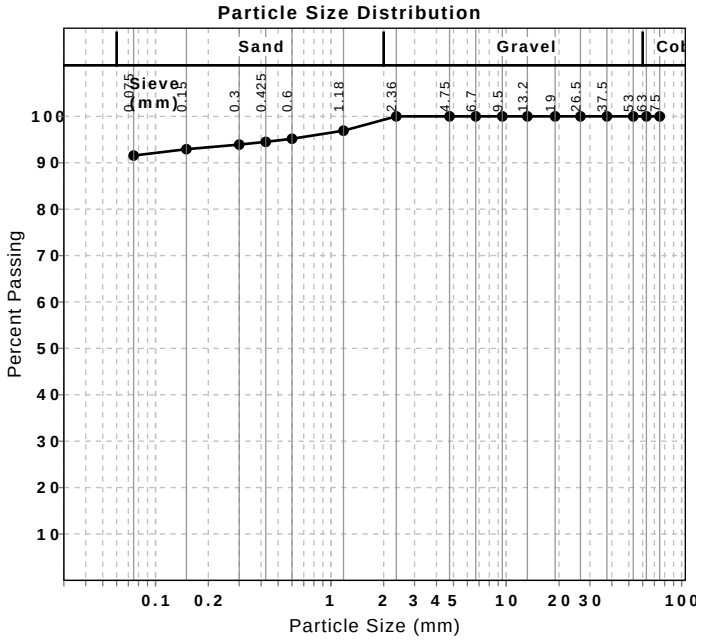
Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **222630.00-11**
Issue Number: 1
Date Issued: 05/10/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 10994
Sample Number: MA-10994B
Date Sampled: 10/08/2023
Dates Tested: 18/08/2023 - 04/09/2023
Sample Location: **202, Depth: 0.5m**
Material: Silty CLAY CI-CH: medium to high plasticity, pale brown and red-brown, trace fine to coarse gravel, stiff, residual

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
75 mm	**100**			0		
63 mm	**100**			0		
53 mm	**100**			0		
37.5 mm	**100**			0		
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**100**			0		
1.18 mm	**97**			3		
0.6 mm	**95**			2		
0.425 mm	**95**			1		
0.3 mm	**94**			1		
0.15 mm	**93**			1		
0.075 mm	**92**			1		



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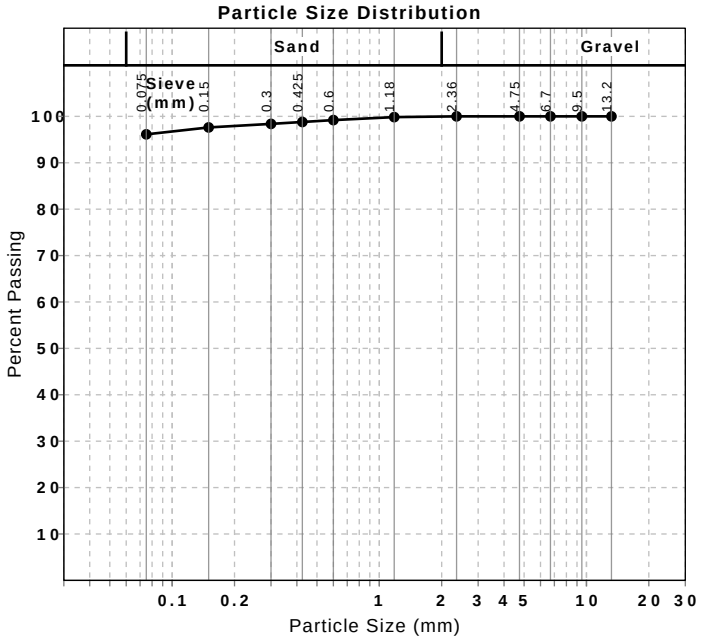
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **222630.00-11**
Issue Number: 1
Date Issued: 05/10/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 10994
Sample Number: MA-10994D
Date Sampled: 10/08/2023
Dates Tested: 18/08/2023 - 04/09/2023
Sample Location: **205, Depth: 0.5m**
Material: Silty CLAY CI-CH: medium to high plasticity, pale brown, trace gravel, stiff, residual

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



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003A
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 15/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **101 , Depth: 0.5 m**
Material: Silty CLAY CH: high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	60		
Plastic Limit (%)	20		
Plasticity Index (%)	**40**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.0**		
Cracking Crumbling Curling	Cracking & Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	19.0		

Material Test Report

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Senior Technician
Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003B
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 15/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **105 , Depth: 0.5 m**
Material: Silty CLAY CH: high plasticity, red-brown mottled grey, trace rootlets, w<PL, residual

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	55		
Plastic Limit (%)	20		
Plasticity Index (%)	**35**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**15.0**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	14.8		

Material Test Report

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Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003C
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 15/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **110 , Depth: 0.5 m**
Material: Silty CLAY CH: high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual

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

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.0**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	21.6		

Material Test Report

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Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003D
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 15/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **113 , Depth: 0.5 m**
Material: Silty CLAY CH: high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Both Sieves		
Liquid Limit (%)	56		
Plastic Limit (%)	19		
Plasticity Index (%)	**37**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.0**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	19.3		

Material Test Report

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Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003E
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 18/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **123 , Depth: 0.5 m**
Material: Silty CLAY CI: medium plasticity, brown, trace ironstone gravel and rootlets, w<PL, very stiff, residual

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	45		
Plastic Limit (%)	21		
Plasticity Index (%)	**24**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**11.5**		
Cracking Crumbling Curling	Cracking & Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	15.6		

Material Test Report

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Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003F
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 18/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **126 , Depth: 0.5 m**
Material: Silty CLAY CH: high plasticity, pale brown, trace fine to coarse gravel and rootlets, with highly weathered shale band, w<pl, stiff to very stiff, residual

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	57		
Plastic Limit (%)	22		
Plasticity Index (%)	**35**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**11.5**		
Cracking Crumbling Curling	Cracking & Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	16.0		

Material Test Report

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Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003G
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 18/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **127 , Depth: 0.5 m**
Material: Silty CLAY CH: high plasticity, red-brown mottled pale grey, trace rootlets, w<PL, stiff, residual

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	72		
Plastic Limit (%)	23		
Plasticity Index (%)	**49**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**17.5**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	27.3		

Material Test Report

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Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003H
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 18/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **202 , Depth: 1.0 m**
Material: Silty CLAY CH: high plasticity, pale brown and red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	66		
Plastic Limit (%)	25		
Plasticity Index (%)	**41**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.0**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	21.3		

Material Test Report

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Senior Technician
Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003I
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 18/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **203 , Depth: 1.0 m**
Material: Silty CLAY CI-CH: medium to high plasticity, brown mottled pale grey, trace gravel, w<PL

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

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.0**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	17.1		

Material Test Report

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Laboratory Accreditation Number: 828

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Sample Number: MA-11003J
Date Sampled: 10/08/2023
Dates Tested: 24/08/2023 - 19/09/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **205 , Depth: 1.0 m**
Material: Silty CLAY CI-CH: medium to high plasticity, pale brown, trace gravel and rootlets, w<PL, stiff, residual

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	51		
Plastic Limit (%)	17		
Plasticity Index (%)	**34**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.0**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	19.5		

Material Test Report

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Laboratory Accreditation Number: 828

Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003K
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**106 (0.5 m)**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

Douglas Partners
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Senior Technician
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Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003L
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**127 , Depth: 0.5 m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale grey, trace rootlets, w<PL, stiff, residual

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

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Senior Technician
Laboratory Accreditation Number: 828

Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003M
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**128 , Depth: 0.5 m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale brown, trace ironstone gravel and rootlets, w<PL, stiff, residual

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

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Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003N
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**202 , Depth: 1.0 m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale brown and red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

Douglas Partners
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Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003O
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**204 , Depth: 1.5 m**
Material:	Silty CLAY CL-CI: low to medium plasticity, brown, trace gravel, w<PL

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
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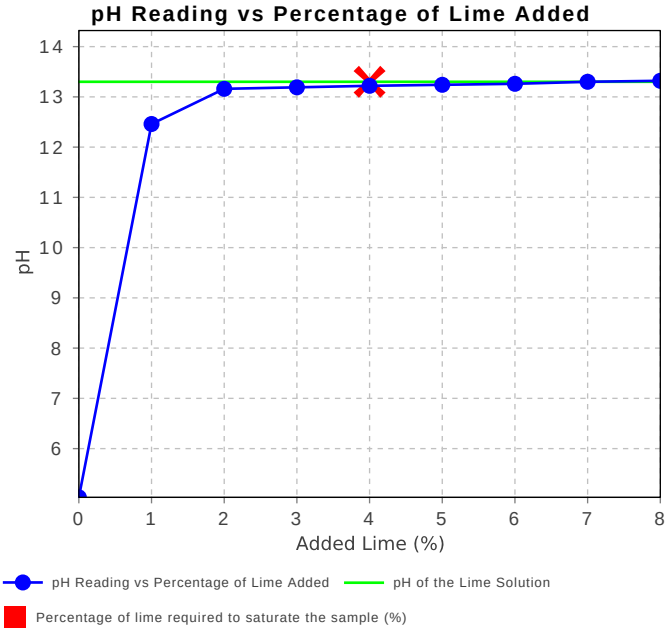
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Email: Peter.Gorseski@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Peter Gorseski
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **222630.00-1**
Issue Number: 1
Date Issued: 30/08/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 10523
Sample Number: NC-10523A
Date Sampled: 10/08/2023
Dates Tested: 23/08/2023 - 24/08/2023
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **103, Depth: 0.6**
Material: Silty Clay

Lime Demand (RMS T144)	
Source of Lime	Boral
Type of Lime	Hydrated
Calcium Hydroxide (%)	72
Percentage of lime required to saturate the sample (%)	4.0



Material Test Report

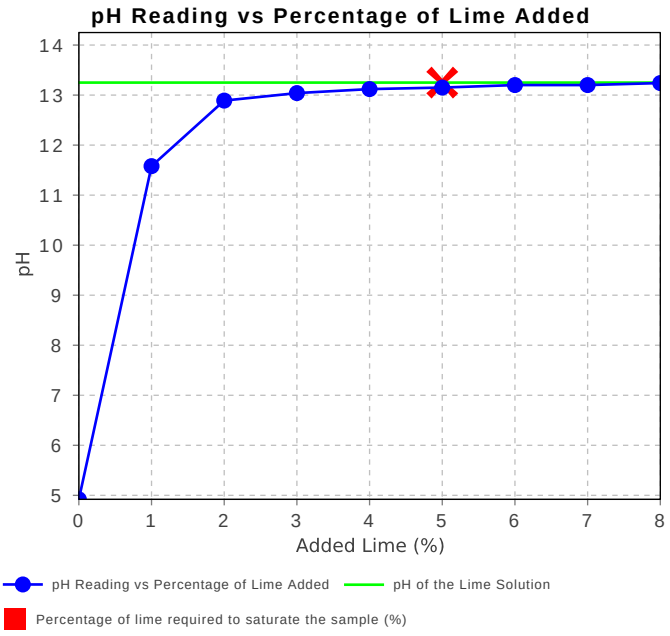
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Email: Peter.Gorseski@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Peter Gorseski
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **222630.00-1**
Issue Number: 1
Date Issued: 30/08/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 10523
Sample Number: NC-10523B
Date Sampled: 10/08/2023
Dates Tested: 23/08/2023 - 24/08/2023
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **110, Depth: 0.5**
Material: Silty Clay

Lime Demand (RMS T144)	
Source of Lime	Boral
Type of Lime	Hydrated
Calcium Hydroxide (%)	72
Percentage of lime required to saturate the sample (%)	5.0



Material Test Report

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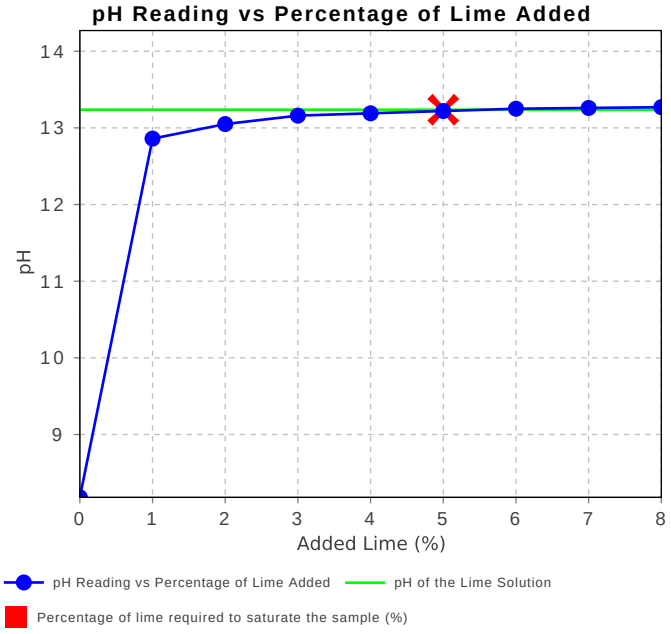
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **222630.00-1**
Issue Number: 1
Date Issued: 30/08/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 10523
Sample Number: NC-10523C
Date Sampled: 10/08/2023
Dates Tested: 23/08/2023 - 24/08/2023
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **117, Depth: 1**
Material: Silty Clay

Lime Demand (RMS T144)	
Source of Lime	Boral
Type of Lime	Hydrated
Calcium Hydroxide (%)	72
Percentage of lime required to saturate the sample (%)	5.0



Material Test Report

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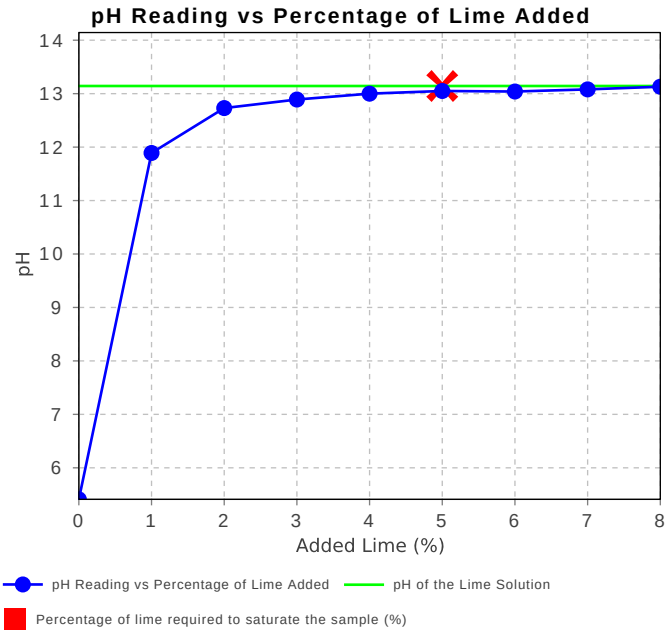
Approved Signatory: Peter Gorseski
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **222630.00-1**
Issue Number: 1
Date Issued: 30/08/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 10523
Sample Number: NC-10523D
Date Sampled: 10/08/2023
Dates Tested: 23/08/2023 - 25/08/2023
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **122, Depth: 0.5**
Material: Silty Clay

Lime Demand (RMS T144)	
Source of Lime	Boral
Type of Lime	Hydrated
Calcium Hydroxide (%)	72
Percentage of lime required to saturate the sample (%)	5.0



Material Test Report

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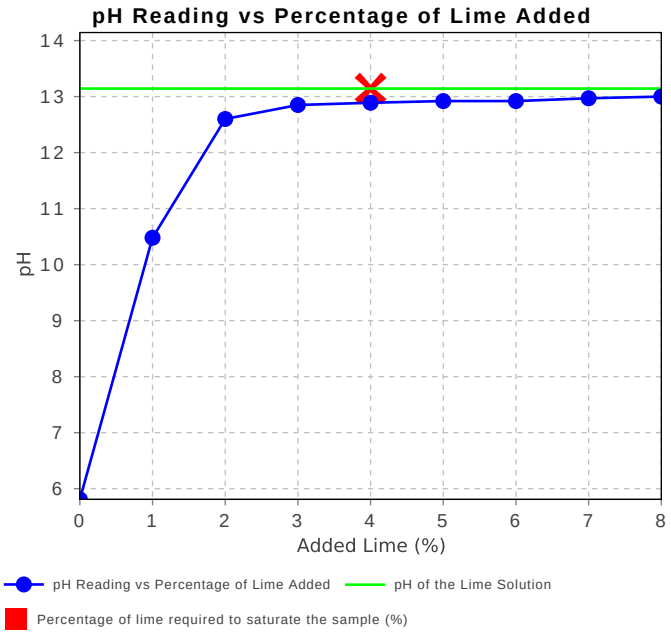
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Peter Gorseski
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **222630.00-1**
Issue Number: 1
Date Issued: 30/08/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 10523
Sample Number: NC-10523E
Date Sampled: 10/08/2023
Dates Tested: 23/08/2023 - 25/08/2023
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **125, Depth: 0.5**
Material: Silty Clay

Lime Demand (RMS T144)	
Source of Lime	Boral
Type of Lime	Hydrated
Calcium Hydroxide (%)	72
Percentage of lime required to saturate the sample (%)	4.0



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Fax (03) 9673 3599

Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Western Parkland City Authority	**Project No. :**	222630.00
		Report No. :	222630.00-6
Project :	Proposed Urban Development	**Report Date :**	27 Sep 2023
		Date Sampled:	10 Aug 2023
Location :	Badgerys Creek Road, Bringelly NSW	**Date of Test:**	15 Sep 2023
		Page:	1 of 1

Sample No:	202	
Depth / Layer:	0.5m	
Sample Description:	Silty CLAY	
Sample Preparation:	Compacted at 98% STD and 100 % Moisture Content Ratio, Cured for 96 Hrs	
Oversized Material Retained:	NIL% on 6.7mm Sieve (Excluded)	
Averaged Sample Length:	67	mm
Averaged Sample Diameter:	63	mm
Length-to-Diameter Ratio	1.1 :1	
Moisture Content After Test:	32.6	%
Permeant Used:	Potable Water	
Mean Effective Stress:	50	kPa
Coefficient of Permeability:	**5×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks: Geotester Ref: MA-10994B

NATA Accredited Laboratory No 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH
Checked: SB

Scott Benbow
Laboratory Manager

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Western Parkland City Authority	**Project No. :**	222630.00
		Report No. :	222630.00-7
Project :	Proposed Urban Development	**Report Date :**	27 Sep 2023
		Date Sampled:	10 Aug 2023
Location :	Badgerys Creek Road, Bringelly NSW	**Date of Test:**	15 Sep 2023
		Page:	1 of 1

Sample No:	203	
Depth / Layer:	0.2 -1.0m	
Sample Description:	Silty CLAY trace gravel	
Sample Preparation:	Compacted at 98% STD and 102.6 % Moisture Content Ratio, Cured for 96 Hrs	
Oversized Material Retained:	2% on 6.7mm Sieve (Excluded)	
Averaged Sample Length:	66	mm
Averaged Sample Diameter:	63	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	23.8	%
Permeant Used:	Potable Water	
Mean Effective Stress:	50	kPa
Coefficient of Permeability:	**9×10^{-11}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks: Geotester Ref: MA-10994C

NATA Accredited Laboratory No 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH
Checked: SB

Scott Benbow
Laboratory Manager

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Geotechnics / Environment / Groundwater

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Western Parkland City Authority	**Project No. :**	222630.00
		Report No. :	222630.00-8
Project :	Proposed Urban Development	**Report Date :**	27 Sep 2023
		Date Sampled:	10 Aug 2023
Location :	Badgerys Creek Road, Bringelly NSW	**Date of Test:**	15 Sep 2023
		Page:	1 of 1

Sample No:	205	
Depth / Layer:	0.5m	
Sample Description:	Silty CLAY trace gravel	
Sample Preparation:	Compacted at 98% STD and 100 % Moisture Content Ratio, Cured for 96 Hrs	
Oversized Material Retained:	NIL% on 6.7mm Sieve (Excluded)	
Averaged Sample Length:	66	mm
Averaged Sample Diameter:	63	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	28.1	%
Permeant Used:	Potable Water	
Mean Effective Stress:	50	kPa
Coefficient of Permeability:	**5×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Remarks: Geotester Ref: MA-10994D

NATA Accredited Laboratory No 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH
Checked: SB

Scott Benbow
Laboratory Manager

Appendix E

Site Photographs

Photo 1: Photo from near Test Pit 106 look south west in Stage 2

Photo 2: Photo from near Test Pit 109 looking south west at Stage 2

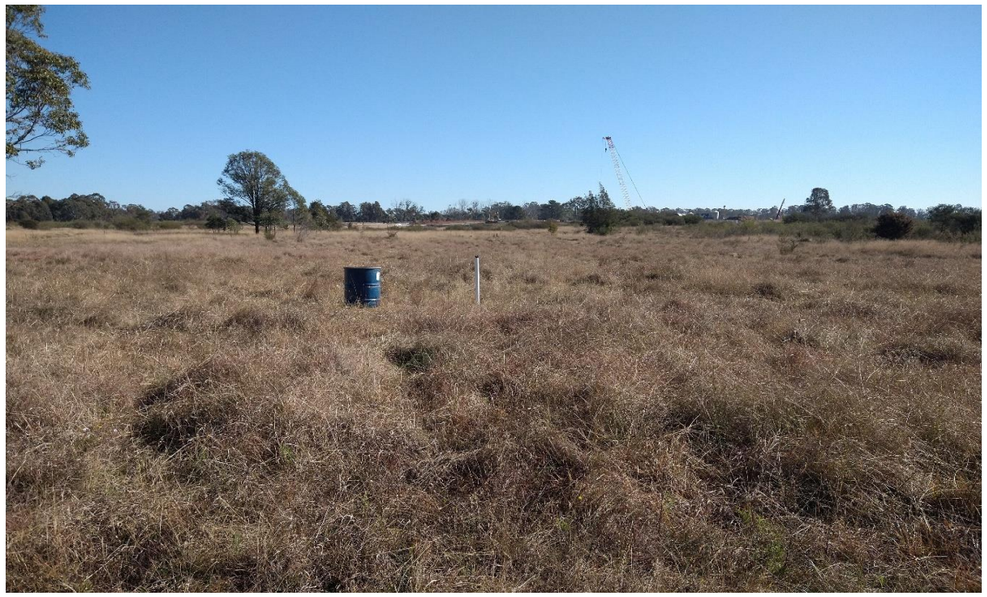

Photo 3: Photo from south east end of site looking north west towards Stage 2

Photo 4: Photo from near Borehole 203 looking west along Moore Gully

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Western Parkland City Authority		
OFFICE:	Macarthur	DRAWN BY:	ECR
SCALE:	NTS	DATE:	4 Oct 2023

Site Photographs 1 to 4
Proposed Urban Development
Bradfield City Centre, Badgerys Creek Road, Bringelly

PROJECT No:	222630.00
PLATE No:	1
REVISION:	0

Photo 5: Test Pit 107 profile (refusal at 1.1m)
Typical of northern part of Stage 2

Photo 6: Spoil from Test Pit 107

Photo 7: Test Pit 117 profile (Refusal at 2.2m)
Typical of central and southern parts of Stage 2

Photo 8: Medium to low strenght shale from base of Pit 117

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Western Parkland City Authority		**Site Photographs 5 to 8**	PROJECT No:	222630.00
	OFFICE: Macarthur	DRAWN BY: ECR	**Proposed Urban Development**	PLATE No:	2
	SCALE: NTS	DATE: 4 Oct 2023	**Bradfield City Centre, Badgerys Creek Road, Bringelly**	REVISION:	0

Photo 9: Test Pit 123 showing profile where the Luddenham Dyke was encountered (Refusal at 0.9m)

Photo 10: Basaltic material from base of Test Pit 123 - high strength

Photo 11: Test Pit 205 in stormwater corridor showing typical alluvial soil profile

Photo 12: Alluvial soil from Pit 205

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Western Parkland City Authority		**Site Photographs 9 to 12**	PROJECT No:	222630.00
	OFFICE: Macarthur	DRAWN BY: ECR	**Proposed Urban Development**	PLATE No:	3
	SCALE: NTS	DATE: 4 Oct 2023	**Bradfield City Centre, Badgerys Creek Road, Bringelly**	REVISION:	0