Report on Geotechnical Investigation

457-527 Cessnock Road Gillieston Heights

304100964

Prepared for

Walker Gillieston Heights Pty Ltd

16 June 2023

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Stantec

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1	05/12/2022	First Issue	JH	IGP
2	16/06/2023	Additional Investigation with Slope Stability Assessment	JH	IGP

Executive Summary

Stantec Australia Pty Ltd (Stantec) have undertaken geotechnical investigation for the proposed residential development located at 457-527 Cessnock Road, Gillieston Heights. The investigation works were undertaken at the request of Zoe Kavanagh on behalf of Walkers Gillieston Heights Pty Ltd (Walkers).

Geotechnical investigation was undertaken in two (2) stages, with the initial investigation undertaken within lots 501-527 Cessnock Road. The initial investigation comprised:

- A site walkover by a geotechnical consultant from Stantec, including visual appraisal and recording of salient site conditions and features.
- Excavation of 28 test pits and logging of subsurface conditions within the proposed allotment areas, basins and road alignments.
- Dynamic cone penetrometer tests (DCP) were conducted at all excavated test pits to aid in the assessment of subsurface strength conditions.
- Disturbed geotechnical/environmental samples of natural materials were collected for subsequent laboratory testing.

Stantec were engaged to undertake additional investigation within lots 457 and 463 Cessnock Road to incorporate the lots within the overall development. The additional investigation comprised:

- Site walkover of additional lots by a geotechnical consultant from Stantec.
- Excavation of an additional 12 test pits and DCP testing.
- Additional sampling and laboratory testing.

Stantec have provided the following recommendations on the following herein for the overall development:

- Preliminary acid sulfate soil assessment.
- Preliminary salinity assessment.
- Earthworks for the development including recommendations on filling operations.
- Basin construction.
- Parameters for retaining wall design.
- Pavement thickness design.
- Slope stability assessment.

Based on the investigation findings and subsequent recommendations presented in this report, several geotechnical constraints have been identified onsite. However, through the adoption of good engineering practice, and engineering controls recommended in this report, the site would be considered suitable for the proposed development geotechnically.

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Appendices

Tables

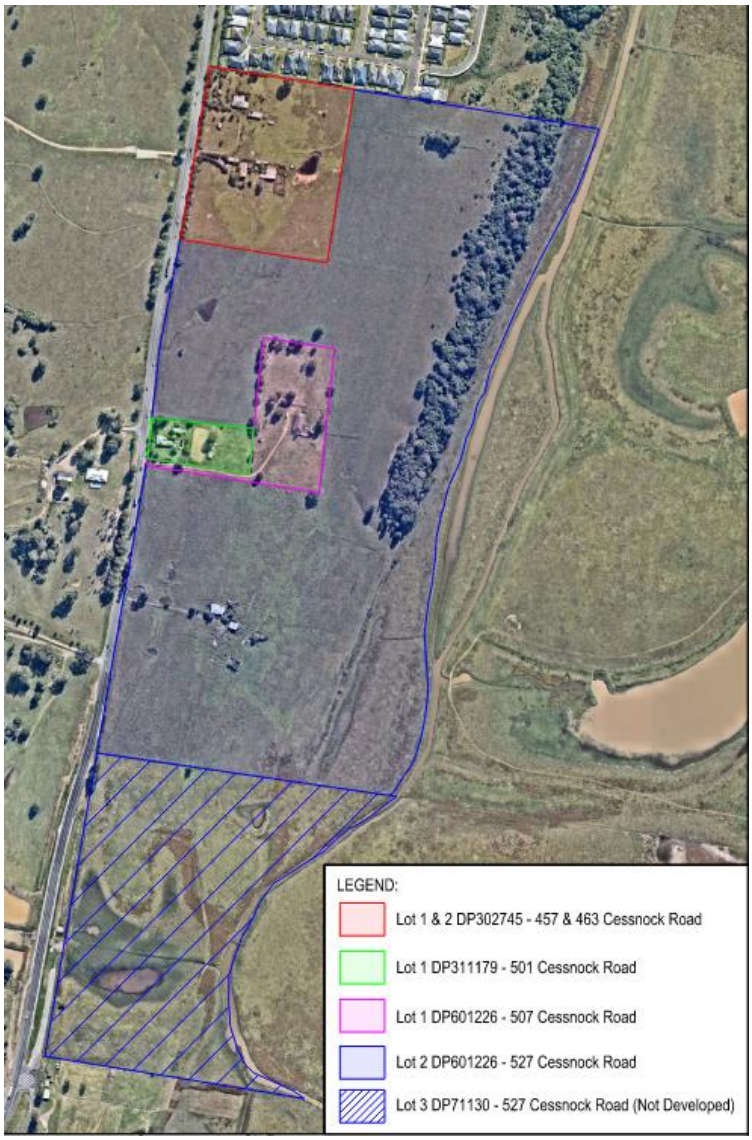
1 Introduction

This report presents the results of a geotechnical investigation undertaken by Stantec Pty Ltd (Stantec) for the proposed South Gillieston Heights residential subdivision. The proposed development comprises subdivision of 457, 463, 501, 507 and 527 Cessnock Road, Gillieston Heights. These addresses are legally identified as Lot 1 and Lot 2 DP302745, Lot 1 DP311179, Lot 1 and Lot 2 DP601226, and Lot 3 DP71130. However, Lot 3 DP71130 does not form part of the site as identified in Maitland City Council's DCP Part F - Urban Release Areas South Gillieston Heights - East Precinct Plan and as such, is excluded from this assessment.

Stantec were engaged by Walker Gillieston Heights Pty Ltd to undertake geotechnical investigation to progress civil design for the development.

It should be noted that geotechnical investigation was undertaken on lots 501, 507 and 527 Cessnock Road, and reported under cover 304100964-002.1, dated 5/12/2022. Further investigation was required following the later acquisition of lots 457 and 463 Cessnock Road. The following report revision of the geotechnical investigation report incorporates the additional lots. The revised report also includes slope stability assessment for the overall development. A locality plan has been provided below in Figure 1-1 for context.

Figure 1-1 Overall locality plan.



For the purpose of this report, Stantec were provided with the following documentation:

- Civil Engineering Plans, prepared by Enspire Solutions Pty Ltd (Enspire) (Ref no. 210039-DA, dated 19/05/2023, revision 2) [1].
- Bulk earthworks plan, prepared by Enspire (Ref no. 210039-DA-C04.01, dated 19/05/2023, revision 2) [2].
- Report on Preliminary Site Investigation and Detailed Site Investigation (Contamination), prepared by Douglas Partners Pty Ltd. (Ref no. 204921.00, dated 20/05/2022, revision 0) [3].

Based on the provided documents prepared by Enspire, it is understood that the proposed subdivision comprises:

- Creation of 322 residential allotments.
- Creation of 2 bio-retention basins.
- Construction of internal pavement roads as shown in Figures 1-3 in Appendix A.
- Construction of associated civil infrastructure (e.g. in-ground utilities, etc).

The purpose of the investigation was to obtain geotechnical information on subsurface conditions as a basis for the following comments and recommendations:

- Preliminary acid sulfate soil and salinity assessments.
- Recommendations for earthwork procedures and guidelines.
- Commentary on founding conditions for residential structures.
- Pavement thickness design for the proposed internal road sections.
- Commentary on basin design and construction procedures.
- Slope stability assessment (SSA) for the development.

The geotechnical investigation was undertaken in conjunction with a Remedial Strategy which is reported by Stantec under separate cover 304100964-002.2 (June, 2023).

2 Desktop Review

2.1 Previous Investigations

2.1.1 Gillieston Heights

Stantec, previously as Cardno have undertaken multiple previous geotechnical investigations within the surrounding area of the development, including multiple stages of the Wallis Creek development that abuts the current development. Geotechnical investigations were undertaken to provide recommendations for pavement design, site classification, founding conditions, earthworks, basin construction, acid sulfate soils and salinity assessments.

Cardno have also facilitated construction testing and provided geotechnical consulting services throughout civil construction of the Wallis Creek development. Experience from inspections and previous investigation have been utilised within recommendations in this report.

Review of previous geotechnical investigations undertaken in proximity to the current proposed development has been undertaken, with relevant data from the following Cardno reports utilised:

- Wallis Creek Stage 10-12 (abuts northern boundary of site): *'Report on Flexible Pavement Design Stage 10-12 Wallis Creek'* (ref. CGS3274-002.1, dated 02/03/2018) [4];
- Wallis Creek Stage 10-12 (abuts northern boundary of site): '*Letter Report on Geotechnical Investigation – Gillieston Heights Subdivision Stage 10-12'* (ref. CGS3240, dated 20/01/2017) [5]
- Wallis Creek Stage 3-9 (north of site): *'Report on Preliminary Geotechnical Investigation, Proposed Wallis Creek Subdivision, Stages 3-9, Cessnock Road, Gillieston Heights'* (ref. CGS1399-004.1, dated 16/10/2012) [6]; and
- Wallis Creek Stage 13-14 (north of site): *'Report on Geotechnical Investigation, Stage 13 & 14 Wallis Creek, Gillieston Heights'* (ref. 81021073-001.2, dated 28/04/2021) [7].

The general subsurface conditions encountered in geotechnical investigations is as follows:

- FILL: Silty SANDs and Sandy CLAYs
- TOPSOIL: Silty SANDs with traces of organic components
- COLLUVIAL: Silty SANDs of grey to brown colour with varying minor components;
- RESIDUAL: Silty CLAYs of medium to high plasticity and of red-brown colour with grey mottling;
- Extremely Weathered Material (EWM): Silty / Sandy CLAYs with colour mottling of orange and grey/pale grey.
- WEATHERED ROCK: PEBBLY / SANDSTONE and or SILTSTONE generally of low strength with some areas of higher strength encountered, with an orange and grey or brown colour.

Where relevant l test pit and geotechnical information relevant to the current investigation from previous Cardno reports has been incorporated, with laboratory testing summarised in Table 5-2.

2.1.2 501-527 Cessnock Road Douglas Partners [3]

Douglas Partners (DP) have previously undertaken an assessment of the Site referenced *"Report on Preliminary Site Investigation and Detailed Site Investigation (Contamination) – Proposed Residential Subdivision, 501-527 Cessnock Road, Gillieston Heights, Project 204921.00, dated May 2022"* [3]. The objective of the PSI and DSI was to identify and investigate the potential for contamination at the Site from the previous and current land uses.

The scope of works comprised desktop review (Site history, published data, NSW EPA data bases, aerial photographs, tittle deeds and council searches), intrusive field investigation, logging of subsurface profile and laboratory analysis of selected soil samples for a range of analytes.

The investigation comprised site walkover, excavation of 58 test pits, and limited laboratory testing. The general subsurface conditions encountered are summarised as follows:

- FILL: Generally comprising silty soils with foreign materials such as glass, metal and brick;
- Sandy Silt/Clayey Silt/Silty Clay/Silt: Generally comprising grey brown silty soils with varying fractions of clay and sand;
- Clay: Clay in all test locations likely alluvial clays and or residual clays; and
- Sandstone: Encountered in the majority of pits, generally extremely weathered and very low strength.

A further seven (7) boreholes were drilled utilising a combination of solid flight augers and coring to depths up to 7 m. Subsurface conditions encountered during drilling works comprised:

- TOPSOIL Sandy SILT of low plasticity, brown, with varying fractions of sand and gravel encountered to depths of 0.1 m bgl.
- Silty CLAY: high plasticity, red-brown, trace fine to medium grained sand encountered to depths of 0.4-2.1 m bgl.
- EWM: Sandy CLAY of low plasticity, brown medium to coarse sand to depths of 2.5-5.5 m bgl.
- WEATHERED ROCK: SANDSTONE brown, fine grained with pebbles, ranging from very low to high strength, encountered to depths of 2.8-7.0 m bgl.

Findings from the previous investigation have been incorporated into this report where considered relevant.

2.2 Published Information

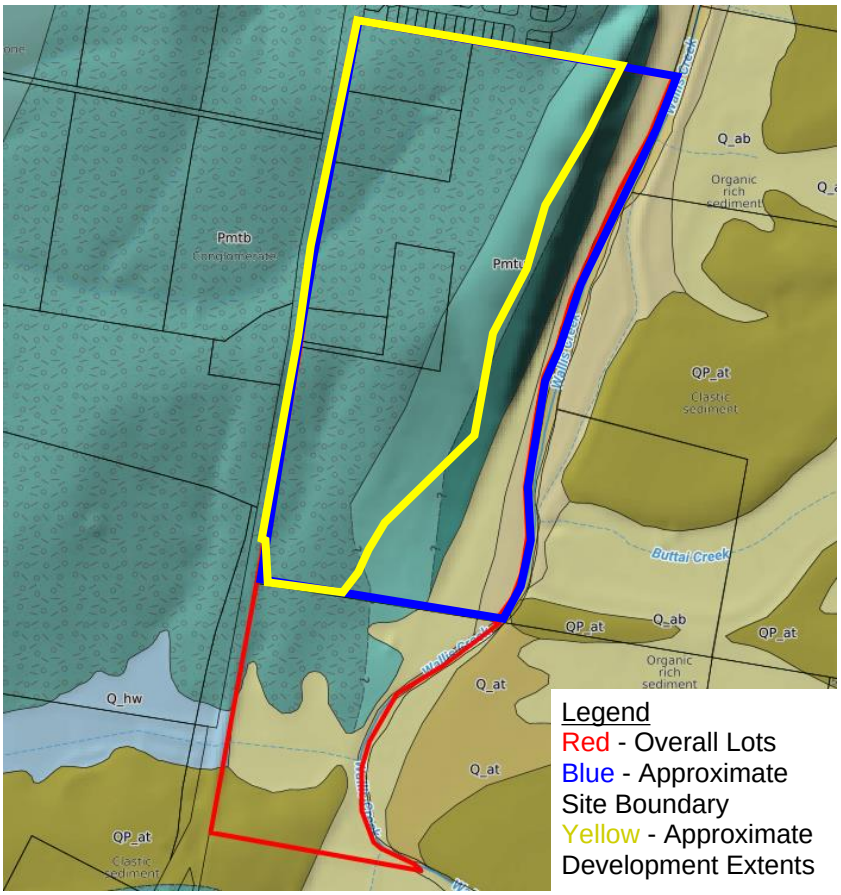
2.2.1 Geological Maps

Reference to the New South Wales Seamless Geology dataset [8] indicates the site is on the border of several geological formations:

- *Branxton Formation (Pmtb)* of the Maitland Group known to comprise conglomerate, sandstone, siltstone and residual soils derived through the decomposition of the parent rock formations;
- *Muree Sandstone (Pmtu)* of the Maitland Group known to comprise fine to coarse grained sandstone, conglomerate, minor claystone and residual soils derived through the decomposition of the parent rock formations;
- *Mulbring Siltstone (Pmtm)* of the Maitland Group known to comprise medium- to dark-grey siltstone, minor claystone, sporadic thin cherty beds (resistant), rare thin sandstone and limestone beds, sporadic marine fossils; and
- Quaternary aged *Alluvial Backswamp Deposits (Q_ab)* typically comprising organic-rich mud, peat, silt and clay likely deposited from Wallis Creek.

The approximate site location has been overlaid onto the geological formation in Figure 2-1 below.

Figure 2-1 Approximate site location over Geological Mapping.



2.2.2 Soil Landscape Maps

A review of the NSW Office of Environment and Heritage, eSPADE v2.2 mapping system (eSPADE) [9] indicates that the investigation site is situated within the Bolwarra Heights (9232bh) soil landscape – comprising in situ weathered parent rock from the Branxton Formation of the Maitland Group. These rocks comprise sandstone, siltstone, conglomerate, erratics. The mapping indicates site is prone to minor to moderate sheet and rill erosion where ground cover has been removed along with minor gully erosion.

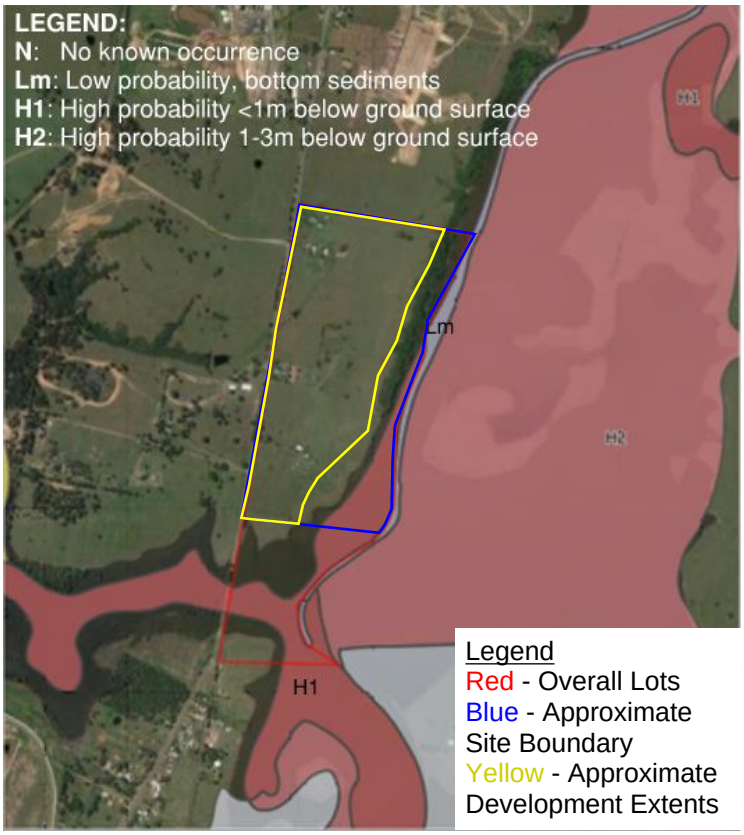
2.2.3 Acid Sulfate Soil Risk Maps

Review of the Maitland Local Environmental Plan (LEP) 2011 Acid Sulfate Soils Risk Map indicates the Site is situated within Class 5 and Class 2 Acid Sulfate Soils. Class 5 indicates that *"works within 500 metres of adjacent Class 1, 2, 3, or 4 land that is below 5 metres AHD and by which the watertable is likely to be lowered below 1 metres AHD on adjacent Class 1, 2, 3 or 4 land, present an environmental risk".* Class 2 indicates that *"works below the natural ground surface. Works by which the watertable is likely to be lowered.*

The NSW Office of Environment and Heritage, eSPADE v2.2 Acid Sulfate Soils Risk Map Probability indicates the site is situated within *H1* (High probability <1m below surface level) and *Lm* (Low probability, bottom sediments) categories. The approximate site location has been overlaid onto the soil landscape map in Figure 2-2 below.

Given the Acid Sulfate Soil (ASS) risk maps for the Gillieston Heights area indicate that the South Gillieston Heights development extents are located within an area of mapped known occurrence of ASS, further laboratory testing was undertaken. It should be noted however, that no development is proposed in area mapped as having high probability of ASS occurring.

Figure 2-2 Approximate site location over ASS Risk Maps.



3 Site Description

The subject site is identified as 457-527 Cessnock Road, Gillieston Heights . The proposed development incorporates the lots summarised in Table 3-1 below.

Table 3-1 South Gillieston Heights Locality.

Lot & DP	Address
Lot 1 & 2 DP302745	457-463 Cessnock Road, Gillieston Heights
Lot 1 DP 311179	501 Cessnock Road, Gillieston Heights
Lot 1 & 2 DP601226	507-527 Cessnock Road, Gillieston Heights

The site is an irregular shaped parcel of land and is bounded by:

- Stages 10-12 of the Wallis Creek Residential Development to the north of site;
- Rural parcels of land to the west of site, separated by Main Road/Cessnock Road;
- Wallis Creek along the eastern boundary of site; and
- Rural parcels of land to the south.

Topographically the site is located within a regionally undulating terrain, characterised by a north-south trending ridgeline traversing the northern portion of the site, and adjacent low-lying alluvial flood plains to the south and east.

Slopes within the northern and central portion of site generally fall to the east towards Wallis Creek and to the west from the ridgeline typically in the order of 5-10 degrees. Slopes in the southern portion of the site fall to the south towards Testers Hollow. It is expected surface flows follow this trend with a series of farm dams and channels observed for water retention to the west of the ridgeline. Vegetation across the site at the time of fieldwork comprised large areas of open thick grazing pasture with isolated mature trees. These features have been highlighted on Figure 1 attached in Appendix A.

Observations noted during the investigation for specific lots has been summarised in Table 3-2 below.

Table 3-2 Specific lot site observations.

Lot & DP	Observations
Lot 1 & 2 DP302745	▪ Rural residential weatherboard and brick house within the central of site with evidence of animal holding areas. ▪ Verdant nature of the pasture, potentially reflecting pasture improvement of fertilizer application. This has the potential to impact trafficability as the surficial soil is more prone to waterlogging. ▪ Evidence of localised slumping around upstream edge within existing farm dam within the eastern portion of site. Southern embankment wall appeared to be constructed using localised surplus material from the impoundment area of the basin. ▪ A gully line was noted downstream of the farm dam in the eastern portion of the Site, trending south west through Lot 2 DP601226 before discharging offsite via Cessnock Road culvert crossing. ▪ Several stockpiles, with several stockpiles noted to contain foreign materials, within the north-western and central portion of site surrounding existing dwellings and sheds. ▪ Evidence of localised cut and fill within areas associated with effluent disposal, dams, pavements and structures. ▪ Retaining walls observed along northern boundary, abutting Stage 11 & 12 of the Wallis Creek residential development. ▪ In-ground concrete pool located within central portion of site, with retaining walls on eastern boundary of pool observed to be failing.
Lot 1 DP 311179	▪ Rural residential housing within the site with evidence of animal holding areas. ▪ Filling noted within driveways/access tracks typically comprised quarry gravel product. ▪ Due to presence of livestock it is anticipated the site has been used for grazing.
Lot 1 & 2 DP601226	▪ Rural residential housing within the site with evidence of animal holding areas.

Lot & DP	Observations
Lot 1 & 2 DP601226 *(continued)*	▪ Ponded water was observed localised at the base of the north-south trending gully line in the western portion of site due to inclement weather prior and during the initial field investigation. ▪ Four gully lines were noted at the Site: – A gully line was noted in close proximity to the northern site boundary, trending offsite north-east towards Wallis Creek. – A gully line was noted along the central western boundary of the site, trending south-west before discharging offsite via Cessnock Road culvert crossing. – A gully was noted in the southern portion of the Site, traversing offsite to the south-west towards Testers Hollow. – A gully line was noted within the central eastern portion of site generally trending east-west discharging flows towards Wallis Creek. ▪ Surficial softening of the topsoil material was noted through rutting across the site, with trafficability issues encountered at the time of the initial fieldwork. ▪ Rock outcropping in the southern portion of site and along the ridgeline on the eastern boundary of site where the break in grade is located. ▪ General refuse was noted in both the western and eastern gully, typically comprising scrap metal, masonry units and bricks. ▪ A farm dam with general refuse typically comprising scrap metal was noted in central-western portion of site as noted on Figure 1 in Appendix A. ▪ Demolition of existing agricultural structures within the southern portion of site with scrap timber and metal sheeting covering site surfaces. ▪ Several paddocks cordoning off sections of the central and southern portion of site were noted. Gates and fences for the paddocks were damaged due to livestock with the area likely used for livestock grazing. ▪ Vegetation comprised predominately grazing grasses, with an increased density of mature trees noted along the eastern portion of the site associated with steepening slopes along the eastern boundary of the site. ▪ The site was noted to slope along the eastern boundary toward a 3 m vertical face.

4 Investigation Methodology

4.1 Site Investigation

Fieldwork for the investigation was undertaken on the 5th and 12th of October 2022 within Lot 1 DP 311179 and Lot 1 & 2 DP601226, with additional investigation undertaken on 19th of April 2023 in Lot 1 & 2 DP302745. It is noted the investigations were undertaken prior to the completion of civil design. The investigations comprised the following:

- A site walkover by a geotechnical engineer from Stantec, including visual appraisal and recording of salient site conditions and features.
- Excavation of a total of forty (40) test pits and logging of subsurface conditions within the proposed allotment areas, basins and road alignments. Test pits were excavated utilising a 5-tonne excavator with a 600mm toothed bucket to a target depth of 1.5m below existing ground level (bgl). It should be noted deeper cuts are proposed for bulk earthworks for the development, with refusal encountered significantly higher than anticipated bulk earthworks levels.
  - 28 test pits within the original proposed allotments (TP001-TP028) with refusal (including slow progress termination) occurring at test pits TP002, TP004, TP007-TP008, TP010, TP012-TP013, TP024 and TP028.
  - An additional 12 test pits within the additional lots (TP101-TP112) with refusal (including slow progress termination) occurring in test pits TP101-TP104 and TP110-TP112.
- Dynamic cone penetrometer tests (DCP) were conducted at all excavated test pits to aid in the assessment of subsurface strength conditions.
- Disturbed geotechnical/environmental samples of natural materials were collected for subsequent laboratory testing.
- All test pits backfilled with excavated spoil upon completion.

Field investigation including logging of subsurface profiles and collection of samples was carried out by an experienced geotechnical engineer from Stantec. Test pits were located using a kml file generated by overlaying proposed test pits onto the supplied development extents and then outputed to a compatible handheld tablet. It is expected that test pit accuracy would be in the range of +/- 5m.

The location of the test pits is shown on Figures F1-F4, attached in Appendix A. Subsurface conditions are summarised below and detailed in the engineering logs attached in Appendix B with explanatory notes.

4.2 Laboratory Testing

Laboratory testing on selected samples recovered during the site investigation comprised the following:

- Eight (8) California Bearing Ratio (CBR) tests to assess proposed subgrade strength.
- Two (2) Emerson Class tests to measure soil dispersion.
- One (1) Permeability test to determine site soil permeability.
- Fifteen (15) acid sulfate soil screening tests using the field screening method.
- Six (6) detailed acid sulfate soil tests using the Chromium Reducible Sulphur (SCr) method.
- Five (5) Salinity profiling tests, comprising Cation Exchange Capacity (CEC), Exchangeable Sodium Percentage (ESP), chloride, Sulfate, pH, Electrical Conductivity (EC) and resistivity.
- Ten (10) additional EC tests were undertaken to further aid in soil salinity assessment.

Geotechnical and environmental laboratory testing was conducted at NATA accredited laboratories. Results of laboratory testing are detailed in the report sheets attached in Appendix C and summarised in Section 5.2 below.

5 Investigation Findings

5.1 Subsurface Conditions

The subsurface conditions encountered across the site have been characterised and summarised as follows:

- FILL: Surficial filling comprising Silty CLAY / Clayey SILT with varying minor components of sand and gravel were encountered within several the test pits to depths in the range of 0-0.5 m BGL.
- TOPSOIL: Sandy SILT or Silty SAND of low plasticity and fine to medium grain size, dark brown in colour, with varying fractions of gravel encountered to depths in range of 0.1-0.30m below ground level (BGL).
- COLLUVIUM SOILS: Silty SAND / Sandy SILT / Silty CLAY generally pale brown to brown in colour, encountered in majority of the test locations. Colluvial materials generally ranged from moist to wet (due to inclement weather) and were predominantly loose to medium-dense (based on the results of DCP testing). It should be noted colluvial soils noted in overland flow paths were virtually saturated due to inclement weather at the time of investigation and ranged from soft to stiff (based on the results of DCP testing).
- RESIDUAL SOILS: Silty / Gravelly / Sandy CLAYs of predominantly a mottling of orange, dark red and brown colour were encountered in all test pits to depths. Residual clays were typically of medium to high plasticity and ranged from firm to hard consistency (based on DCP testing). Moisture condition was observed to range from above to below plastic limit across the site.
- EXTREMELY WEATHERED MATERIAL (EWM): Extremely weathered SANDSTONE / Pebbly SANDSTONE and or SILTSTONE countered at all test locations (excluding TP022, TP024 & TP111). Extremely weathered materials were generally consistent with very stiff to hard Silty / Gravelly / Sandy CLAY and medium dense to very dense Silty / Clayey SAND. EWM clay materials were noted to be low to medium plasticity and predominantly below the plastic limit in moisture condition. Sands were generally observed to be in a dry to moist condition.
- WEATHERED ROCK: Fine to coarse grained SANDSTONE / Pebbly SANDSTONE, CONGLOMERATE and or SILTSTONE encountered at majority of the test locations (excluding TP003, TP005, TP009, TP011, TP014-TP017, TP019-TP023, TP025, TP027, TP028, TP105-TP107 &TP109). Encountered weathered rock was generally observed to be highly weathered with inferred very low to low strength. Practical bucket refusal on generally low strength (or stronger) rock was encountered at majority of the test locations.

Seepage was encountered in within test pit TP016, associated with perched water within the gravelly fill profile at the time of fieldwork. Potential groundwater seepage was encountered within a heavily fractured siltstone profile in test pit TP111.

It should be noted that initial fieldwork was conducted following an extended period of wet weather with the presence of ponded water in multiple isolated locations across the site. It should be appreciated considering the site topography and material types encountered, groundwater levels are expected to be impacted by prolonged periods of inclement weather in proximity to existing gully lines.

The second portion of the investigation was undertaken following a period of dry weather. Trafficability of the site was easily achieved with a 4x4 vehicle with little to no disturbance of surficial soils.

It should also be noted that following periods of inclement weather, surficial soils may be susceptible to rutting and may cause trafficability issues.

The subsurface conditions are detailed in the engineering logs in Appendix B and summarised in Table 5-1 below.

Table 5-1 Summary of Subsurface Conditions

Test Location	Depth to Base of Fill	Topsoil Thickness (m)	Depth to Base of Colluvium	Depth to Base of Residual	Depth to Base of EWM	Depth of Rock Refusal[1][2]
TP001	0.25	-	-	0.85	1.20	1.50[2]
TP002	0.20	-	0.35	0.75	1.20	1.40
TP003	0.15	-	0.30	1.00	1.60	-
TP004	-	0.25	0.45	0.80	1.00	1.30

Test Location	Depth to Base of Fill	Topsoil Thickness (m)	Depth to Base of Colluvium	Depth to Base of Residual	Depth to Base of EWM	Depth of Rock Refusal(1)(2)
TP005	-	0.10	0.50	0.90	1.50	-
TP006	-	0.15	0.30	1.20	1.45	1.60(2)
TP007	-	0.20	0.35	1.00	1.30	1.40
TP008	-	0.20	0.50	0.90	1.00	1.10
TP009	-	0.20	-	0.90	1.50	-
TP010	0.15	-	0.35	1.05	1.30	1.40
TP011	0.10	-	0.25	0.60	1.50	-
TP012	0.30	-	-	0.90	1.10	1.30
TP013	0.25	-	-	0.95	1.10	1.20
TP014	0.40	-	-	1.40	1.50	-
TP015	0.30	-	-	0.75	1.60	-
TP016	0.45	-	-	1.40	1.70	-
TP017	0.35	-	-	1.10	1.50	-
TP018	0.25	-	-	0.85	1.20	1.50(2)
TP019	0.15	-	0.30	1.30	1.50	-
TP020	0.45	-	-	1.40	1.50	-
TP021	0.25	-	-	1.20	1.50	-
TP022	0.50	-	1.05	1.60	-	-
TP023	0.15	-	-	1.25	1.50	-
TP024	0.20	-	-	0.60	-	0.85
TP025	-	0.20	-	0.80	1.50	-
TP026	-	0.15	0.30	0.80	1.20	1.50(2)
TP027	-	0.15	0.30	1.15	1.60	-
TP028	-	0.15	-	0.70	1.40	-
TP101	-	0.25	0.45	0.65	0.80	0.90
TP102	0.70	-	-	1.00	1.25	-
TP103	0.40	-	-	0.75	1.20	-
TP104	0.25	-	0.40	0.80	1.60	-
TP105	-	0.30	1.00	1.60	2.50(2)	-
TP106	-	0.20	0.35	1.05	2.00(2)	-
TP107	0.60	-	1.30	2.20	2.30(2)	-
TP108	-	0.25	0.80	1.60	1.90	2.20(2)
TP109	-	0.25	-	1.80	2.30(2)	-
TP110	-	0.25	-	1.00	1.25	1.40
TP111	0.50	-	-	0.65	-	1.30
TP112	0.25	-	-	0.50	0.90	1.10

Notes to table:
All depths in metres below existing ground levels (m bgl).
(1) Indicates refusal / slow progress refusal with a 5-tonne excavator fitted with a 600mm toothed bucket.
(2) Termination depth of 1.5m bgl or greater where rock refusal not encountered.
(3) Organics predominantly present within top 100-150mm (nominal).

5.2 Laboratory Results

The results of the geotechnical testing undertaken on representative samples are summarised below with the laboratory report sheets attached in Appendix C.

5.2.1 Geotechnical

5.2.1.1 California Bearing Ratio Test Results

The results of the standard compaction CBR testing undertaken on representative samples of the proposed internal road subgrade are summarised below in Table 5-2 with the laboratory report sheets attached in Appendix C.

Table 5-2 Summary of CBR Test Results

Pit ID	Depth (m)	Material Description	W (%)	SOMC (%)	SMDD (%)	Swell (%)	CBR (%)
TP002	0.4 – 0.6	RS: Silty CLAY, trace sand	23.5	22.5	1.60	1.5	6.0
TP004	0.5–0.65	RS: Silty Sandy CLAY, trace gravel	22.8	20.0	1.65	0.5	6.0
TP006	1.1 – 1.4	RS: Silty Sandy CLAY	14.9	12.5	1.93	1.0	8.0
TP009	0.3 – 0.6	RS: Silty CLAY, trace sand	32.5	25.5	1.50	1.5	3.0
TP010	0.6 – 0.8	RS: Silty CLAY, trace sand	28.7	26.5	1.51	1.5	3.5
TP011	0.6 – 0.9	EWM: Silty Sandy CLAY	17.1	14.5	1.83	1.0	7.0
TP105	0.5 - 0.8	COL: Silty CLAY	28.1	27.5	1.49	3.0	2.5
TP109	1.8 – 2.0	EWM: Sandy CLAY	15.1	15.5	1.83	1.0	12.0
TP072(1)	0.4 – 0.7	Silty CLAY, red-grey mottled orange	28.0	23.4	1.58	2.1	4.0
TP079(1)	0.4 – 0.7	Silty CLAY, brown	24.5	19.1	1.66	2.1	3.0
TB1305(2)	0.4–0.55	Silty CLAY	15.6	18.0	1.71	2.0	3.5
TB1305(2)	0.55–0.7	SILTSTONE	10.2	14.5	1.80	1.0	8.0
TB1402(2)	0.2 – 0.4	Silty CLAY	24.9	25.0	1.53	1.5	5.0

Notes to table:
W: Field Moisture Content
SOMC: Standard Optimum Moisture Content
SMDD: Standard Maximum Dry Density
(1) Test results sourced from previous investigation associated with report CGS3274-002.1 [4]
(2) Test results sourced from previous investigation associated with report 81021073-001.2 [7]

5.2.1.2 Emerson Class Test Results

The result of the Emerson Class test undertaken on a representative sample of the water quality basin material is summarised below in Table 5-3 with the laboratory report sheets attached in Appendix C.

Table 5-3 Summary of Emerson Class Test Results

Hole ID	Depth (m)	Soil Type	Emerson Class	Notes
TP014	0.6 – 0.7	Silty CLAY: orange-brown mottled grey	4(1)	No Dispersion
TP023	0.55 - 0.9	Silty CLAY: brown mottled grey and pale grey	8	No Swelling

Notes to table:
(1): Minerals present: Carbonate and Gypsum

5.2.1.3 Permeability Test Results

The results of the permeability test undertaken on a selected sample of site clay summarised below in Table 5-4.

Table 5-4 Summary of Permeability Test Results

Pit ID	Depth (m)	Soil Type	Sample Compaction (%)	Coefficient of Permeability (m/sec)
TP023	0.55 – 0.90	CLAY, with sand, brown	99	2×10^{-10}

5.2.2 Environmental Laboratory Testing

5.2.2.1 Salinity Test Results

Salinity and sodicity assessment results are summarised in Table 5-5 and Table 5-6 below. The assessment results are also detailed in report sheets attached in Appendix C.

Table 5-5 Summary of Salinity Results

Location	Depth (m)	Soil Description	Structure	EC (dS/m)	ECe [1] (dS/m)	Salinity Assessment
TP001	1.25-1.30	SANDSTONE	HW. ROCK	0.07	<2	Non-saline
TP002	0.20 - 0.30	Silty SAND	COLLUVIAL	0.02	<2	Non-saline
TP002	1.20 - 1.40	SANDSTONE	HW. ROCK	0.08	<2	Non-saline
TP005	0.20 - 0.40	Sandy SILT	COLLUVIAL	<0.01	<2	Non-saline
TP006	1.20 - 1.30	Silty Sandy CLAY	EWM	0.05	<2	Non-saline
TP007	0.05 - 0.10	Silty SAND	TOPSOIL	0.01	<2	Non-saline
TP007	0.65 - 0.80	Silty Sandy CLAY	RESIDUAL	0.04	<2	Non-saline
TP007	1.30 - 1.40	SILTSTONE	HW. ROCK	0.04	<2	Non-saline
TP014	0.45 - 0.60	Silty CLAY	RESIDUAL	0.03	<2	Non-saline
TP014	0.9 – 1.0	Silty CLAY	RESIDUAL	0.09	<2	Non-saline
TP018	1.2 – 1.3	SILTSTONE	HW. ROCK	0.11	<2	Non-saline
TP022	0.3 – 0.5	Sandy SILT	COLLUVIAL	<0.01	<2	Non-saline
TP022	0.6 – 0.8	Silty CLAY	COLLUVIAL	0.78	4	Slightly Saline
TP028	1.0– 1.2	Clayey SAND	EWM	0.13	<2	Non-saline

Notes to table:
[1] EC_e results are EC data multiplied by a conversion factor contained in Table 6.1 of Department of Land Water Conservation NSW, 2002: Site Investigations for urban salinity, based on soil type.
EC: Electrical Conductivity
HW Highly Weathered
EWM Extremely Weathered Material

Table 5-6 Summary of ESP Results

Location	Depth (m)	Soil Description	Structure	ESP	Sodicity Assessment
TP001	1.25 – 1.30	SANDSTONE	HW. ROCK	4.2	Non-sodic
TP006	1.20 – 1.30	Silty Sandy CLAY	EWM	15.0	Sodic
TP014	0.45 – 0.60	Silty CLAY	RESIDUAL	0.2	Non-sodic
TP022	0.60 – 0.80	Silty CLAY	COLLUVIAL	19.0	Highly-sodic
TP028	1.00 – 1.20	Clayey SAND	EWM	3.5	Non-sodic

Notes to table:
ESP Exchangeable Sodium Potential
EWM Extremely Weathered Material

5.2.2.2 Acid Sulfate Soils

Preliminary acid sulfate field screening and detailed results on selected samples, are contained in laboratory report sheets attached in Appendix C and summarised below in Table 5-7.

Table 5-7 Acid Sulfate Soil Test Results

Location	Depth (m)	Date Sampled	Filling (F) / Natural (N)	Material Description	pH_F	pH_{FOX}	pH_F - pH_{FOX}	Reaction Rate	pH kcl	TAA	SCr	
					pH units	pH units	pH units		pH units	mole H+/t	%w/w	mole H+/t
TP004	0.05 - 0.10	5/10/22	N	TS: Silty SAND	6.2	3.3	*2.9*	Extreme	5.6	8.3	<0.005	< 3
TP005	0.20 - 0.40	5/10/22	N	ALV: Sandy SILT	6.1	4.4	*1.7*	Moderate	-	-	-	-
TP005	0.50 - 0.60	5/10/22	N	RS: Silty Sandy CLAY	6.1	4.5	*1.6*	Moderate	-	-	-	-
TP008	0.10 - 0.25	5/10/22	N	TS: Silty SAND	6.2	*2.9*	*3.3*	Strong	5	15	<0.005	< 3
TP011	0.45 - 0.55	5/10/22	N	RS: CLAY	6.1	4.7	*1.4*	Strong	-	-	-	-
TP014	0.45 - 0.6	12/10/22	N	RS: CLAY	6.7	4.6	*2.1*	Strong	-	-	-	-
TP014	1.1 - 1.2	12/10/22	N	RS: CLAY	*5.2*	4.3	0.9	Moderate	-	-	-	-
TP014	1.4 - 1.5	12/10/22	N	EWM: Silty CLAY	5.7	4.5	*1.2*	No Reaction to Slight	-	-	-	-
TP022	0.3 - 0.5	12/10/22	N	Poss ALV: Sandy SILT	6.5	4.4	*2.1*	Strong	5.1	12	<0.005	< 3
TP022	0.6 - 0.8	12/10/22	N	ALV: Silty CLAY	*5.2*	4	*1.2*	Moderate	4.4	74	<0.005	< 3
TP022	1.2 - 1.4	12/10/22	N	RS: CLAY	*5.4*	3.9	*1.5*	No Reaction to Slight	-	-	-	-
TP024	0.2 - 0.4	12/10/22	N	RS: CLAY	6.2	3.8	*2.4*	Moderate	4.5	59	<0.005	< 3
TP028	0.05 - 0.1	12/10/22	N	TS: Sandy SILT	6.1	3.3	*2.8*	Extreme	6.5	<2	<0.005	< 3
TP028	0.2-0.35	12/10/22	N	RS: Silty CLAY	6.4	4.6	*1.8*	Extreme	-	-	-	-
TP028	1.0 - 1.2	12/10/22	N	EWM: Clayey SAND	8.4	8.8	-0.4	Extreme	-	-	-	-
Guideline Value				**Eurofins LOR**	-	-	-	-	-	2	0.005	3
ASSMAC (1998) Potential Acid Sulfate Soil Indicator Value					4 - 5.5 [1]	< 3 [3]	1 [4]	-	-	-	-	-
ASSMAC (1998) Actual Acid Sulfate Soil Indicator Value					≤ 4 [2]	-	-	-	-	-	-	-
ASSMAC (1998) Action Criteria - Course Soils (1 - 1000 tonnes) [5]					-	-	-	-	-	-	0.03	18
ASSMAC (1998) Action Criteria - Medium Soils (1 - 1000 tonnes) [6]					-	-	-	-	-	-	0.06	36
ASSMAC (1998) Action Criteria - Fine Soils (1 - 1000 tonnes) [7]					-	-	-	-	-	-	0.10	62
ASSMAC (1998) Action Criteria - Course Soils (>1000 tonnes) [5]					-	-	-	-	-	-	0.03	18
ASSMAC (1998) Action Criteria - Medium Soils (>1000 tonnes) [6]					-	-	-	-	-	-	0.03	18
ASSMAC (1998) Action Criteria - Fine Soils (>1000 tonnes) [7]					-	-	-	-	-	-	0.03	18

Notes to Table:

1 - pH values >4 and <5.5 are acid and may be the result of some previous or limited oxidation of sulfides, but is not confirmatory of actual acid sulfate soils

2 - pH readings of pH≤4, indicates that actual acid sulfate soils are present with the sulfides having been oxidized in the past, resulting in acid soils (and soil pore water)

3 - The lower the final pH_{FOX} value is, the better the indication of a positive result.

» If the pH_{FOX} < 3 and there was a strong reaction to the peroxide, there is a high level of certainty of a potential acid sulfate soils. The more the pH_{FOX} drops below 3, the more positive the presence of sulfides.

» A pH_{FOX} 3-4 is less positive and laboratory analyses are needed to confirm if sulfides are present.

» For pH_{FOX} 4-5 the test is neither positive nor negative. Sulfides may be present either in small quantities and be poorly reactive under quick test field conditions.

» For pH_{FOX} >5 and little or no drop in pH from the field value, little net acid generating ability is indicated.

4 - If the pH_{FOX} value is at least one unit below field pH_F, it may indicate potential acid sulfate soils. The greater the difference between the two measurements, the more indicative the value is of a potential acid sulfate soils.

5 - Course soils comprise sands to loamy sands - Approximate clay content (% < 0.002mm) ≤ 5%

6 - Medium soils comprise sandy loams to light clays - Approximate clay content (% < 0.002mm) between 5 and 40%

7 - Fine soils comprise medium to heavy clays and silty clays - Approximate clay content (% < 0.002mm) ≥ 40%

Contaminant Exceedance Indicators:

Bold	Indicates the laboratory result is within the specified range of the ASSMAC (1998) Actual Acid Sulfate Soil Indicator Values
Italics	Indicates the laboratory result either exceeds or is within the specified range of the ASSMAC (1998) Potential Acid Sulfate Soil Indicator Values
	Indicates exceedance of the ASSMAC (1998) Action Criteria triggering the need to prepare a ASS Management Plan
	Indicates the requirement for localised lime treatment of the material, that is, when the laboratory results for SCr (%w/w) > 0.03 and the SCr (mole H=/t) > 18

6 Geotechnical Comments & Recommendations

6.1 Preliminary Acid Sulfate Soil Assessment

Laboratory testing detailed in Section 4.2 comprised preliminary screening of samples from various materials encountered within the subsurface profile across the site.

Following review of preliminary screening results, an additional six (6) detailed chromium suite tests were undertaken with results compared against the Acid Sulfate Soil Action Criteria guidelines [10] as detailed in Section 6.1.1 below.

Acid sulfate test results are detailed in laboratory report sheets contained within Appendix C of this report and summarised in Table 5-7 above.

6.1.1 Acid Sulfate Soil Action Criteria

Review of the New South Wales Planning, Industry & Environment mapping portal 'eSPADE' [11] and Maitland Local Environmental Plan (LEP) 2011 Acid Sulfate Soils Risk Map indicates the Site is situated within Class 5 and Class 2 Acid Sulfate Soils.

The acid sulfate criteria in which the soils were assessed against is described below:

Table 6-1 Action Criteria based on Proposed Disturbance - ASSMAC (1998) [10]

Proposed Disturbance	Criteria	Fine Soils(1)	Medium Soils(2)	Coarse Soils(3)
> 1,000 tonnes	Sulfur Trail (Spos) %	0.03	0.03	0.03
	Acid Trail (TPA / TSA) H+/t	18	18	18

Notes to table:
(1) Medium to heavy clays and silty clays - Approximate clay content (%<0.002mm) ≥ 40%
(2) Sandy loams to light clays - Approximate clay content (%<0.002mm) > 5% to < 40%
(3) Sands to loamy sands - Approximate clay content (%<0.002mm) ≤ 5%

6.1.2 Preliminary Assessment

The results of the limited laboratory testing indicated minor exceedance of total actual acidity (TAA) following field screening and detailed chromium suite testing, however there was no detection of chromium reducible sulfur. Based on the results of the testing, it's considered that the subsurface soils are naturally acidic but not considered an acid sulfate soil by definition.

6.2 Preliminary Salinity Assessment

The salinity assessment was undertaken in general accordance with Department of Land and Water Conservation – Site Investigations for Urban Salinity [12]. The salinity assessment comprised:

- A desktop review of available data in the area;
- Site walkover to inspect for signs of saline and sodic soils; and
- Intrusive sampling and laboratory testing.

6.2.1 Site Walkover

A site walkover was undertaken by a geotechnical principal from Stantec on 12th October 2022. The site walkover was undertaken to assess for indicators of saline soils across the site in general accordance with the Department of Land and Water Conservation – Site Investigations for Urban Salinity [12]. Observations made during the investigation are presented in Table 6-2 below.

Table 6-2 Potential Saline soil indicators.

Potential Indicator [1]	Site Observation
Bare soil patches	Minor areas around existing dams.
Salt crystals present on surface	Not Observed.
'Puffiness' of soil when dry or greasy when wet	Not Observed.
Black staining on soils	Not Observed.
Presence of indicator vegetation species	Not Observed.
Die back of trees	Not Observed.
Staining of structural foundations	Not Observed.
Erosion paths around existing water bodies	Minor head scape noted on the upstream side of existing farm dams.

Notes to table:
[1] Based on Phase One of Department of Land Water Conservation NSW, 2002: Site Investigations for urban salinity.

The existing site supported well established vegetation comprising open pasture with isolated mature trees. No indication of saline soils were noted during the inspection. Minor indications of erosion were observed around the existing central eastern farm dam in the form of a head scape on the upstream wall. as shown Figure 6-1.

Figure 6-1 Existing Rural Dam

6.2.2 Salinity Assessment Criteria

Salinity assessment criteria adopted from the Department of Land and Water Conservation NSW [12] and assessment results are summarised below Table 6-3 and Table 6-4 respectively. The assessment results are also detailed in report sheets attached in Appendix C.

Table 6-3 Salinity Class Assessment Criteria

Class	ECe (dS/m)
Non- saline	<2
Slightly saline	2-4
Moderately saline	4-8
Very saline	8-16
Highly saline	>16

Notes to table:
[1] Based on Table 6.2 of Department of Land Water Conservation NSW, 2002: Site Investigations for urban salinity.

Table 6-4 Sodic Class Assessment Criteria

Class	ESP (%)
Non-sodic	< 5
Sodic	5 - 15
Highly sodic	> 15

Salinity and sodicity laboratory results are summarised in Section 5 above, with laboratory test reports attached in Appendix C.

6.2.3 Preliminary Assessment

Based on laboratory testing and site observations, site soils are generally considered non-saline with the exception of the test from TP022 indicating it is a slightly saline soil. Based on the results and extent of proposed earthworks, it is considered saline soils will not be an issue at the site and therefore will not require remediation.

Based on the above testing, colluvial soils are highly sodic in nature and as such prone to erosion. As a result, depending on proposed use of soils, amelioration of exposed soils may be required by the treatment of gypsum. Where sodic soils are buried at depth in fill areas, treatment may not be required. This would be subject to inspection by suitably qualified geotechnical consultant and further confirmatory laboratory testing undertaken during construction.

Where required, it is anticipated soil sodicity can be managed by the application of gypsum at a typical nominal rate of 2kg per/m^2. Validation testing following preliminary excavation and dosing would be required to confirm application rates.

It should be noted that where the general site soils are protected by topsoiling and revegetation, no specific treatment would be required.

6.3 Earthworks

At the time of reporting, preliminary regrade plans for a staged development application of the whole site were supplied to Stantec [2]. Based on the supplied documentation, earthworks for the proposed development are expected to comprise:

- Regrade to all allotments, with maximum cut depths generally ranging from 1.0 to 6.0m below existing ground level (bgl) and localised areas of cutting in excess of 7.0m.
- Filling in the order of 0.5 to 3.0 m above existing ground level to achieve design levels and form residential allotments. It is anticipated filling within low lying areas of site, gulleys and decommissioning existing rural dams will exceed 5.0m.
- A combination of cutting and filling to portions of all the proposed internal road pavements to depths typically in the order of 1.0 to 2.0m bgl (incl. allowance for subgrade boxout), which includes isolated areas of deeper cut to approximately 3.0 to 4.0 m bgl around the eastern portion of site.
- Based on the provided plans there are two (2) permanent basins proposed across the residential development, with two temporary sediment basins proposed within the future footprints of the temporary basins.

Recommendations regarding earthworks for the development are provided below and should be referenced for construction.

During the investigation, refusal was generally encountered at depths of 1.5 m bgl in the weathered rock profile. It should be noted this is significantly shallower than some areas of proposed excavations. Reference to previous boreholes reported in the DP Report [3] indicate higher strength rock has been encountered in portions of the site at depths ranging from 2.8-7.0 m bgl. As such, it is likely higher strength rock will be encountered during excavation.

6.3.1 Topsoil Stripping

Topsoil was encountered in most test pits at thickness ranging from 0.1-0.3 m. All topsoil should be stripped and stockpiled onsite during bulk earthworks. Topsoil impacted by vegetation can not be used as general fill and should be subject to relevant testing for re-use as site topsoil. Topsoil re-use would be subject to inspection by a suitable qualified geotechnical consultant.

6.3.2 Uncontrolled Filling

Uncontrolled filling was encountered during the investigation associated with existing sheds, private service trenches, effluent beds, driveways/access track and within existing farm dams and drainage channels. Uncontrolled filling encountered during the investigation generally comprised:

- Filling typically consistent with encountered subsurface conditions within service trenches and drainage channels. It is therefore anticipated filling associated with service trenching and drainage channels comprised site won fill.
- Filling noted within driveways/access tracks typically comprised quarry gravel product.
- Foreign materials such as bricks, masonry blocks and scrap metal, noted within farms dams and existing drainage channels.

Based on conditions encountered during the investigation, it is expected the uncontrolled fill could be excavated, assessed, reconditioned and used onsite as general fill. This would be subject to inspection by a suitably qualified geotechnical engineer. The inclusion of foreign material could be sorted during bulk earthworks and either recycled or disposed offsite as waste once classified.

Areas of uncontrolled fill are noted on Figure F1 attached in Appendix A.

6.3.3 Colluvial Soils within Filling Areas

Colluvial soils were encountered in most test pits across the site to depths ranging from 0.25-1.3 m bgl. During stripping, where colluvial soils are encountered in areas of proposed filling and minimal cuts, further stripping of colluvial soils may be required, particularly where colluvial materials are encountered during stripping on slopes greater than 8 degrees.

Stripping extents would be subject to final bulk earthworks design levels, and inspection by a suitably qualified geotechnical consultant.

6.3.4 Excavations

Design excavations across the site are anticipated to reach depths in the order of 7.0 m. This may increase where deeper service trenching is proposed.

6.3.4.1 Excavatability

Based on anticipated depths of cut and encountered subsurface conditions at the test pit locations, excavations are expected to be undertaken within the alluvium, colluvium, residual soils, extremely weathered soils and weathered rock profile. Excavations into the colluvial and residual soils are expected to be readily undertaken utilising conventional earthmoving equipment, such as backhoes and small excavators.

Considering the likely excavation depths, bedrock is expected to be encountered during construction particularly in areas of deeper cut for proposed in ground services excavation and road box out. Although machine refusal was not encountered at all test locations, it should be noted the weathered rock profile was encountered at majority of the test pit locations at depths ranging from 0.6 to 1.0m bgl. Excavation progression within the weathered rock profile was generally observed to be slow, and should be considered with respect to plant selection.

Considering the anticipated cutting depths and rock depth encountered at the test locations across site, it would be considered prudent to make allowance for hydraulic rock hammer excavation, the use of large capacity excavators with a single ripper attachment, or large plant with rock ripping capabilities. This is particularly necessary where excavations are expected to extend significantly into the weathered rock, and in particular, confined service trenching proposed within weathered rock.

As refusal was encountered prior to anticipated excavations depths, it may be considered prudent to undertake further investigation in the form of test pitting with larger machines or drilling within areas of proposed deeper excavation. This would be recommended to gather information on deeper rock excavatability, strength, and inform on potential plant selection.

6.3.4.2 Stability of Excavations

Excavations or trenches in the alluvium, colluvium soils, residual stiff or better soils and the weathered rock profile could be expected to stand close to vertical in the short-term. Unsupported excavations into the natural site soils will likely be subject to local slumping if elevated groundwater conditions exist and seepage occurs (e.g. after sustained periods of wet weather). Particular care should be made where virtually saturated topsoil and colluvium materials are encountered. Should areas of instability or significant groundwater flows be encountered during excavation, a suitably qualified geotechnical engineer should inspect the excavations with respect to stability.

Where personnel are to enter excavations, options for short-term excavations include benching or battering back of the excavations at 1H:1V or the support of excavations within the residual soil and extremely weathered rock profile. Short-term excavations within the more competent rock may be battered at steeper than 1H:1V and may not require support, however this would be subject to specific geotechnical assessment.

It is recommended that long-term excavations should be either battered at 2H:1V or flatter and protected against erosion or be supported by engineer designed and suitably constructed retaining walls. Excavations may be battered steeper than 2H:1V in rock materials, subject to specific geotechnical assessment.

6.3.4.3 Basin Materials

Where suitable site-won residual/colluvial clay is available for construction of the clay core associated with the proposed basins, appropriate care should be taken during excavations to ensure sufficient suitable material is sourced. This would include a multistage excavation process to avoid blending with colluvium and weathered rock material generally including:

(1) Stripping of surficial topsoil and or fill materials;

(2) Excavation/removal of colluvium material until the residual/colluvial clay layer is exposed; and

(3) Excavation of suitable clay and placement into a separate stockpile. Excavations should be to design invert level or to the transition into weathered rock material (whatever is encountered first). Weathered rock material should not be excavated and mixed with the clay material.

Where insufficient suitable material is able to be sourced through in areas of proposed basin construction, utilisation of a clay borrow area may be necessary subject to guidance by an experienced geotechnical

consultant. Material proposed to be used within the clay core should be subject to inspection by a suitably qualified geotechnical consultant.

6.3.5 Filling & Batter Slopes

Fill should be placed and compacted in accordance with AS 3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments* [13].

It is expected that construction of fill platforms during bulk earthworks, which would be suitable to support structural loads associated with residential developments, would comprise the following:

- Removal of any existing uncontrolled fill (if present), stockpiles (if present), topsoil, slopewash, alluvium, colluvium or deleterious materials from the areas where fill is to be placed. Any unsuitable material including foreign matter must be removed from the fill areas.
- Breaching and draining of any ponded water within the existing farm dam as soon as practical to allow any sediment to dry as much as possible prior to construction/removal.
- Stripping within the existing rural farm dam and gully line footprints. It should be noted that the removal of all sediment as well as the existing dam wall from the development area is required.
- The fill materials must be free of vegetation including tree stumps, roots, root fibres or other organic matter. Silts or material with high silt portions such as the colluvium material must be blended with other site soils to be used as fill.
- Fill should not comprise material with particle sizes of greater than 200mm or 2/3 of the compacted layer thickness. On-site ripped rock may need to be treated to allow the reuse in road alignments and for general filling during bulk earthworks.
- Benching of the slopes where fill is to be placed with slopes steeper than 8H:1V will be required.
- Placement of fill below 2m total proposed depth should comprise placement in uniform horizontal layers with compaction of each layer to a minimum dry density ratio of 95% standard Compaction (AS 1289-5.5.1) at moisture contents in the order of 85-115% of SOMC or ±2% but generally as close to SOMC as practical. Over compaction should be avoided.
- Placement of fill in exceedance of 2m in height is recommended to have compaction of each uniform layer to a minimum dry density ratio of 98% Standard Compaction (AS 1289-5.5.1).
- Within the road alignment, subgrade formation should be in accordance with Section 7.3.1 and the moisture specification will need to be maintain at -2 to 0% of OMC.

Where high reactivity material is used as fill, it should be placed a suitable distance from the surface to avoid the material impacting negatively on-site classifications. It is suggested that this material only be used in lots requiring filling of >1.0m, where the top 1.0m of filling consists of lower reactivity material such as weathered rock.

All fill should be battered at a slope of 2H:1V or preferably flatter and temporary erosion control should be provided. To prevent erosion in the long term, provision of protection by vegetation and with the provision of adequate drainage is also required. Where a batter of 2H:1V is not possible, the fill should be supported by an engineer designed and suitably constructed retaining walls.

Where filling is expected to exceed 2.0 m, consideration to consolidation of the fill material should be made. This may comprise revision of compaction effort, preliminary settlement analysis, and/or the application of geogrids within pavement embankments.

It should also be noted that where deeper service trenching is proposed within areas of deep fill, consideration should be made to backfill operations to prevent vertical joints in pavements and abrupt changes in subgrade conditions. This may require the application of geogrids to reduce differential movement.

6.3.5.1 Material Suitability

Fill materials are expected to comprise:

- Site won colluvial/residual clays and overlying colluvium materials: Generally, soils excavated on site with the exception of topsoil and high silt content soils are considered suitable for reuse as engineering fill. All

vegetation including tree stumps, roots, root fibres or other foreign material should be removed from the site won materials.

- Existing filling: Existing filling is considered generally suitable for re-use from a geotechnical perspective however should be subject to excavation, recondition and removal of any significant component of foreign material. This would be subject to inspection by a suitably qualified geotechnical consultant.
- Site won ripped weathered rock: Generally, all site won ripped rock would be suitable for re-use following reconditioning and grading for particle size requirements. It is recommended to use sandstone material at levels close to road subgrade and towards the surface in residential lot filling.

6.3.6 Drainage

Given virtually saturated soils were encountered during the investigation, it is expected poor drainage conditions may result in trafficability issues during construction. Temporary drainage measures should be implemented to intercept and direct overland flows to protect earthworks during construction.

Due to the anticipated excavation depths, fracturing in the weathered rock may be observed close to design levels. Where seepage is observed through fracturing in the weathered rock, application of drainage blankets may be required. This is to be determined onsite during construction by a suitably qualified geotechnical engineer.

The soils encountered at the site should be protected from erosion by vegetation (or similar) together with the provision of adequate drainage where exposed. Appropriate surface drainage should be installed to intercept up-slope overland surface flows and to restrict overland surface flows from flowing onto residential allotments.

All collected stormwater run-off should be appropriately detained on site, or where required; directed to appropriate discharge points within the site in a controlled manner.

6.3.7 Existing Dam Decommissioning

It is noted that there are several existing rural farm dams and gully lines which are to be decommissioned/filled as part of the bulk earthworks. Decommissioning of the dams and drainage lines are expected to comprise the following:

- Breaching and draining of any ponded water within the existing dams as soon as practical to allow any sediment to dry as much as possible prior to removal.
- Removal of any existing fill (dam wall), stockpiles, topsoil, slope-wash / colluvium, over-wet, silt, organic or deleterious materials from the areas where fill is to be placed.
- Stripping within the existing dam footprints. It should be noted that the removal of the dam wall and all sediment from the development area is required.
- Inspection of all stripped surfaces should be undertaken by an experienced geotechnical consultant to confirm removal of all deleterious material and suitable foundation materials prior to placement of fill, with fill operations undertaken as detailed in Section 6.3.5.

6.4 Basin Construction

Based on the supplied plans [2] two (2) bio-retention basins are to be constructed within the central-western, and southern portions of site.

6.4.1 Proposed Basin Earthworks

Bulk earthworks plans [2] provided at the time of investigation were preliminary in nature, however based on the current landform and proposed development, likely earthworks for the proposed basins are summarised below.

6.4.1.1 Basin 'A' – Bio-Retention

Review of the supplied plans [1] indicates Basin A proposed to be a bioretention basin situated within the southern portion of the site. Based on the design plans provided, earthworks for the proposed basin are expected to comprise:

- Filling in the order of 1.0-2.0m to create the eastern and western basin walls. Given the site topography, deeper filling is expected on the southern wall in excess of 2.0m. Filling materials required for the basins shall meet the requirements outlined in Table 6-5.
- A combination of cutting and filling in the order of 1.0m is proposed for the northern embankment wall. Cutting in the basin impoundment area is expected to grade to an assumed maximum of 2.0m within the deepest portion of the basin. Deeper cuts are expected within the impoundment area when considering the biofiltration media.

The basin involves two headwalls, comprised of one inlet along the northern side of the basin and an outlet on the south side discharging flows to the generally south trending towards Wallis Creek. The basin also comprises a high flow spillway discharging to the south, with all discharge points proposed to comprise appropriate scour protection.

Test pits TP014 & TP015 were excavated within the vicinity of the footprint of the proposed Basin A. Encountered subsurface conditions comprised a surficial coverage of fill overlying, residual stiff to very stiff Silty CLAYs of medium to high plasticity with varying minor components of fine sand and gravel, overlying extremely weathered Silty / Sandy CLAY of low to medium plasticity and hard consistency.

6.4.1.2 Basin "B" – Bio-Retention

Review of the supplied plans [1] indicates Basin B is situated within the central-eastern portion of the Site immediately adjacent to Cessnock Road. Located within the footprint of the proposed basin is an existing gully directing surface flows south-west to the Cessnock Road culvert crossing. Basin B also encompasses the footprint of an existing farm dam. It is anticipated that the basin comprises one smaller biofiltration basin to the south that gradually discharges into the larger On-Site Detention (OSD) basin to the north. Based on the design plans provided, earthworks for the proposed basin are expected to comprise:

- The biofiltration basin is predominantly constructed within cutting, in the order of 1.0-2.0m for the embankment walls. Deeper cuts in the order of 2.0-3.0m are expected within the impoundment area when considering the biofiltration media.
- A combination of cutting and filling in the order of 1.0-2.0m to create the eastern and western embankment walls is proposed. Deeper filling associated with the removal of the existing dam wall and gully line is expected on the northern wall in the order of 3.0-4.0m. Filling materials required for the basins shall meet the requirements outlined in Table 6-5.
- Given the site topography sloping north-west towards the existing gully line, deeper cutting is proposed in the eastern portion of the permanent basin impoundment area to grade to a maximum of 4.0m bgl.

The biofiltration basin is expected to comprise one headwall with one inlet at the eastern side and an outlet on the northern side discharging flows into the OSD basin. The basin also comprises a high flow spillway into the OSD basin.

The OSD basin is expected to comprise two headwalls with two inlets at the southern and eastern side, with an outlet on the western side discharging flows to the generally west trending existing gully line beyond Main Road. All discharge points are expected to comprise appropriate scour protection.

Test pit TP023 was excavated within the footprint of the proposed Basin B. Encountered subsurface conditions comprised a surficial coverage of fill overlying, a highly plastic residual CLAY with a consistency ranging from stiff to hard with depth. Residual CLAY was encountered to a depth of 1.25m, overlying an extremely weathered Silty Sandy CLAY of low to medium plasticity with a hard consistency to a target depth of 1.50m. Test pit TP022 was conducted within close proximity of Basin B and comprised similar subsurface conditions, however, the inclusion of a highly plastic colluvial Silty CLAY layer was overlying the residual clay layer. It should be noted weathered rock profiles were not encountered in either TP022 or TP023 to target depths of 1.50 and 1.60m bgl respectively, however are likely to be encountered based on anticipated excavation depths and encountered subsurface conditions across the site.

6.4.2 Embankment Requirements

Table 6-5 below provides general material requirements and compaction specifications for the construction of a zoned embankment for temporary and permanent basins.

Table 6-5 Embankment Material Specification

Specifications	Zone 1 – Clay Core Material	Zone 2 – Embankment Fill
Material Property		
Material Description	CLAY / Silty CLAY	
Plasticity Index	10-50%	
Permeability	< 10^{-9} m/s	N/A
Emerson Class	Minimum Class 4	Minimum Class 2
Maximum particle Size	50mm	200mm or 2/3 of the compacted layer
Percentage Fine Content (Material Passing 0.075mm)	> 25%	> 20%
Compaction Requirements		
Compaction (Standard Relative Density AS1289 5.7.1)	Minimum 98%	Minimum 95%
Moisture Content	-1 to +2 of SOMC	-1 to +2 of SOMC

Notes to table:
SOMC: Standard Optimum Moisture Content
N/A: Not applicable

Based on the results of the laboratory testing and observations made during the investigation, suitable site clays were encountered across the site. Clays excavated from a deeper profile are more likely to be viable for clay core construction. Highly plastic clays are only permitted for use as embankment filling materials. Clays proposed to be used for basin construction should be inspected by an experience geotechnical consultant during construction to confirm suitability and/or provide further guidance on treatment/conditioning.

Based on the supplied civil plans the foundation for the clay core would comprise residual soils and weathered rock. All batter slopes within the impoundment area should be 5H:1V or flatter. All batter slopes for external walls should be graded at 3H:1V or flatter. Where this cannot be achieved, engineered retaining walls may be required.

Basins A and B will require a retention system as insufficient geometric area is available for formation. Review of the supplied plans indicated masonry infilled blockwork retaining walls are proposed and will be founded on piles. It is recommended that buoyancy or uplift be considered for the design of these walls.

6.4.3 Embankment Foundation Treatment

Based on the subsurface conditions encountered during the investigation and review of the proposed basin plans, embankment foundation conditions are expected to be within residual clay and weathered rock profile (after removal of any unsuitable colluvium and topsoil). Where virtually saturated materials are encountered within the proposed keyway, over excavation and replacement may be required. Deeper filling within the existing gully line to create the north-eastern embankment wall of Basin B will require unsuitable material is to be removed as a part of the bulk earthworks.

The following general foundation preparation requirements must be adopted:

- Removal of topsoil and colluvium soils.
- Static proof-rolling of the exposed foundation area under the embankment with a heavy (minimum 10 tonne) roller. Soft or weak areas detected during the proof rolling shall be excavated and replaced with compacted fill comprising low permeability clay meeting the requirements of Zone 1 material.
- Protection of the prepared foundation to prevent excessive wetting or drying prior to placement of embankment fill material. Trafficking of the exposed foundation should be limited (or avoided where possible) to prevent permanent deformation.

- Embankment clay core to have a minimum 500 mm key into the residual clay (assumed foundation material) targeted at a depth below the basin invert.
- Inspection by an experienced geotechnical consultant shall be conducted to confirm foundation suitability.

6.4.4 Impoundment Area

Excavations form the foundation of the proposed Basin A and Basin B impoundment areas would be expected to be founded within residual clay and EWM profiles. The civil plans, indicate deeper cut depths into the existing natural profile to be in the order of 2.0-4.0 m bgl within the deepest portion of the proposed basins. Where excavations within these basins expose the underlying weathered rock and sandy EWM, the application of a clay liner may be required and inspection of the exposed subsurface profile within impoundment area would be required to assess any defects of the soil and or rock profile. This would be subject to inspection by a suitably qualified geotechnical consultant.

Excavations form the foundation of the proposed Basin C impoundment areas would be expected to predominantly comprise filling given the existing site slopes. Inspection should be undertaken by a suitably qualified geotechnical consultant to ensure appropriate material is utilised as filling within the impoundment area.

All batter slopes within the impoundment area should be 5H:1V or flatter.

6.4.5 Stormwater Outlets & Seepage Collars

A seepage collar will be required to be constructed along the stormwater pipes traversing the proposed basin embankments to increase the length of the percolation path and reduce the risk of piping developing around the stormwater pipes.

Seepage collars are generally made of concrete with a required width depending on pipe diameter but are typically three times the pipe diameter.

6.4.6 Surface Erosion Control

Topsoil shall be spread over the exposed surfaces of the embankment to a depth of at least 150mm and sown with pasture grass to establish a good cover as soon as practical. Jute mat is recommended over the topsoil to encourage the grass development and reduce topsoil/seed loss at early stages.

Appropriate management of the sodic residual clays through the application of gypsum treatment is required for any surface area of exposed clay material within the basin walls and impoundment area. This may not be necessary where turf is placed within the impoundment area (subject to inspection) however the clay core will need to be treated.

Large vegetation shall not be allowed to become established on or near the embankment. Tree roots (especially eucalyptus tree roots) can cause the core to crack and encourage piping development, resulting in the failure of the dam wall.

All trees and shrubs shall be restricted to a minimum distance of 1.5 times the height of the tree away from the embankment of the dam.

6.4.7 Embankment Construction & Upstream Batters

Following the preparation of the embankment foundations, formation of the embankment must be undertaken from foundation to the crown using the compaction requirements specified in Table 6-5. Compaction of the embankment material must be undertaken using pad foot rollers.

Upstream batters of the basin should be graded at 5H:1V or flatter, with diversion drains/bunds to divert any surface flows towards the specified inlet discharge points to limit erosion of the batter faces. Where this can not be achieved, additional advice should be sought from a suitably qualified geotechnical engineer.

6.5 Retaining Structures

Detailed in the supplied civil [1] set is the inclusion of retaining structures, to establish level building platforms for the residential structures and support basin design, particularly in areas of increased site grades.

All retaining structures greater than 1.0m in height are to be designed by a suitably qualified engineer. Design of retaining structures should consider the following;

- Surcharge loading from slopes and structures above the wall;

- Account for loading from any proposed compaction or fill behind the wall;
- Provide adequate surface and subsurface drainage behind all retaining walls including a free draining granular backfill to prevent the build-up of hydrostatic pore pressures behind the wall;
- Utilise materials that are not susceptible to deterioration; and
- Ensure all walls are founded in materials appropriate for the loading conditions.

Footings for the proposed retaining walls should be founded below any topsoil, uncontrolled filling, or deleterious materials within the natural residual / extremely weathered soils or underlying weathered rock profile.

Review of proposed retaining structures within detention basins would be required and the parameters below would only be appropriate for walls that aren't subject to inundation.

It should be noted that the retaining wall parameters provided in Table 6-6 below are typical, and could be refined on a wall by wall basis.

Table 6-6 Retaining Wall Design Parameters

Parameter	Very Stiff (or better) EWM CLAYs and Controlled CLAY FILLING	Weathered Rock – SANDSTONE OR SILTSTONE
Bulk Unit Weight (kN/m^3)	20	22
Effective Friction Angle, ϕ'	26°	-
Effective Cohesion, c'	2 kPa	-
Undrained Shear Strength, S_U	75kPa	-
Active Earth Pressure Coefficient, K_A	0.39	0.1
Passive Earth Pressure Coefficient, K_P	2.56	-

Notes to table:
N/A: Not applicable

7 Pavement Thickness Design

Pavement thickness design has been undertaken based on the findings of the geotechnical investigation and Maitland City Council (MCC) requirements. The following guidelines have been adopted for the design of the internal roads:

- Pavement thicknesses for flexible pavements in accordance with mechanistic procedure presented in Austroads Guide to Pavement Technology, Part 2: Pavement Structural Design [14]; and
- Maitland City Council (MCC) Manual of Engineering Standards, Chapter 5: Road Pavement Design [15].

7.1 Design Parameters

7.1.1 Design Traffic Loading

Design traffic loading for the internal roads has been adopted from MCC Engineering Manual, Chapter 4: Road Design [16] and Chapter 5: Pavement Design [15] based on the road type designations specified by lot serviceability. Table 7-1 below provides a summary of the proposed internal road traffic loading.

Table 7-1 Design Traffic Loading Roads 1-10

Road(1)	Road Designation	Design Equivalent Standard Axles (DESA)
Road 2-6,8(4),9-11	Local - Secondary	2×10^5
Road 1	Collector – Primary	1.5×10^6
Bus Route(5)	Public Route	5×10^6
Road 7	Sub-Arterial	1×10^7

Notes to table:
(1) Roads are unnamed on supplied plans.
(2) Increased DESA for industrial vehicle access to sewerage pumping station - most southern road of site.
(3) Road adjoining Main Road and Aspen Street, extending along the eastern boundary of site.
(4) Specific roundabout pavement design will be required.
(5) To be utilised where bus route proposed.

A public bus route design has been included where bus routes are proposed for the development. The design traffic loading above is consistent with previous stages of the Wallis Creek development abutting pavement designs.

Where the road designation differs from those presented in Table 7-1 above, additional consultation with Stantec would be required.

7.1.1.2 Reactive Clays

Where pavements are founded on highly reactive soils, significant loss of pavement shape and potential damage to pavements due to volume change can occur as a result of moisture variations. Where expansive soils are encountered at subgrade, potential for volume change should be minimised by adopting some, or all, of the strategies outlined in clause 5.3.5 of Austroads [14]. The specific considerations in relation to highly reactive soils should include, but not be limited to:

- Specification of a moisture content range which is maintained for preparation of the subgrade until subbase is placed
- The need for subsoil drainage to not be located in the expansive soils
- The need for a low permeability lower subbase / select layer
- Recommendation for sealed shoulders and impermeable verge material
- Recommend appropriate construction techniques
- Reduction of the volume expansion potential of the expansive soils by lime stabilisation.

Swell testing conducted during CBR testing indicates the natural clay materials generally have a moderate swell potential as defined in Table 5.2 of Austroads [14] with swell readings in the range of 0.5 to 1.5%. Observations made during the conducted test pits and previous experience in surrounding areas has indicated the presence of clays of high reactivity at the site, particularly in the top portion (<1.0 m) of the

subsurface profiles and as such a select material is proposed to negate expansive cracking in areas identified as having highly reactive clays.

Given that the site clay testing is low to highly reactive clays no specific treatment of reactivity other than good subgrade preparations would be required. However, assessment of the reactivity of subgrade materials will to be undertaken during the construction phase by an on-site experienced geotechnical consultant/engineer. Where highly reactive clays are exposed at subgrade level, suitable measures should be undertaken in order to mitigate the potential for volume change including those abovementioned.

It is considered that given the proposed earthworks required to reach geometric design levels, control of the bulk earthworks can achieve a subgrade that places any highly reactive material at depth and ensures coverage with a low reactive material.

Typical earthworks would be conducted such that where any highly reactive clay is encountered at subgrade level during construction, over excavation of an additional 300 mm and replace with site-won, weathered “ripped” rock.

It should also be ensured that any over-excavated reactive clays to be utilised as fill are placed lower where possible in road alignments or lots.

It is understood that, over excavation and placement of a 300 mm imported, low reactive select fill layer (min 15% CBR) is a minimum requirement of Maitland City Council for construction on reactive clays.

7.1.1.3 Design CBR

The results of the CBR test undertaken on potential subgrade materials indicate that CBR values for the sites natural clay soils and weathered rock encountered within the test pits and in previous investigations produced CBR values range from 3% to 8% respectively. It should be noted that test pits were not extended to design subgrade where deeper areas of excavations are proposed due to refusal on weathered rock. It should be noted however that representative samples of proposed subgrade material were taken where weathered rock was encountered at other shallower locations within the site for laboratory testing and as such assumptions for subgrade design can be readily undertaken.

For the purpose of design, and to allow for variability in clay CBR values, a design CBR of 3.0% has been adopted for residual clays and a design CBR of 8% adopted for site-won weathered rock. However, it is suggested that confirmatory testing on clay subgrade and weathered “ripped” rock during construction is conducted to confirm design CBR values.

It is recommended pavements founded on reactive clays in transition zones between cut and fill areas would require over excavation to a minimum depth of 0.3 m and replaced with suitable low reactive weathered “ripped” rock material. It is further recommended that filling from a depth of 0.5 m below top of subgrade be of low reactive weathered “ripped” rock material.

Allowance for a minimum 300 mm select layer with CBR≥15% can increase overall CBR value to 8% which has also been added as an option.

7.2 Flexible Pavement Thickness Design

Based on the subsurface conditions present at the time of investigation and the results of the CBR testing, flexible unbound granular pavement would be the most cost-effective option for the construction of the internal roads.

Pavement compositions associated with a design CBR of 8% should only be used for design purposes under direction from an experienced geotechnical consultant who has inspected and confirmed the material type present at design subgrade level. It is understood the preference of MCC where reactive soils are encountered within pavement subgrade is the application of a 300 mm select layer. This has been included in pavement design.

Additional sampling and testing of proposed subgrade materials should be carried out during pavement construction to confirm design CBR values.

Pavement design thicknesses calculated for the Internal Roads are summarised below in Table 7-2, Table 7-3, Table 7-5 and Table 7-5 below. It should be noted layer thicknesses are minimum thickness regardless of construction tolerances.

Table 7-2 Pavement Thickness Design for Road 2-6, 8, 9-11 - DESA = $2x10^5$ (Local - Secondary)

	Thickness		Recommended Material Type (1)
Wearing Course	30mm (7 mm primer seal)	30mm (7 mm primer seal)	AC10 with C450 binder
Base Course (2)	160mm	160mm	DGB, GMB or NGB
Subbase Course	125mm(3)	125mm(3)	DGS, GMS or NGS
Select Material	Min 300mm	-	CBR ≥ 15%
Total Thickness	615mm (4)	315mm(4)	-
Subgrade Material	SELECT FILL overlying Silty CLAY	WEATHERED ROCK	-
Subgrade CBR	3%	8%	-
Design traffic	2×10^5 DESA		
Design Life	30 years		

Notes to table:
(1) Refer to Section 7.3.2 for material specifications.
(2) 160mm basecourse has been selected for tie in with 190mm kerb and gutter. Minimum 140mm base material as per Figure 8.4 of Austroads [14] has been neglected for constructability purposes.
(3) Minimum subbase thickness of 125mm as per MCC Guidelines.
(4) Minimum pavement thickness of 300mm as per MCC Guidelines has been increased to 315mm to facilitate tie in with 190mm kerb and gutter.

Table 7-3 Pavement Thickness Design for Road 1 - DESA = $1.5x10^6$ (Collector – Primary)

	Thickness		Recommended Material Type (1)
Wearing Course	30mm (7 mm primer seal)	30mm (7 mm primer seal)	AC10 with C450 binder
Base Course (2)	160mm	160mm	DGB or GMB
Subbase Course	125mm(3)	125mm(3)	DGS or GMS
Select Material	Min 300mm	-	CBR ≥ 15%
Total Thickness (4)	615mm	315mm	-
Subgrade Material	SELECT FILL overlying Silty CLAY	WEATHERED ROCK	-
Subgrade CBR	3%	8%	-
Design traffic	1.5×10^6 DESA		
Design Life	30 years		

Notes to table:
(1) Refer to Section 7.3.2 for material specifications.
(2) 160mm basecourse has been selected for tie in with 190mm kerb and gutter. Minimum 140mm base material as per Figure 8.4 of Austroads [14] has been neglected for constructability purposes.
(3) Minimum subbase thickness of 125mm as per MCC Guidelines.
(4) Includes select layer where applicable.

Table 7-4 Pavement Thickness Design for Bus Route - DESA = $5x10^6$ (Public Route)

	Thickness		Recommended Material Type (1)
Wearing Course	40mm (7 mm primer seal)	40mm (7 mm primer seal)	AC14 with C450 binder
Base Course	160mm	160mm	DGB or GMB
Subbase Course	150mm	150mm	DGS or GMS
Select Material	Min 300mm	-	CBR ≥ 15%
Total Thickness (2)	650mm	350mm	-
Subgrade Material	SELECT FILL overlying Silty CLAY	WEATHERED ROCK	-
Subgrade CBR	3%	8%	-
Design traffic	5×10^6 DESA		
Design Life	30 years		

Notes to table:
(1) Refer to Section 7.3.2 for material specifications.
(2) Includes select layer where applicable.

Table 7-5 Pavement Thickness Design for Road 7 - DESA = $1x10^7$ (Sub-Arterial)

	Thickness		Recommended Material Type (1)
Wearing Course	40mm (7 mm primer seal)	40mm (7 mm primer seal)	AC14 with C450 binder
Base Course	170mm	170mm	DGB or GMB
Subbase Course	175mm	175mm	DGS or GMS
Select Material	Min 300mm	-	CBR ≥ 15%
Total Thickness (2)	685mm	385mm	-
Subgrade Material	SELECT FILL overlying Silty CLAY	WEATHERED ROCK	-
Subgrade CBR	3%	8%	-
Design traffic	1×10^7 DESA		
Design Life	30 years		

Notes to table:
(1) Refer to Section 7.3.2 for material specifications.
(2) Includes select layer where applicable.

Select material thicknesses in above tables are minimum only and previous experience in the area indicates additional site won or select fill may be required, subject to inspection by a suitably qualified geotechnical engineer.

During boxing out of subgrade levels, where thin clay layers are present in locations such as transitions between bedrock and subgrade fill, over-excavation may be required to remove these thin layers and replacement with select material would be required.

Inspection of the finished subgrade by a geotechnical engineer during boxing is required to assess subgrade conditions, over-excavation and select subgrade quality.

MCC Pavement Design Specifications [15] Chapter 5.1 states that AC wearing course for flexible pavements may be included in total pavement thickness. This has been included by reducing the subbase thickness where possible to limit pavement depths. Where additional pavements (to those specified) are required to facilitate a bus route, Stantec should be notified and amendments to design may be required.

7.3 Construction Notes

7.3.1 Subgrade Preparation

Prior to and following the investigation, significant rainfalls have occurred within and the surrounding area of the site, which may cause fluctuations of the in-situ moisture contents. Elevated moisture contents are likely to occur within the low-lying gully lines to the south and central portion of the site that flow into the existing rural dams.

Options to ameliorate the subgrade conditions may include:

- Removal and replacement of the materials significantly wet of SOMC;
- Moisture re-conditioning and blending of site won granular material with cohesive materials to improve structure and ability to support the proposed pavements. It should be appreciated that moisture re-conditioning will need to allow sufficient time for the materials to 'dry back' and will extend the construction program; or
- Reconditioning including the addition of lime to the subgrade to reduce moisture content only.

The most efficient and cost-effective treatment would be best determined at construction as soil moisture levels and the final design levels will impact on suitable treatment options.

Based on the preliminary civil plans [1], large diameter stormwater pipes are proposed under roads with deeper backfilling required. Care should be taken where backfilling of deeper service trenching is noted within areas of significant excavation, particularly where service trenching is located within pavement subgrade. Over-excavation and replacement or additional drainage measures may be required to prevent sudden changes in subgrade conditions and impact on pavement from preferential flow paths.

It is noted the investigation was undertaken prior to bulk earthworks plans being issued, and test pitting to design level has not been undertaken in all areas of deeper cuts. As such, confirmatory CBR testing may be required during subgrade preparation to confirm design assumptions made in the pavement thickness design.

Where construction of a new pavement is proposed, subgrade preparation should be in general accordance with the relevant council construction specifications and the following procedures.

- Removal of topsoil, colluvium, uncontrolled fill, and deleterious to subgrade formation level, with the spoiling of any deleterious or over wet material to either allow reconditioning and reuse or offsite disposal;
- Where highly reactive materials are identified at subgrade level by an experienced geotechnical consultant during construction, strategies outlined in clause 5.3.5 of Austroads [14] should be adopted to minimise the potential for volume change to occur as discussed in Section 7.1.1.2.
- Excavation of loose and oversize filling and elimination of abrupt changes between subgrade conditions, such from rock to soil, and from granular fill to fine grained natural soils.
- All subgrade surfaces in cut shall be ripped, loosened and compacted to a minimum depth of 150mm below the design subgrade, including up to 150mm behind the back of the kerb.
- Subgrades in rock are to be thoroughly ripped to a minimum of 300mm below the design subgrade level and to extend to the sides of the formation to provide drainage away from the pavement. Ripped material is to conform to the particle size characteristics described for fill material and is to be compacted to form the subgrade construction layer unless the ripped material is deemed unsuitable for subgrade purposes.
- Fill material to be used as subgrade shall conform to the appropriate specifications as detailed in this report and MCC Specifications.
- Static proof-rolling of the exposed subgrade using a heavy (minimum 10 tonne) roller under the direction of an experienced geotechnical consultant. Loose or yielding areas should be excavated and replaced with compacted select fill or suitable subgrade replacement comprising of material of similar consistency to the subgrade.
- Compaction of the subgrade filling or select should be to at least 100% of SMDD in layers of not greater than 300 mm compacted thickness at a ratio of less than 100% of SOMC.
- Protection of the subgrade to prevent any excessive wetting or drying.
- Formation of the pavement in accordance with the below recommendations and specifications.

Following satisfactory preparation of the subgrade, the pavement should be placed in accordance with the requirements of the appropriate section of this report, depending on the proposed pavement type.

7.3.2 Specification & Compaction Requirements

Pavement materials and compaction requirements for the new pavement construction should conform to Maitland City Council design and construction specifications [15] [17], and the following requirements.

Table 7-6 Pavement Material Specification and Compaction Requirements

Pavement Course	Material Specification	Compaction Requirements
Internal Roads (Flexible Pavements)		
Wearing Course Asphalt or Sprayed Seal	Material complying with MCC's Engineering Requirements for Development (MCC requirements) [15] [17]	Material complying with MCC's Engineering Requirements for Development [15] [17]
Base Course Quality crushed rock	Material complying with MCC requirements [17] [15] and a CBR > 80%, PT <6%	Min 98% Modified (AS 1289 5.2.1) or 102% Standard (AS1289.5.1.1)
Subbase Crushed rock or gravel	Material complying with MCC requirements [17] [15] and a CBR > 30%, PT <12%	Min 95% Modified (AS 1289 5.2.1) or 100% Standard (AS1289.5.1.1)
Select Crushed rock or gravel	CBR ≥ 15%	Min 100% Standard (AS 1289 5.1.1)
Subgrade or replacement	Minimum CBR 8% Select fill and weathered rock	Min 100% Standard (AS 1289 5.1.1)

All granular pavement material quality should be in general accordance with MCC Construction Specifications [17] for relevant design traffic. The selection of appropriate construction materials that are durable and insensitive to moisture change is essential in areas subject to periodic inundation and/or wet ground conditions.

Minimum testing on all potential imported pavement materials should be to RMS QA Specification 3051 [18] including a four-day soaked CBR, Atterberg Limits, Particle Size Distribution analysis and Wet/Dry strength determination. Pre-treatment of material prior to testing would be advisable for materials subject to breakdown.

7.3.3 Wearing Course

Wearing courses should be in accordance with Maitland City Council specifications [15] with consideration to TfNSW QA Specifications R116 [19] and Austroads AGPT04B-07 Guide to Pavement Technology, Part 4B: Asphalt [20].

The design and construction of wearing courses should be in in consultation with the preferred supplier taking into account traffic volume and type. All pavement surfaces should be primed or primer sealed prior to the application of bituminous sprayed seal.

7.3.4 Drainage

The moisture regime associated with a pavement has a major influence on the performance considering the stiffness/strength of the pavement materials is dependent on the moisture content of the material used. Accordingly, to protect the pavement materials from wetting up and softening, particular care would be required to provide a waterproof seal for the pavement materials, together with adequate surface and sub-surface drainage of the pavement and adjacent areas.

Owing to the potential for cracking along the interface where new pavements are joined to existing pavements, it is suggested that an intra-pavement drain should be provided at the interface between any section of new and existing pavements.

Following investigation and observation of the present geotechnical conditions, it is recommended that subsoil drainage be installed at subgrade level on both sides of the road. Detailing of subsoil drainage should be in accordance with Austroads 2017 [14] taking into consideration the presence of moderately to highly expansive soils. The subgrade should be constructed with sufficient cross fall (in general 3%) to assist in reducing retention time for moisture entering the pavement. The subsoil drains should be located below or behind the kerb to intercept any moisture ingress from outside and within the roadway. The drains will require flush-out points and regular maintenance to ensure their correct operation, and detailing should take

into account the presence of moderately to highly expansive soils where encountered. Provision of adequate cross fall to direct runoff from the pavement to drainage lines should be achieved.

The pavement thickness designs presented above assume drained pavement conditions. The selection, construction and maintenance of appropriate drainage mechanisms would be required for adequate performance. The selection of appropriate construction materials that are relatively insensitive to moisture change is also essential in area subject to periodic inundation, even if for a relatively short period of time.

7.3.5 Pavement Compaction

Difficulty obtaining specified compaction requirements can be expected in areas of low strength subgrade which are evident in areas where the road is to be constructed in fill and firm clays near surface are expected and subgrade replacement is not undertaken. Vibratory compaction can lead to potential problems with the development of excess pore pressures and permanent deformation of the subgrade. Large capacity oscillating rollers are better suited to deep lift compaction. Static or low amplitude rolling may be appropriate in conjunction with thinner layers in poor subgrade areas.

It is essential to ensure that compaction is achieved though the full thickness of any pavement layers. A rough interface and bond is required between all pavement layers, generally achieved through scarification of the first layer prior to placement and compaction of the second and subsequent pavement layers.

7.3.6 Pavement Interface and Tie-in

Where new pavement construction abuts an existing pavement, care should be exercised to bench into the base course layer for a minimum of 0.5m for the entire pavement width.

Adequate compaction of the subgrade and pavements in this area is essential to maximise performance of the pavement. It is noted that where variable pavements are abutted, the potential for localised failure is generally greater. Consideration should be given to sealing any cracks that may develop between existing and new pavements. The use of a strain alleviating membranes at the interface may also be appropriate. It may also be prudent to install intra-pavement drainage at subgrade level at interfaces of variable existing and new pavements.

7.3.7 Inspections

The subgrade will require inspection by an experienced geotechnical consultant after boxing out or filling to design subgrade level. The purpose of inspections is to confirm design parameters, assess the suitability of the subgrade to support the pavement, and delineate areas which may require subgrade replacement or remedial treatment prior to construction.

7.3.8 References

All works and materials used in construction should be designed and constructed in accordance with Maitland City Council Specifications or as specified in this report. Where discrepancies may occur, clarification should be sought from Council.

Earthworks and testing should generally be undertaken in accordance with AS 3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments* [13] where not otherwise specified.

8 Slope Stability Assessment

Stantec have undertaken a slope stability assessment (SSA) of the site as part of the additional investigation works. The following assessment for the proposed subdivision has been undertaken in general accordance with the principles outlined in Australian Geotech Society (AGS) Landslide Taskforce paper referenced "Practice Note Guidelines for Landslide Risk Management 2007c," *Journal and News of the Austrailian Geomechsanics Society,* vol. 42, no. 1, pp. 63-114, 2007c [21].

8.1 Definitions

Definitions utilised in the SSA have been outline below.

- **Hazard:** A condition with the potential for causing an undesirable consequence. A particular hazard may be severe, but it may or may not pose a high risk to persons or property. For the purpose of this study, a hazard is defined as a condition with the potential for causing an undesirable consequence.
- **Undesirable consequence:** Injury or loss of life to persons or damage to property.
- **Risk:** The measure of the probability and the severity of an adverse effect (undesirable consequence) to health, property or environment *from a hazard*.
- **Tolerable risk:** A risk within a range that society can live with so as to secure certain net benefits. It is a range of risk regarded as non-negligible and needing to be kept under review and reduced further if possible [21].
- **Acceptable risk:** A level of risk for which for the purpose of life or work we as a society are prepared to accept as it is with no regard to its management. Society does not generally consider expenditure in further reducing such risks justifiable [21].

8.2 Method

The analysis for this study is focused on estimation of future risk to property based on the proposed draft development layout (ignoring regrade and any other remedial measures including rock pitching) together with consideration of the existing conditions observed at the time of the investigation.

The risk assessment procedure adopted herein is in general accordance with the principles outlined AGS 2007c [21]. Stantec have assessed the risk to property using the qualitative assessment matrices of the AGS 2007 Guidelines.

This comprises utilisation of risk matrices/tables that comprise qualitative descriptions for levels of consequence and likelihood of occurrence.

Assessment of landslide hazards includes an assessment of the likelihood of occurrence. Likelihood has been assessed based on the site-specific models derived from the geological mapping and observations, anecdotal evidence, the relationship between geomorphology and geology combined with judgement and experience have been used to estimate likelihood of failure for the current condition.

Likelihood (Table 8-1) and consequence (Table 8-2) are combined in the matrix shown in Table 8-3, resulting in risk level that can range from very low (VL) to very high (VH). The standard definition of the risk levels from AGS 2007c are presented in Table 8-4.

Table 8-1 Qualitative Measures of Likelihood

Level	Descriptor	Description	Approximate Annual Probability
A	ALMOST CERTAIN	The event is expected to occur over the design life	10^{-1}
B	LIKELY	The event will probably occur under adverse conditions over the design life	10^{-2}
C	POSSIBLE	The event could occur under adverse conditions over the design life	10^{-3}
D	UNLIKELY	The event might occur under very adverse circumstances over the design life	10^{-4}

Level	Descriptor	Description	Approximate Annual Probability
E	RARE	The event is conceivable but only under exceptional circumstances over the design life	10^{-5}
F	BARELY CREDIBLE	The event is inconceivable or fanciful over the design life	10^{-6}

Table 8-2 Qualitative Measures of Consequences to Property

Level	Descriptor	Description
1	CATASTROPHIC	Structure(s) completely destroyed and/or large-scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.
2	MAJOR	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.
3	MEDIUM	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.
4	MINOR	Limited damage to part of structure, and/or part of site requiring reinstatement stabilisation works.
5	INSIGNIFICANT	Little damage.

Table 8-3 Qualitative Risk Analysis Matrix

Likelihood		Consequence to Property				
	Approx. Annual Probability	1: 200% Catastrophic	2: 60% Major	3: 20% Medium	4: 5% Minor	5: 0.5% Insignificant
A – Almost Certain	10^{-1}	VH	VH	VH	H	M / L
B - Likely	10^{-2}	VH	VH	H	M	L
C - Possible	10^{-3}	VH	H	M	M	L
D - Unlikely	10^{-4}	H	M	L	L	VL
E - Rare	10^{-5}	M	L	L	VL	VL
F - Barely Credible	10^{-6}	L	VL	VL	VL	VL

Table 8-4 Risk Level Implications

Risk Level		Example Implications
VH	Very High	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work will likely cost more than the value of the property
H	High	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	Moderate	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce risk to Low.
L	Low	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	Very Low	Acceptable. Manage by normal slope maintenance procedures.

8.3 Hazard Assessment

Hazard assessment is a part of the risk assessment process and includes identification of hazards and assessment of the likelihood that the hazard will impact the elements most at risk.

Assessment of landslide hazards involves identification of failure mechanism(s) and an assessment of the likelihood that identified mechanism(s) will result in a failure. Likelihood of occurrence is generally a product of the probability of detachment multiplied by the probability that the detached material once mobilised, will impact the element / area at risk.

The scope of this hazard assessment has been based on geotechnical investigation.

8.3.1 Mechanism

The primary slope stability hazards identified at the site were observed along the eastern boundary of the site, associated with the vertical rock face bordering the riparian zone. Sections showing the approximate slopes along the eastern boundary are shown on Figures 4-6 attached in Appendix A.

Hazards and mechanisms associated with the eastern border include:

- Overland flow paths eroding rock seams in the exposed vertical rockface causing block failure.
- Creep of surficial soils (colluvial deposits).
- Root Jacking of rock joints in the exposed vertical rockface causing isolated falls.
- Concentrated overland flows causing erosion on slopes.
- Global stability failure of vertical rock face due to underlying geological units.

8.3.2 Likelihood / Frequency of Occurrence (P_h)

Assessment of landslide hazards (landslips and rock falls) includes an assessment of the likelihood of occurrence within a given period of time, or a frequency analysis. Likelihood of Occurrence is estimated based on the probability of detachment combined with the probability that the detached object / material, once mobilised, will reach or affect the element at risk. The likelihood of occurrence has been inferred from Table 8-1 based on observed site conditions, a review of published data and past experience in the area.

The likelihood of failure for a specific mechanism at a specific location cannot be accurately calculated without detailed analysis of the lithology and geometry for that particular location. Detailed stability analysis is applicable to site-specific investigations that address specific subject areas. The stability analyses as a part of this report have been generalised and are broadly applicable to the subdivision area on which the analysis is based.

Table 8-5 below outlines indicative probability parameters adopted for the assessment for the site in its existing condition without considering remediation measures.

Table 8-5 Risk Assessment Adopted Parameters for the site in Existing Condition

Hazard	Estimated Approximate Annual Probability (P_h)
Overland flow paths eroding rock seams causing block failure.	10^{-2}
Creep of Surficial Soils (colluvium deposits).	10^{-3}
Root Jacking of rock joints causing isolated falls.	10^{-3}
Concentrated overland flows causing erosion along slopes.	10^{-2}
Global stability failure due to underlying geological units.	10^{-5}

8.4 Risk Assessment

8.4.1 Risk Acceptance Criteria

An acceptable risk is a risk for which for the purpose of life or work we are prepared to accept as it is with no regard to its management. Society does not generally consider expenditure in further reducing such risks justifiable [21].

A tolerable risk is a risk within a range that society can live with so as to secure certain net benefits. It is a range of risk regarded as non-negligible and needing to be kept under review and reduced further if possible [21].

The regulator is the appropriate authority to set the standards for tolerable risk which may relate not only to perceived safety in relation to other risks, but also to government policy [21]. Implementation of a tolerable risk level has implications for the community at large, both in terms of relative risks or safety, but also in terms of economic impact.

AGS [21] suggests that a risk of 'very low' or 'low' is an appropriate acceptance criterion for tolerable risk for *developments* near or on existing slopes. Regulators usually adopt this risk level as the measure to gauge risk for existing developments.

When considering risk, it should be noted that:

- Estimations of risk are approximate and the acceptance criteria / tolerable risk level should not be considered absolute values. Variations of up to one order of magnitude may be appropriate for the acceptance criteria for particular circumstances.
- Risk estimation is only one input into the decision process. Owners, society and regulators need to also consider political, social, and legal issues in their assessments and may consult the public affected by the hazard.
- The risk can change with time because of natural processes and development, e.g. removal of vegetation by fire or other natural process, **or new construction/development**.
- It is ultimately up to Council to set its standard for tolerable risk criteria for loss to property. For assessment of risk to property, AGS suggests that a qualitative risk level of 'Low' or 'Very Low' is an appropriate acceptance criteria [21].

8.4.2 Slope Risk Assessment

The table shown below presents the risk based on the AGS 2007 guidelines for landslide risk. The risk to loss of property is predominately a desktop assessment, with limited inspection and risk assessment primarily based on available information and existing site conditions.

Risk assessment has been provided based on current site conditions and has been performed as generalised across the site based on worst case or with reference to the element most at risk i.e. closest proposed building envelope etc.

Table 8-6 Slope stability risk assessment

Risk	Risk to Property
Overland flow paths eroding rock seams causing block failure.	Moderate
Creep of Surficial Soils (colluvium deposits).	Moderate
Root Jacking of rock joints causing isolated falls.	Moderate
Concentrated overland flows causing erosion along slopes.	Moderate
Global stability failure due to underlying geological units.	Moderate

Commentary regarding possible slope stability risks and remediation measures are presented below.

8.5 Slope Stability Controls and Residual Risk

Based on the above risk assessment, remediation recommendations that should be implemented to prevent destabilisation along the eastern border of the site are presented in Table 8-7, along with residual risk to the site following implementation.

Table 8-7 Slope stability controls and residual risk.

Risk	Controls	Risk to Property
Overland flow paths eroding rock seams causing block failure.	▪ Maintain 10 m offset to vertical rockface for proposed infrastructure. ▪ Minimise disturbance of mature vegetation is proposed along the eastern boundary of the site. ▪ No concentrated stormwater discharge is to be directed to the eastern slope.	Low
Creep of Surficial Soils (colluvium deposits).	▪ Minimise disturbance of mature vegetation is proposed along the eastern boundary of the site. ▪ Colluvial soils are proposed to be removed based on bulk earthworks plans. This may require additional stripping during bulk earthworks in areas of filling or reduced cut. ▪ No concentrated stormwater discharge is to be directed to the eastern slope.	Low
Root Jacking of rock joints causing isolated falls.	▪ Maintain 10 m offset to vertical rockface for proposed infrastructure. ▪ Relatively minor isolated falls.	Low
Concentrated overland flows causing erosion along slopes.	▪ Minimise disturbance of mature vegetation is proposed along the eastern boundary of the site. ▪ No concentrated stormwater discharge is to be directed to the eastern slope.	Low
Global stability failure due to underlying geological units.	▪ Maintain 10 m offset to vertical rockface for proposed infrastructure. ▪ No observations of deep seeded instability have been observed onsite.	Low

Areas identified as having potential slope stability risks are predominately situated along the eastern boundary of the site within the riparian corridor upslope of Wallis Creek. Supplied bulk earthworks plans [2] indicate extensive cuts in the order of 5m are proposed to the broad crested ridgeline to accommodate the north-south trending road alignment.

Given the proposed earthworks, the extent of development, offset of the vertical slope to the proposed infrastructure, and distance from the riparian corridor, where the above controls are implemented for the proposed development, the development would be considered low risk with regards to slope stability.

Consideration of the Australian Geoguide (LR8) Hillside Construction Practice document should also be made for the development (attached to this report as Appendix D).

9 Limitations

Stantec has performed investigation and consulting services for this project in general accordance with current professional and industry standards. The extent of testing was limited to discrete test locations and variations in ground conditions can occur between test locations that cannot be inferred or predicted.

A geotechnical consultant or qualified engineer shall provide inspections during construction to confirm assumed conditions in this assessment. If subsurface conditions encountered during construction differ from those given in this report, further advice shall be sought without delay.

Stantec, or any other reputable consultant, cannot provide unqualified warranties nor does it assume any liability for the site conditions not observed or accessible during the investigations. Site conditions may also change subsequent to the investigations and assessment due to ongoing use.

This report and associated documentation was undertaken for the specific purpose described in the report and shall not be relied on for other purposes. This report was prepared solely for the use by Walker Gillieston Heights Pty Ltd and any reliance assumed by other parties on this report shall be at such parties own risk.

10 References

[1] Enspire Solutions Pty Ltd, “South Gillieston Heights - Civil Engineering Works - Development Application,” 19/05/2023.

[2] Enspire Solutions Pty Ltd, “Preliminary Cut Fill Plan- (210039-DA-C04.01, revision 2),” 19 May 2023.

[3] Douglas Partners Pty Ltd, “Report on Preliminary Site Investigation and Detailed Site Investigation (Contamination) - 204921.00,” 20/05/2022.

[4] Cardno Geotech Solutions (CGS) Pty Ltd, “Report on Flexible Pavement Design Stage 10-12 Wallis Creek - CGS3274-002.1,” March 2018.

[5] Cardno Geotech Solutions (CGS) Pty Ltd, “Letter Report on Geotechnical Investigation – Gillieston Heights Subdivision Stage 10-12 - CGS3240,” January 2017.

[6] Cardno Geotech Solutions (CGS) Pty Ltd, “Report on Preliminary Geotechnical Investigation, Proposed Wallis Creek Subdivision, Stages 3-9, Cessnock Road, Gillieston Heights - CGS1399-004.1,” October 2012.

[7] Cardno (NSW/ACT) Pty Ltd, “Report on Geotechnical Investigation, Stage 13 & 14 Wallis Creek, Gillieston Heights - 81021073-001.2,” April 2021 .

[8] NSW Department of Planning, Industry & Environment, “MinView,” 2019. [Online]. Available: https://minview.geoscience.nsw.gov.au/. [Accessed August 2020].

[9] NSW office of Environment and Heritage, “eSPADE v2.1,” 2016.

[10] ASSMAC, “Acid Sulfate Soil Manual, New South Wales,” Acid Sulfate Soil Management Advisory Committee, August 1998.

[11] State of NSW and Department of Planning, Industry & Environment 2022, “eSPADE,” 2022.

[12] Department of Land and Water Conservation, Site Investigations for Urban Salinity, Sydney, 2002.

[13] Australian Standard AS3798-2007, “Guidelines on Earthworks for Commercial and Residential Structures,” Standards Australia, 2007.

[14] Austroads AGPT02-17, “Guide to Pavement Technology Part 2: Pavement Structural Design,” Austroads Ltd, 2017.

[15] Maitland City Council, “Manual of Engineering Standards: Chapter 5 - Pavement Design,” Maitland City Council, 2014.

[16] Maitland City Council, “Manual of Engineering Standards; Chatper 4 - Road Design,” Maitland City Council, 2014.

[17] Maitland City Council, “Manual of Engineering Standards - Construction: Roads, Drainage, Concrete,” 2014.

[18] RMS QA Specification 3051 (Ed 6 Rev 2), “Granular Base and Subbase Materials for Surfaced Road Pavements,” Roads and Maritime Services, April 2011.

[19] RMS QA Specification R116 (Ed 8 Rev 2), “Heavy Duty Dense Graded Asphalt,” Roads and Maritime Services, January 2012.

[20] Austroads AGPT04B-07, Guide to Pavement Technology Part 4B: Asphalt, Austroads Ltd, May 2007.

[21] AGS Landslide Taskforce, “Practice Note Guidelines for Landslide Risk Management 2007c,” *Journal and News of the Austrailian Geomechsanics Society,* vol. 42, no. 1, pp. 63-114, 2007c.

APPENDIX

A

FIGURES

Cardno

now

Stantec

DATE PLOTTED: 14 June 2023 12:03 PM BY: : JACK HANLON

NOTES:

Image underlay adapted from nearmaps aerial imagery.

LEGEND:

- Development Footprint
- Site Boundary
- TPXXX — 501-527 Cessnock Road: Approximate test pit locations and numbers.
- TP1 XX — 457-463 Cessnock Road: Approximate test pit locations and numbers.
- Approximate Areas of Softened Zones
- Approximate Areas of Farm Dams

NORTH

TP101, TP102, TP104, TP027, TP028, TP103, TP011, TP106, TP112, TP105, TP107, TP026, TP108, TP111, TP110, TP109, TP024, TP010, TP009, TP025, TP007, TP008, TP023, TP022, TP006, TP021, TP005, TP019, TP018, TP003, TP004, TP001, TP017, TP002, TP020, TP016, TP012, TP013, TP015, TP014

Evidence of Disturbed Ground

DCP01, DCP02, DCP03

Outcropping rock along break in grade (Pebbly Sandstone)

Uncontrolled Fill berm

Evidence of Disturbed Ground

Access track comprising uncontrolled filling materials

Uncontrolled Fill Berm

Driveways comprising imported fill materials

Driveways comprising imported fill materials

Existing gully line containing waste materials

ESA1

Possible private drainage service

Driveways comprising imported fill materials

Outcropping rock (Pebbly Sandstone)

Uncontrolled fill associated with former dairy farming

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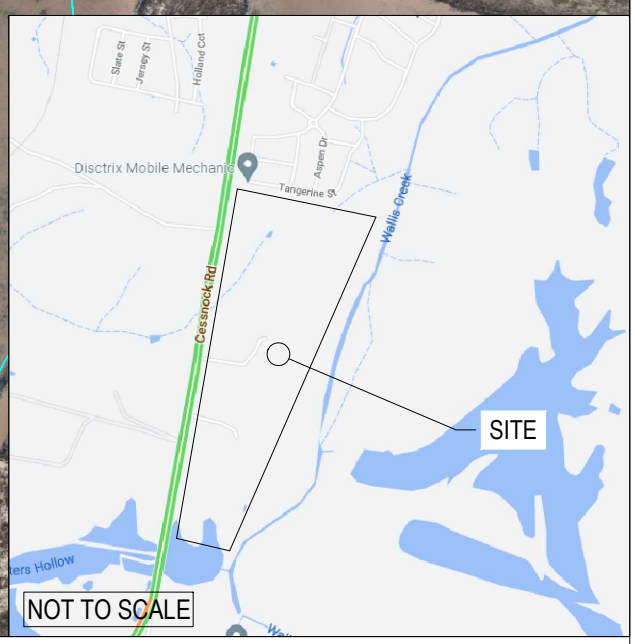

NOT TO SCALE

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Drawn JH	Date 14/06/2023	Client	Walker Gillieston Heights Pty Ltd
Checked KS	Date 14/06/2023	Project	457-527 CESSNOCK ROAD, GILLIESTON HEIGHTS GEOTECHNICAL INVESTIGATION
Designed	Date	Title	SITE PLAN GEOTECHNICAL TESTING LOCATIONS AND SITE OBSERVATIONS
Verified	Date		
Approved			

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
304100964	1:3000m	A3

Figure Number	Revision
F1	2

XREFs:
CAD File: N:\Projects\810\FY23 - 304100964_South Gillieston Heights GIS\Drawing\South Gillo Site Plan (JH).dwg

NOTES:

Image underlay adapted from nearmaps aerial imagery.

LEGEND:

Development Footprint

Site Boundary

TPXXX — 501-527 Cessnock Road: Approximate test pit locations and numbers.

TP1 XX — 457-463 Cessnock Road: Approximate test pit locations and numbers.

NORTH

TP101 TP102 TP104 TP027 TP028 TP103 TP011 TP106 TP112 TP105 DCP01 DCP02 DCP03 TP107 TP026 TP108 TP111 TP110 TP109 TP024 TP010 TP009 TP025 TP007 TP008 TP023 TP006 TP022 TP021 TP005 TP019 TP018 TP003 TP004 TP001 TP017 TP002 ESA1 TP020 TP016 TP012 TP013 TP015 TP014

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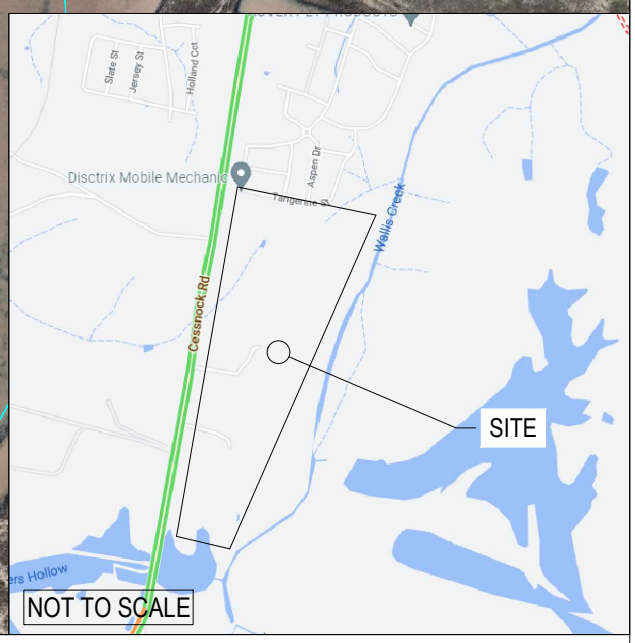

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Drawn JH	Date 14/06/2023	Client	Walker Gillieston Heights Pty Ltd
Checked KS	Date 14/06/2023	Project	457-527 CESSNOCK ROAD, GILLIESTON HEIGHTS GEOTECHNICAL INVESTIGATION
Designed	Date	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES
Verified	Date	Project Number	Scale 1:3000m / Size A3
Approved		Figure Number	F2 / Revision 2
		Title	SITE PLAN GEOTECHNICAL TESTING LOCATIONS WITH LOT LAYOUT

DATE PLOTTED: 14 June 2023 12:06 PM BY: : JACK HANLON

XREFs:
CAD File: N:\Projects\810\FY23 - 3041\00964_South Gillieston Heights GIDrawing\South Gillo Site Plan (JH).dwg

NOTES:

Image underlay adapted from nearmaps aerial imagery.
Cut Fill Plan prepared by Inspire Solutions Pty Ltd. (Ref no. 210039-DA-C04.01, dated 09/06/2023, revision 2)

LEGEND:

TPXXX 501-527 Cessnock Road: Approximate test pit locations and numbers.

TP1 XX 457-463 Cessnock Road: Approximate test pit locations and numbers.

NORTH

TP101 TP102 TP104 TP027 TP028 TP103 TP011 TP106 TP112 TP105 TP107 TP026 TP108 TP111 TP110 TP109 TP024 TP010 TP009 TP025 TP007 TP008 TP023 TP006 TP022 TP021 TP005 TP019 TP018 TP003 TP004 TP001 TP017 TP002 TP020 TP016 TP012 TP013 TP015 TP014

LEGEND

- GREATER THAN 7.0m CUT
- 6.0m TO 7.0m CUT
- 5.0m TO 6.0m CUT
- 4.0m TO 5.0m CUT
- 3.0m TO 4.0m CUT
- 2.0m TO 3.0m CUT
- 1.0m TO 2.0m CUT
- 0.0m TO 1.0m CUT
- 0.0m TO 1.0m FILL
- 1.0m TO 2.0m FILL
- 2.0m TO 3.0m FILL
- 3.0m TO 4.0m FILL
- 4.0m TO 5.0m FILL
- GREATER THAN 5.0m FILL

NOTES

1. REFER SPECIFICATION NOTES FOR EARTHWORKS GENERAL REQUIREMENTS.
2. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH COUNCIL/RELEVANT AUTHORITY SPECIFICATIONS AND DETAILS.
3. NO ALLOWANCE HAS BEEN MADE FOR BULKING FACTORS.
4. NO ALLOWANCE HAS BEEN MADE FOR DETAILED EARTHWORKS. Ie SERVICE TRENCHING, DETAILED EXCAVATION AND THE LIKE.
5. ESTIMATED EARTHWORKS VOLUMES REPRESENT ANALYSIS BETWEEN EXISTING SURFACE STRIPPED 150mm TO BULK EARTHWORKS DESIGN LEVEL. BULK EARTHWORKS LEVELS INCLUDES ROAD BOXING AND ALLOWS FOR 150mm FUTURE PLACEMENT OF TOPSOIL ON LOTS AND ROAD LEVELS.
6. APPROXIMATE BULK EARTHWORKS VALUES AS FOLLOWS;
   - 6.1 CUT 282,049 m³
   - 6.2 FILL 261,451 m³
   - 6.3 BALANCE 20,598 m³ (EXPORT)

Disctrix Mobile Mechanic, Tangerine St, Aspen Dr, Slate St, Jersey St, Holland Cct, Wallis Creek, Cessnock Rd, SITE

NOT TO SCALE

0 50 100m

SCALE 1:3000 @A3

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Drawn JH	Date 14/06/2023	
Checked KS	Date 14/06/2023	
Designed	Date	
Verified	Date	
Approved		

Client: Walker Gillieston Heights Pty Ltd

Project: 457-527 CESSNOCK ROAD, GILLIESTON HEIGHTS
GEOTECHNICAL INVESTIGATION

Title: SITE PLAN
GEOTECHNICAL TESTING LOCATIONS
WITH CUT FILL PLAN

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
304100964	1:3000m	A3

Figure Number	Revision
F3	2

DATE PLOTTED: 14 June 2023 1:01 PM BY: - JACK HANLON

XREFs:
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DATE PLOTTED: 14 June 2023 12:09 PM BY: : JACK HANLON

NOTES:

Image underlay adapted from nearmaps aerial imagery.

LEGEND:

Development Footprint

Site Boundary

NORTH

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0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 252

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320

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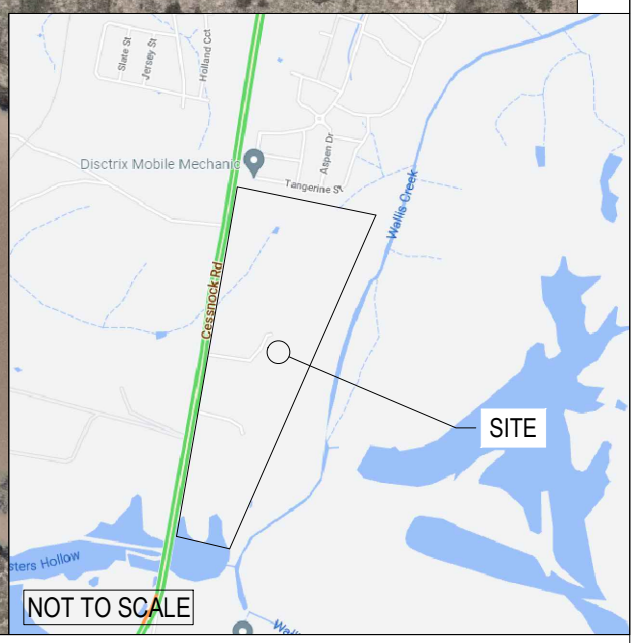

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Drawn JH	Date 14/06/2023	
Checked KS	Date 14/06/2023	
Designed	Date	
Verified	Date	
Approved		

Client: Walker Gillieston Heights Pty Ltd

Project: 457-527 CESSNOCK ROAD, GILLIESTON HEIGHTS
GEOTECHNICAL INVESTIGATION

Title: SECTION LAYOUT

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

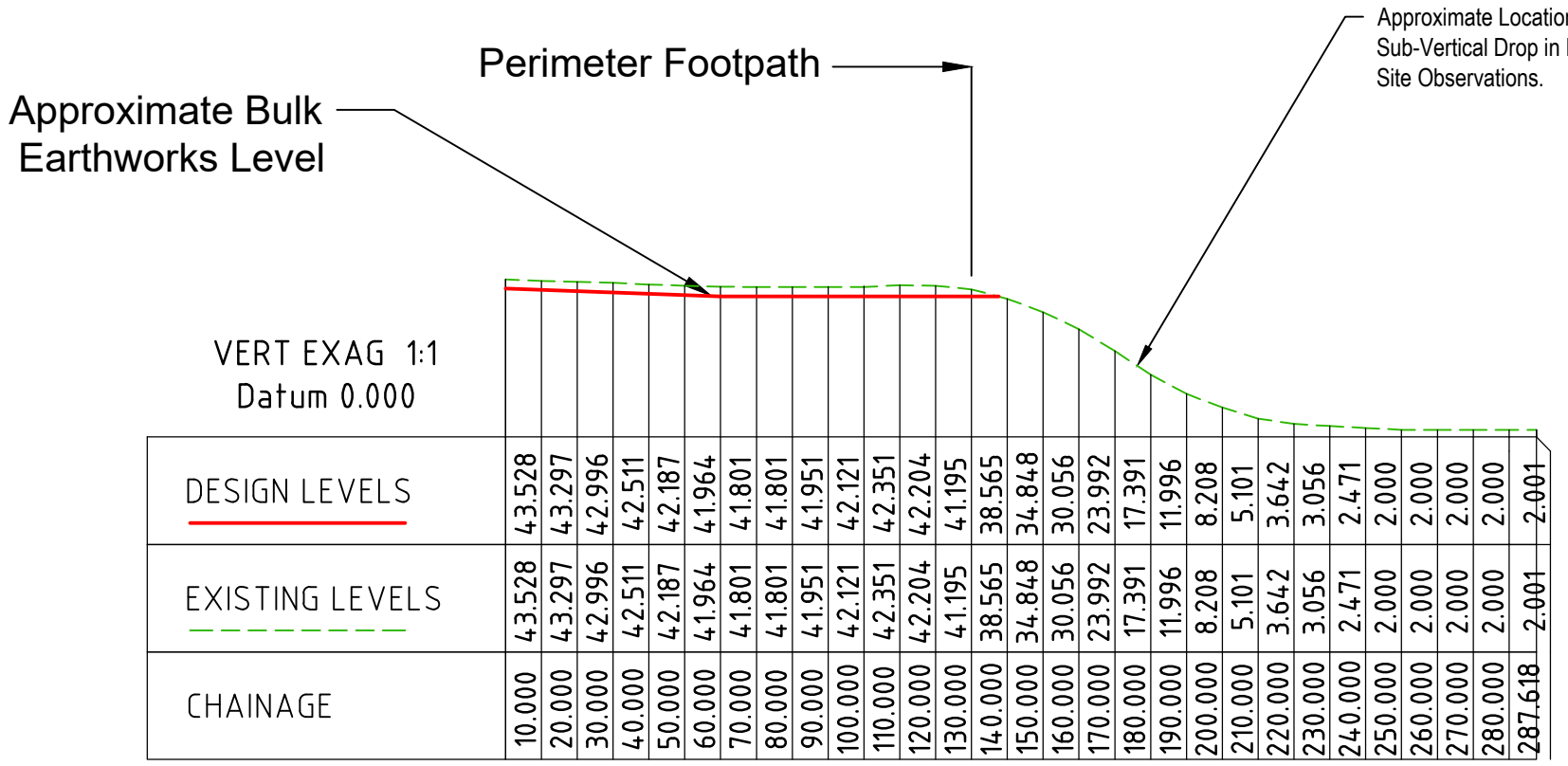
Project Number	Scale	Size
304100964	1:3000m	A3

Figure Number: F4

Revision: 2

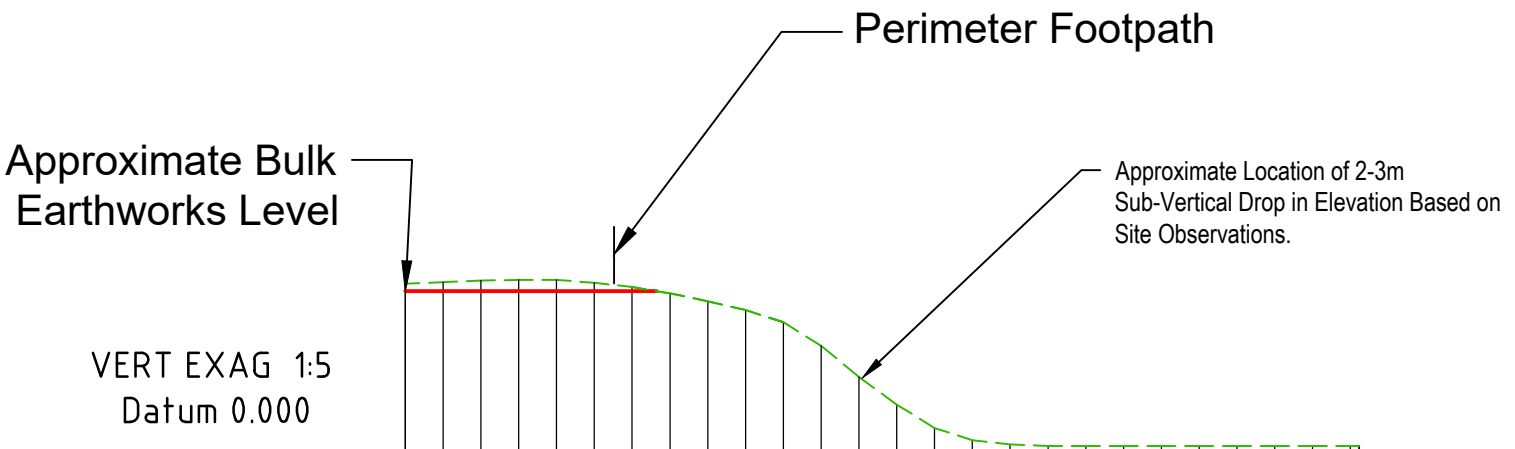
XREFs:
CAD File: N:\Projects\810\FY23 - 304100964_South Gillieston Heights GIDrawing\South Gillo Site Plan (JH).dwg

NOTES:
Sections cut from LiDAR dated 2019. Given limitation of LiDAR due to dense tree coverage on eastern boundary of site, sub-vertical elevation changes have been inferred from site observations and denoted on sections below.



DESIGN LEVELS	43.528	43.297	42.996	42.511	42.187	41.964	41.801	41.801	41.951	42.121	42.351	42.204	41.195	38.565	34.848	30.056	23.992	17.391	11.996	8.208	5.101	3.642	3.056	2.471	2.000	2.000	2.000	2.000	2.000	2.001
EXISTING LEVELS	43.528	43.297	42.996	42.511	42.187	41.964	41.801	41.801	41.951	42.121	42.351	42.204	41.195	38.565	34.848	30.056	23.992	17.391	11.996	8.208	5.101	3.642	3.056	2.471	2.000	2.000	2.000	2.000	2.000	2.001
CHAINAGE	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	280.000	287.618	

SECTION 1 LONG SECTION



DESIGN LEVELS	45.342	45.827	46.000	46.000	45.190	44.107	42.393	40.321	38.002	34.763	28.503	20.297	12.986	6.770	3.556	2.455	2.000	2.000	2.000	2.000	2.000	2.000	2.004	2.007	2.010	2.011
EXISTING LEVELS	45.342	45.827	46.000	46.000	45.190	44.107	42.393	40.321	38.002	34.763	28.503	20.297	12.986	6.770	3.556	2.455	2.000	2.000	2.000	2.000	2.000	2.000	2.004	2.007	2.010	2.011
CHAINAGE	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	252.360

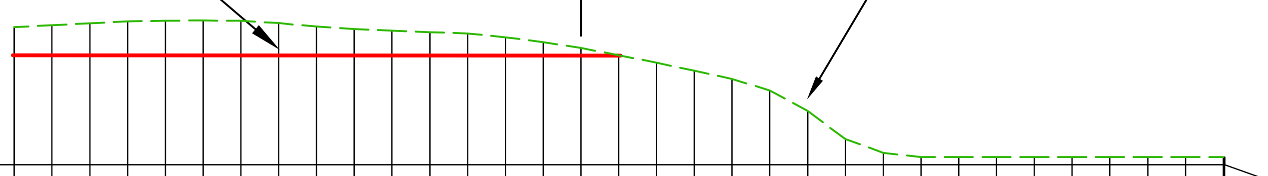
SECTION 2 LONG SECTION

0 50m
SCALE 1:2000 @A3

Stantec
Stantec Australia Pty Ltd | ABN 17 007 820 322
Level 2 Suite 202, 22 Honeysuckle Drive
Newcastle, NSW 2300
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.stantec.com

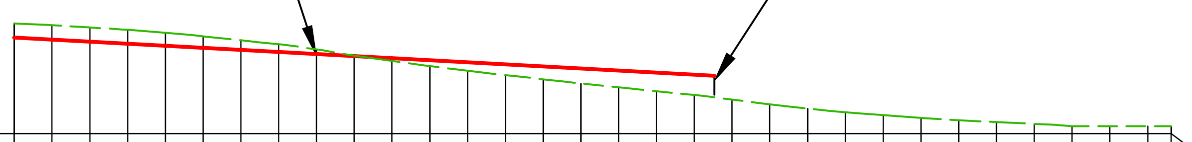
Drawn JH	Date 14/06/2023	Client	Walker Gillieston Heights Pty Ltd
Checked KS	Date 14/06/2023	Project	457-527 CESSNOCK ROAD, GILLIESTON HEIGHTS GEOTECHNICAL INVESTIGATION
Designed	Date	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES
Verified	Date	Title	CROSS SECTIONS 1 & 2
Approved		Project Number	304100964
		Scale	1:2000m
		Size	A3
		Figure Number	F5
		Revision	2

NOTES:
Sections cut from LiDAR dated 2019. Given limitation of LiDAR due to dense tree coverage on eastern boundary of site, sub-vertical elevation changes have been inferred from site observations and denoted on sections below.



CHAINAGE	DESIGN LEVELS	EXISTING LEVELS
10.000	36.919	36.919
20.000	37.427	37.427
30.000	37.939	37.939
40.000	38.119	38.119
50.000	38.172	38.172
60.000	38.067	38.067
70.000	37.474	37.474
80.000	36.546	36.546
90.000	35.915	35.915
100.000	35.474	35.474
110.000	35.094	35.094
120.000	34.530	34.530
130.000	33.705	33.705
140.000	32.454	32.454
150.000	30.892	30.892
160.000	28.998	28.998
170.000	26.974	26.974
180.000	24.889	24.889
190.000	22.678	22.678
200.000	19.650	19.650
210.000	14.256	14.256
220.000	6.789	6.789
230.000	3.141	3.141
240.000	2.000	2.000
250.000	2.000	2.000
260.000	2.000	2.000
270.000	2.000	2.000
280.000	2.000	2.000
290.000	2.000	2.000
300.000	2.000	2.000
310.000	2.000	2.000
320.000	2.000	2.000
320.371	2.000	2.000

SECTION 3 LONG SECTION



CHAINAGE	DESIGN LEVELS	EXISTING LEVELS
10.000	28.565	28.565
20.000	27.970	27.970
30.000	27.372	27.372
40.000	26.601	26.601
50.000	25.638	25.638
60.000	24.592	24.592
70.000	23.602	23.602
80.000	22.204	22.204
90.000	20.535	20.535
100.000	19.162	19.162
110.000	17.834	17.834
120.000	16.583	16.583
130.000	15.433	15.433
140.000	14.333	14.333
150.000	13.258	13.258
160.000	12.194	12.194
170.000	11.185	11.185
180.000	10.189	10.189
190.000	8.991	8.991
200.000	7.749	7.749
210.000	6.609	6.609
220.000	5.631	5.631
230.000	4.855	4.855
240.000	4.147	4.147
250.000	3.552	3.552
260.000	3.073	3.073
270.000	2.575	2.575
280.000	2.000	2.000
290.000	2.000	2.000
300.000	2.000	2.000
306.247	2.000	2.000

SECTION 4 LONG SECTION

0 50m
SCALE 1:2000 @A3

Stantec
Stantec Australia Pty Ltd | ABN 17 007 820 322
Level 2 Suite 202, 22 Honeysuckle Drive
Newcastle, NSW 2300
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.stantec.com

Drawn JH	Date 14/06/2023	
Checked KS	Date 14/06/2023	
Designed	Date	
Verified	Date	
Approved		

Client: Walker Gillieston Heights Pty Ltd
Project: 457-527 CESSNOCK ROAD, GILLIESTON HEIGHTS GEOTECHNICAL INVESTIGATION
Title: CROSS SECTIONS 3 & 4
Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES
Project Number: 304100964
Scale: 1:2000m
Size: A3
Figure Number: F6
Revision: 2

DATE PLOTTED: 14 June 2023 12:12 PM BY : JACK HANLON
CAD File: N:\Projects\810\FY23 - 304100964_South Gillieston Heights GI\Drawing\South Gillo Site Plan (JH).dwg
XREF's:

APPENDIX

B

ENGINEERING LOGS

Cardno

now

Stantec

Explanatory Notes

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. Material descriptions are deduced from field observation or engineering examination, and may be appended or confirmed by in situ or laboratory testing. The information is dependent on the scope of investigation, the extent of sampling and testing, and the inherent variability of the conditions encountered.

Subsurface investigation may be conducted by one or a combination of the following methods.

Method	
Test Pitting: excavation/trench	
BH	Backhoe bucket
EX	Excavator bucket
R	Ripper
H	Hydraulic Hammer
X	Existing excavation
N	Natural exposure
Manual drilling: hand operated tools	
HA	Hand Auger
Continuous sample drilling	
PT	Push tube
PS	Percussion sampling
SON	Sonic drilling
Hammer drilling	
AH	Air hammer
AT	Air track
Spiral flight auger drilling	
AS	Auger screwing
AD/V	Continuous flight auger: V-bit
AD/T	Continuous spiral flight auger: TC-Bit
HFA	Continuous hollow flight auger
Rotary non-core drilling	
WB	Washbore drilling
RR	Rock roller
Rotary core drilling	
PQ	85mm core (wire line core barrel)
HQ	63.5mm core (wire line core barrel)
NMLC	51.94mm core (conventional core barrel)
NQ	47.6mm core (wire line core barrel)
DT	Diatube (concrete coring)

Sampling is conducted to facilitate further assessment of selected materials encountered.

Sampling method	
Soil sampling	
B	Bulk disturbed sample
D	Disturbed sample
C	Core sample
ES	Environmental soil sample
SPT	Standard Penetration Test sample
U	Thin wall tube ‘undisturbed’ sample
Water sampling	
WS	Environmental water sample

Field testing may be conducted as a means of assessment of the in situ conditions of materials.

Field testing	
SPT	Standard Penetration Test
HP/PP	Hand/Pocket Penetrometer
Dynamic Penetrometers (blows per noted increment)	
DCP	Dynamic Cone Penetrometer
PSP	Perth Sand Penetrometer
MC	Moisture Content
VS	Vane Shear
PBT	Plate Bearing Test
IMP	Borehole Impression Test
PID	Photo Ionization Detector

If encountered, refusal (R), virtual refusal (VR) or hammer bouncing (HB) of penetrometers may be noted.

The quality of the rock can be assessed by the degree of natural defects/fractures and the following.

Rock quality description	
TCR	Total Core Recovery (%) (length of core recovered divided by the length of core run)
RQD	Rock Quality Designation (%) (sum of axial lengths of core greater than 100mm long divided by the length of core run)

Notes on groundwater conditions encountered may include.

Groundwater	
Not Encountered	Excavation is dry in the short term
Not Observed	Water level observation not possible
Seepage	Water seeping into hole
Inflow	Water flowing/flooding into hole

Perched groundwater may result in a misleading indication of the depth to the true water table. Groundwater levels are also likely to fluctuate with variations in climatic and site conditions.

Notes on the stability of excavations may include.

Excavation conditions	
Stable	No obvious/gross short term instability noted
Spalling	Material falling into excavation (minor/major)
Unstable	Collapse of the majority, or one or more face of the excavation

Explanatory Notes: General Soil Description

The methods of description and classification of soils used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. In practice, a material is described as a soil if it can be remoulded by hand in its field condition or in water. The dominant component is shown in upper case, with secondary components in lower case. In general descriptions cover: soil type, plasticity or particle size/shape, colour, strength or density, moisture and inclusions.

In general, soil types are classified according to the dominant particle on the basis of the following particle sizes.

Soil Classification		Particle Size (mm)
CLAY		< 0.002
SILT		0.002 0.075
SAND	fine	0.075 to 0.21
	medium	0.21 to 0.6
	coarse	0.6 to 2.36
GRAVEL	fine	2.36 to 6.7
	medium	6.7 to 19
	coarse	19 to 63
COBBLES		63 to 200
BOULDERS		> 200

Soil types may be qualified by the presence of minor components on the basis of field examination methods and/or the soil grading.

Terminology	In coarse grained soils		In fine soils
	% fines	% coarse	% coarse
Trace	≤5	≤15	≤15
With	>5, ≤12	>15, ≤30	>15, ≤30

The strength of cohesive soils is classified by engineering assessment or field/lab testing as follows.

Strength	Symbol	Undrained shear strength
Very Soft	VS	≤12kPa
Soft	S	12kPa to ≤25kPa
Firm	F	25kPa to ≤50kPa
Stiff	St	50kPa to ≤100kPa
Very Stiff	VSt	100kPa to ≤200kPa
Hard	H	>200kPa

Cohesionless soils are classified on the basis of relative density as follows.

Relative Density	Symbol	Density Index
Very Loose	VL	<15%
Loose	L	15% to ≤35%
Medium Dense	MD	35% to ≤65%
Dense	D	65% to ≤85%
Very Dense	VD	>85%

The plasticity of cohesive soils is defined by the Liquid Limit (LL) as follows.

Plasticity	Silt LL	Clay LL
Low plasticity	≤ 35%	≤ 35%
Medium plasticity	N/A	> 35% ≤ 50%
High plasticity	> 50%	> 50%

The moisture condition of soil (*w*) is described by appearance and feel and may be described in relation to the Plastic Limit (PL), Liquid Limit (LL) or Optimum Moisture Content (OMC).

Moisture condition and description	
Dry	Cohesive soils: hard, friable, dry of plastic limit. Granular soils: cohesionless and free-running
Moist	Cool feel and darkened colour: Cohesive soils can be moulded. Granular soils tend to cohere
Wet	Cool feel and darkened colour: Cohesive soils usually weakened and free water forms when handling. Granular soils tend to cohere

The structure of the soil may be described as follows.

Zoning	Description
Layer	Continuous across exposure or sample
Lens	Discontinuous layer (lenticular shape)
Pocket	Irregular inclusion of different material

The structure of soil layers may include: defects such as softened zones, fissures, cracks, joints and root-holes; and coarse grained soils may be described as strongly or weakly cemented.

The soil origin may also be noted if possible to deduce.

Soil origin and description	
Fill	Anthropogenic deposits or disturbed material
Topsoil	Zone of soil affected by roots and root fibres
Peat	Significantly organic soils
Colluvial	Transported down slopes by gravity/water
Aeolian	Transported and deposited by wind
Alluvial	Deposited by rivers
Estuarine	Deposited in coastal estuaries
Lacustrine	Deposited in freshwater lakes
Marine	Deposits in marine environments
Residual soil	Soil formed by in situ weathering of rock, with no structure/fabric of parent rock evident
Extremely weathered material	Formed by in situ weathering of geological formations, with the structure/fabric of parent rock intact but with soil strength properties

The origin of the soil generally cannot be deduced solely on the appearance of the material and the inference may be supplemented by further geological evidence or other field observation. Where there is doubt, the terms ‘possibly’ or ‘probably’ may be used

Explanatory Notes: General Rock Description

The methods of description and classification of rocks used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. In practice, if a material cannot be remoulded by hand in its field condition or in water, it is described as a rock. In general, descriptions cover: rock type, grain size, structure, colour, degree of weathering, strength, minor components or inclusions, and where applicable, the defect types, shape, roughness and coating/infill.

Rock types are generally described according to the predominant grain or crystal size, and in groups for each rock type as follows.

Rock type	Groups
Sedimentary	Deposited, carbonate (porous or non), volcanic ejection
Igneous	Felsic (much quartz, pale), Intermediate, or mafic (little quartz, dark)
Metamorphic	Foliated or non-foliated
Duricrust	Cementing minerology (iron oxides or hydroxides, silica, calcium carbonate, gypsum)

Reference should be made to AS1726 for details of the rock types and methods of classification.

The classification of rock weathering is described based on definitions in AS1726 and summarised as follows.

Term and symbol		Definition
Residual Soil	RS	Soil developed on rock with the mass structure and substance of the parent rock no longer evident
Extremely weathered	XW	Weathered to such an extent that the rock has 'soil-like' properties. Mass structure and substance still evident
Distinctly weathered	DW	The strength is usually changed and may be highly discoloured. Porosity may be increased by leaching, or decreased due to deposition in pores. May be distinguished into MW (Moderately Weathered) and HW (Highly Weathered).
Slightly weathered	SW	Slightly discoloured; little or no change of strength from fresh rock
Fresh Rock	FR	The rock shows no sign of decomposition or staining

The rock material strength can be defined based on the point load index as follows.

Term and symbol		Point Load Index I_s50 (MPa)
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1.0
High	H	1.0 to 3
Very High	VH	3 to 10
Extremely High	EH	> 10

It is important to note that the rock material strength as above is distinct from the rock mass strength which can be significantly weaker due to the effect of defects.

A preliminary assessment of rock strength may be made using the field guide detailed in AS1726, and this is conducted in the absence of point load testing.

The defect spacing measured normal to defects of the same set or bedding, is described as follows.

Definition	Defect Spacing (mm)
Thinly laminated	< 6
Laminated	6 to 20
Very thinly bedded	20 to 60
Thinly bedded	60 to 200
Medium bedded	200 to 600
Thickly bedded	600 to 2000
Very thickly bedded	> 2000

Terms for describing rock and defects are as follows.

Defect Terms			
Joint	JT	Sheared zone	SZ
Bedding Parting	BP	Seam	SM
Foliation	FL	Vein	VN
Cleavage	CL	Drill Lift	DL
Crushed Seam	CS	Handling Break	HB
Fracture Zone	FZ	Drilling Break	DB

The shape and roughness of defects in the rock mass are described using the following terms.

Planarity		Roughness	
Planar	PR	Very Rough	VR
Curved	CU	Rough	RF
Undulose	UN	Smooth	S
Irregular	IR	Slickensided	SL
Stepped	ST	Polished	POL
Discontinuous	DIS		

The coating or infill associated with defects in the rock mass are described as follows.

Infill and Coating		
Clean	CN	
Stained	SN	
Carbonaceous	X	
Minerals	MU	Unidentified mineral
	MS	Secondary mineral
	KT	Chlorite
	CA	Calcite
	Fe	Iron Oxide
	Qz	Quartz
Veneer	VNR	Thin or patchy coating
Coating	CT	Infill up to 1mm

Graphic Symbols Index

CLAY	SILT	SAND	GRAVEL
Silty CLAY	Clayey SILT	Clayey SAND	Clayey GRAVEL
Sandy CLAY	Sandy SILT	Silty SAND	Silty GRAVEL
Gravelly CLAY	Gravelly SILT	Gravelly SAND	Sandy GRAVEL
Silty Gravelly CLAY	Clayey Sandy SILT	Clayey Silty SAND	Clayey Silty GRAVEL
Silty Sandy CLAY	Clayey Gravelly SILT	Clayey Gravelly SAND	Clayey Sandy GRAVEL
Sandy Gravelly CLAY	Sandy Gravelly SILT	Silty Gravelly SAND	Silty Sandy GRAVEL

COBBLES & BOULDERS	Sedimentary rock: fine, mostly clay (CLAYSTONE)	Igneous rock: Felsic, fine (RHYOLITE)
PEAT, highly organic soil	Sedimentary rock: fine, mostly silt (SILTSTONE)	Igneous rock: Felsic, coarse (GRANITE)
TOPSOIL	Sedimentary rock: fine, silt and clay (MUDSTONE, SHALE, LAMINITE)	Igneous rock: Mafic, fine to medium (BASALT, DOLERITE)
FILL	Sedimentary rock: medium (SANDSTONE, GREYWACKE)	Igneous rock: Mafic, coarse (GABBRO)
FILL: Asphalt or Bituminous Seal	Sedimentary rock: fine to coarse, angular (BRECCIA)	Metamorphic rock: Foliated, fine to medium (SLATE, PHYLLITE, SHIST)
FILL: Ballast	Sedimentary rock: coarse, rounded (CONGLOMERATE)	Metamorphic rock: Foliated, coarse (GNEISS)
FILL: Concrete	Sedimentary rock: Organic (COAL)	Metamorphic rock: Non-foliated (QUARTZITE, HORNFELS, MARBLE)
FILL: Roadbase	Sedimentary rock: Carbonate (LIMESTONE, DOLOMITE)	
	Sedimentary rock: Volcanic (TUFF, VOLCANIC BRECCIA, AGGLOMERATE)	

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP001

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered	ES 0.05 - 0.10 m	1				TOPSOIL FILL: Clayey SILT, low plasticity, dark brown, trace rootlets	M (<PL)		FILL
				ES 0.10 - 0.20 m					0.15m			
					3				FILL: Clayey GRAVEL, fine to coarse, angular to sub angular, dark brown, trace rootlets	M		
				ES 0.25 - 0.35 m					0.25m			
					3				Silty CLAY, medium plasticity, dark red mottled orange and grey, trace rootlets, trace fine grained sand, trace fine angular to sub-rounded gravel			RESIDUAL SOIL
					4	0.5					St	
					6				As above, Orange mottled dark red	M (>PL)		
	F-H				13						H	
				ES 0.85 - 0.90 m	/50mm				0.85m			
						1.0			Clayey SAND/ Sandy CLAY, pale brown mottled orange, fine to medium grained SAND, low plasticity CLAY	D / M (<PL)	D	EXTREMELY WEATHERED
				ES 1.00 - 1.15 m					1.00m			
									Clayey SAND, fine to medium grained, pale brown with fine to coarse, angular to sub-angular parent rock fragments	D	D	
									1.20m			
	H			ES 1.25 - 1.30 m					SANDSTONE, fine to medium grained, brown mottled orange, low strength, highly weathered			WEATHERED ROCK
						1.5			1.50m			
									TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP002

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered	ES 0.05 - 0.10 m	1				FILL: Clayey SILT, dark brown, trace rootlets, trace plastic rope fragments	M (≈PL)		FILL
									0.20m			
				ES 0.20 - 0.30 m	5				Silty SAND, fine to medium grained, pale brown, trace fine to medium, rounded to sub-rounded gravel	M	MD	COLLUVIUM
									0.35m			
				B 0.40 - 0.60 m	5				Silty CLAY, medium plasticity, orange mottled dark red, trace fine to medium grained sand, trace rootlets	M (<PL)	VSt	RESIDUAL SOIL
					6	0.5						
	F-H				9							
					9							
					9	1.0			Clayey SAND, fine to coarse grained, orange mottled brown, with fine to coarse, angular to sub-angular sandstone gravels, trace cobble	D	D	EXTREMELY WEATHERED
					13				1.20m			
	H			ES 1.20 - 1.40 m	/25mm VR				SANDSTONE, fine to medium grained, mottled pale grey and brown			WEATHERED ROCK
									1.40m			
						1.5			TERMINATED AT 1.40 m Refusal on Weathered Rock			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP003

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket									FILL: Clayey SILT, dark brown, trace rootlets	M (≈PL)		FILL
									0.15m			
									Silty SAND, fine to medium grained, pale brown, with fine to medium sub-rounded gravel	M	L	COLLUVIUM
									0.30m			
	E								Silty CLAY, medium plasticity, mottled orange and dark red -brown, trace rootlets, trace fine grained sand	M (<PL)	St	RESIDUAL SOIL
		Stable	Not Encountered			0.5						
						1.0			Sandy CLAY, low plasticity, orange brown mottled red, fine to medium grained sand			EXTREMELY WEATHERED
	F-H								As above, Orange brown mottled pale grey	M (<PL)	VSt	
						1.5			1.60m			
					/125mm VR				TERMINATED AT 1.60 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP004

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered	ES 0.05 - 0.10 m	1				TOPSOIL: Silty SAND, fine to medium grained, dark brown, trace organics	D		TOPSOIL
	E-F				2				0.25m Silty SAND, fine to medium grained, pale brown, with fine to medium sub-rounded gravel	M	MD	COLLUVIUM
				B 0.50 - 0.65 m	5	0.5			0.45m Silty Sandy CLAY, medium plasticity, brown mottled orange and grey, trace organics, fine to medium grained sand, trace medium to coarse sub-rounded gravel	M (≈PL)	St - VSt	RESIDUAL SOIL
					5				0.80m Sandy CLAY, low plasticity, orange brown mottled red, fine to medium grained sand	M (<PL)	H	EXTREMELY WEATHERED
	F				7				1.00m			
					14	1.0			SANDSTONE, medium to coarse grained, orange mottled brown and red, highly weathered, very low strength			WEATHERED ROCK
	H				/100mm VR				1.30m TERMINATED AT 1.30 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP005

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		2	0			TOPSOIL: Silty SAND, fine to medium grained, dark brown, trace organics	D		TOPSOIL
						0.10m			Sandy SILT, low plasticity, dark brown, fine grained sand, trace organics	M (<PL)	F	COLLUVIUM
				ES 0.20 - 0.40 m	1 4	0.20m			Sandy SILT, low plasticity, pale grey mottled pale brown	M (<PL)	St	
	F			ES 0.50 - 0.60 m	5 4	0.5 0.50m			Silty Sandy CLAY, medium plasticity, brown mottled red and pale grey, trace organics, fine to medium grained sand, trace medium to coarse sub-rounded gravel	M (>PL)	St / VSt	RESIDUAL SOIL
					9 /100mm VR	0.90m			Silty CLAY, low plasticity, orange mottled red and pale grey, trace medium to coarse sandstone fragments, trace sandstone cobble	M (<PL)	H	EXTREMELY WEATHERED
	F-H					1.0			As above, Lenses of Gravelly SAND (very low strength rock)			
	H			ES 1.40 - 1.50 m		1.50m			TERMINATED AT 1.50 m Target depth			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP006

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		1				TOPSOIL: Sandy SILT, low plasticity, brown, trace gravel	M (<PL)		TOPSOIL
									0.15m			
					2				Silty SAND, fine to medium grained, pale brown, with gravel	M (<PL)	L	COLLUVIUM
									0.30m			
	F				3				Silty CLAY, medium to high plasticity, mottled orange and dark red -brown, trace rootlets, trace fine grained sand			RESIDUAL SOIL
					5	0.5					St	
					5					M (>PL)		
	E-F				7							
					8	1.0					VSt	
					/50mm HB							
				B 1.10 - 1.40 m	7							
				ES 1.20 - 1.30 m								
	F											
									1.20m			
									Silty Sandy CLAY, low plasticity, orange brown, mottled red and pale grey, fine to medium grained sand	M (<PL)	H	EXTREMELY WEATHERED
									As above, Brown orange mottled pale grey			
									1.45m			
						1.5			SANDSTONE, fine to medium grained, brown mottled pale grey and orange, very low strength, highly weathered			WEATHERED ROCK
									1.60m			
									TERMINATED AT 1.60 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP007

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	F	Stable	Not Encountered	ES 0.05 - 0.10 m	2	0.0			TOPSOIL: Silty SAND, fine to medium grained, dark brown, trace organics, trace fine to medium, sub-rounded to rounded gravel	M		TOPSOIL
					2	0.20m			Silty SAND, fine to medium grained, brown mottled pale brown, with fine to coarse, sub-rounded to rounded gravel	M	L	COLLUVIUM
					2	0.35m			Silty CLAY, medium plasticity, mottled orange and dark red -brown, trace rootlets, trace fine grained sand	M (>PL)	F - St	RESIDUAL SOIL
				ES 0.65 - 0.80 m	4	0.5						
					5	0.70m			Silty Sandy CLAY, medium plasticity, mottled red orange and pale grey, fine to medium grained sand, trace medium to coarse rounded gravel	M (≈PL)	VSt	
					9	1.00m			Silty Clayey SAND, medium to coarse grained, brown-orange mottled pale grey and red	D	D - VD	EXTREMELY WEATHERED
					/25mm HB	1.0						
	H			ES 1.30 - 1.40 m		1.30m			SILTSTONE, grey mottled pale grey and purple, interbedded with SANDSTONE, fine to medium grained, brown mottled pale grey and orange, very low strength, highly weathered			WEATHERED ROCK
						1.40m			TERMINATED AT 1.40 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP008

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered	ES 0.10 - 0.25 m	2	0.0			TOPSOIL: Silty SAND, fine to medium grained, dark brown, trace organics, trace fine to medium, sub-rounded to rounded gravel	M		TOPSOIL
					1	0.20m			Sandy SILT, low plasticity, dark brown, fine to medium grained sand	M (<PL)	L	COLLUVIUM
	F				2				As above, Pale grey, trace rootlets			
						0.50m			Silty CLAY, medium plasticity, brown mottled grey and red, trace rootlets, trace fine to medium grained sand	M (>PL)	F	RESIDUAL SOIL
					3	0.5			As above, Red mottled pale grey and orange, with sand			
					4				As above, Grey mottled brown, trace sub-rounded cobble			
					3	0.90m			Clayey SAND, medium to coarse grained, orange brown mottled pale grey with fine to coarse angular sandstone fragments, with lenses of silty sandy CLAY	D	D	EXTREMELY WEATHERED
	H				/50mm HB	1.00m 1.0			SANDSTONE, medium to coarse grained, orange mottled brown, fine to medium, rounded to sub-rounded gravel clasts			WEATHERED ROCK
						1.10m			TERMINATED AT 1.10 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
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PBT - Plate Bearing Test
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PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
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St - Stiff
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H - Hard

RELATIVE DENSITY
VL - Very Loose
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MD - Medium Dense
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VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP009

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered	B 0.30 - 0.60 m	1 2 2 2 3 4 6 9 12	0.5 1.0 1.5			TOPSOIL: Silty SAND, fine to medium grained, dark brown, trace organics, trace fine to medium, sub-rounded to rounded gravel	M		TOPSOIL
									0.20m Silty CLAY, medium to high plasticity, brown mottled grey, trace fine to medium rounded gravel, trace fine grained sand, trace rootlets	M (>PL)	F	RESIDUAL SOIL
	F								As above, High plasticity, mottled pale grey and red			
									0.90m Silty CLAY, low to medium plasticity, mottled orange brown	M (≈PL)	St	EXTREMELY WEATHERED
									As above, Pale grey, mottled red orange, trace coarse angular sandstone fragments		VSt	
									1.50m TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP010

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		1	0.0			FILL: Silty SAND, fine to medium grained, dark brown trace gravel, trace organics, trace glass fragments	M		FILL
					1	0.15m			Sandy SILT, low plasticity, dark brown, fine to medium grained sand, trace organics	M (<PL)	S	COLLUVIUM
					4	0.35m			Silty CLAY, medium plasticity, mottled orange and dark red -brown, trace rootlets, trace fine grained sand			RESIDUAL SOIL
	F			B 0.60 - 0.80 m	4	0.5			As above, High plasticity, trace fine to medium, sub-rounded to sub-angular gravel	M (>PL)	St	
					4							
					3							
					4	1.0						
	F-H				11 /100mm HB	1.05m			Silty Sandy CLAY, low to medium plasticity, mottled pale grey orange and red, fine to medium grained sand	M (<PL)	VSt to H	EXTREMELY WEATHERED
	H					1.30m			SANDSTONE, medium to coarse grained, grey orange brown, fine to medium, rounded to sub-rounded gravel clasts			WEATHERED ROCK
						1.40m			TERMINATED AT 1.40 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP011

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 5/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered	ES 0.05 - 0.10 m	2				FILL: Silty clayey SAND, fine grained, brown orange	M		FILL
					2				0.10m Sandy SILT, low plasticity, dark brown, fine to medium grained sand, trace organics	M (<PL)	F	COLLUVIUM
					2				0.25m Silty CLAY, medium plasticity, brown orange mottled red , trace rootlets, with fine grained sand	M (>PL)	F to St	RESIDUAL SOIL
				ES 0.45 - 0.55 m	5	0.5			0.60m Silty Sandy CLAY, low to medium plasticity, mottled pale grey brown orange red, fine to medium grained sand, trace organics		VSt	EXTREMELY WEATHERED
				B 0.60 - 0.90 m	6							
					8					M (<PL)		
					17	1.0					H	
					21				1.25m Silty Clayey SAND, fine to medium grained sand, brown to orange mottled pale grey, with fine to coarse angular pebbly sandstone fragments	M	D - VD	
						1.5			1.50m TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Hole No: TP012

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		2	0.0			FILL: Silty SAND, fine to medium grained, dark brown, with lenses of clay, trace rootlets	M		FILL
					2	0.15m			FILL: Clayey Sandy SILT, low plasticity, brown to pale brown trace gravel, fine to coarse grained sand, trace medium sub-rounded gravel	M (<PL)		
					5	0.30m			Sandy CLAY, medium to high plasticity, mottled orange-brown and grey, fine to medium grained sand	M (>PL)	St	RESIDUAL SOIL
					4	0.45m			Silty CLAY, medium plasticity, orange mottled brown and red, with fine grained sand	M (≈PL)	St to VSt	
					4	0.5						
					7	0.90m			Clayey SAND, fine to medium grained, orange mottled pale grey, with medium to coarse, angular to sub-angular gravel	D	D	EXTREMELY WEATHERED
	F				8	1.0						
	H				/50mm HB	1.10m			SANDSTONE, fine to medium grained, orange mottled pale grey, highly weathered, very low strength			WEATHERED ROCK
						1.30m			TERMINATED AT 1.30 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

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TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP013

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		1 2 2 3 3 5	0.5			FILL: Silty CLAY, low to medium plasticity, dark brown, with fine to coarse angular to sub-angular gravel, trace rootlets, trace metal fragments	M (≈PL)		FILL
									0.25m Silty CLAY, medium to high plasticity, orange brown mottled grey, trace fine sub-rounded to angular gravel, trace rootlets	M (>PL)	St	RESIDUAL SOIL
	F								0.95m Sandy CLAY, low plasticity, pale orange mottled pale grey, fine to medium grained sand	M (<PL)	H	EXTREMELY WEATHERED
	H				14 /25mm HB 6	1.0			1.10m SANDSTONE, fine to medium grained, grey mottled red orange, fine to medium, rounded to sub-rounded gravel clasts			WEATHERED ROCK
						1.5			1.20m TERMINATED AT 1.20 m Refusal on Weathered Rock			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger: V-Bit
AD/T	Solid flight auger: TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy (No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard (Refusal)

WATER

Water Level on Date shown
water inflow
water outflow

FIELD TESTS

SPT	-	Standard Penetration Test
HP	-	Hand/Pocket Penetrometer
DCP	-	Dynamic Cone Penetrometer
PSP	-	Perth Sand Penetrometer
MC	-	Moisture Content
PBT	-	Plate Bearing Test
IMP	-	Borehole Impression Test
PID	-	Photoionisation Detector
VS	-	Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES

B	-	Bulk disturbed sample
D	-	Disturbed sample
ES	-	Environmental sample
U	-	Thin wall tube 'undisturbed'

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet
PL	-	Plastic limit
LL	-	Liquid limit
w	-	Moisture content

SOIL CONSISTENCY

VS	-	Very Soft
S	-	Soft
F	-	Firm
St	-	Stiff
VSt	-	Very Stiff
H	-	Hard

RELATIVE DENSITY

VL	-	Very Loose
L	-	Loose
MD	-	Medium Dense
D	-	Dense
VD	-	Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP014

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered	ES 0.05 - 0.10 m	2				FILL: Clayey Sandy SILT, low plasticity, dark brown, fine to medium grained sand, trace organics, trace fine to medium, sub-rounded to angular gravel	M (<PL)		FILL
				ES 0.25 - 0.35 m	1				0.25m FILL: Clayey GRAVEL, fine to coarse, sub-rounded to sub-angular, yellow brown	M - W		
					3				0.40m Silty CLAY, high plasticity, orange brown mottled grey, trace fine sub-rounded to angular gravel, trace rootlets			RESIDUAL SOIL
				ES 0.45 - 0.60 m	4	0.5						
				B 0.60 - 0.70 m	4					M (≈PL)	St to VSt	
	F				7							
				ES 0.90 - 1.00 m	14	1.0			1.00m		H	
				B 1.00 - 1.20 m	/100mm HB				Silty CLAY, medium to high plasticity, red mottled pale grey and orange, trace fine grained sand, trace rootlets			
				ES 1.10 - 1.20 m	15					M (<PL)	H	
	F-H								1.40m			
				ES 1.40 - 1.50 m					Silty CLAY, low to medium plasticity, pale grey mottled orange	M (<PL)	H	EXTREMELY WEATHERED
						1.5			1.50m TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP015

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		1 2	0			FILL: Sandy SILT, low plasticity, dark brown, with medium to coarse, angular to sub-angular gravel, trace rootlets	M (<PL)		FILL
					3 5	0.30m			Silty CLAY, medium to high plasticity, mottled dark red and grey, with fine to medium grained sand, trace rootlets	M (>PL)	St	RESIDUAL SOIL
	F				10	0.5					VSt	
					17	0.75m			Silty Sandy CLAY, medium plasticity, mottled pale grey and orange	M (<PL)	H	EXTREMELY WEATHERED
	F-H					1.0			As above, With medium to coarse angular sandstone fragments			
						1.5						
						1.60m			TERMINATED AT 1.60 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP016

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered	ES 0.30 - 0.40 m	0 2 6 4 9 16	0.5 1.0 1.5			FILL: Clayey Gravelly SILT, low plasticity, dark brown, fine to coarse angular to sub angular gravel	M (<PL)		FILL 0.00 m: Ponded water on surface
									0.25m FILL: Clayey Silty GRAVEL, fine to medium sub-rounded to angular, pale grey, trace organics	W		0.40 m: Water Seepage
									0.45m Silty CLAY, medium plasticity, mottled grey, dark red and orange, with fine to coarse sub-rounded to angular gravel, with fine grained sand, trace rootlets, trace sub-rounded cobbles	M (>PL)	St to VSt	RESIDUAL SOIL
									0.80m Silty CLAY, medium to high plasticity, mottled dark red and grey, with fine to medium grained sand, trace rootlets	M (<PL)	H	
	F								1.40m Silty Sandy CLAY/ Sandy Clayey SILT, low plasticity, red brown mottled grey, fine to medium grained sand	M (<PL)		EXTREMELY WEATHERED
									1.70m TERMINATED AT 1.70 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP017

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered		1, 3	0.5			FILL: Clayey SILT, low plasticity, dark brown, trace organics			FILL
									As above, With fine to coarse angular to sub-angular gravel, grey to brown	M (<PL)		
									0.35m			
	F				3, 4, 9				Silty CLAY, high plasticity, brown mottled grey and pale brown, trace fine grained sand, trace organics		St	RESIDUAL SOIL
									As above, Pale red mottled pale grey and brown orange, no organics	M (>PL)	VSt	
					15, 18 /100mm VR	1.0					H	
									1.10m			
	F-H								Silty CLAY, low to medium plasticity, mottled pale grey and orange brown, with medium to coarse angular to sub-angular fragments	M (<PL)	H	EXTREMELY WEATHERED
						1.5			1.50m			
									TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP018

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered		1 3				FILL: Silty CLAY, low plasticity, dark brown, with fine to coarse angular to sub-angular gravel, trace cobbles	M (<PL)		FILL
									0.25m			
				ES 0.30 - 0.60 m	4 5 6	0.5			Silty CLAY, high plasticity, brown mottled grey and pale brown, trace fine grained sand, trace organics	M (>PL)	St	RESIDUAL SOIL
	F								As above, Pale brown mottled orange		VSt	
									0.85m			
				ES 0.90 - 1.00 m	16 /50mm HB	1.0			Silty Gravelly CLAY, low plasticity, pale brown mottled grey, fine to medium angular to sub-angular gravel	M (<PL)	H	EXTREMELY WEATHERED
									1.20m			
				ES 1.20 - 1.30 m	11				SILTSTONE, grey to dark blue, very low strength, highly weathered			WEATHERED ROCK
	F-H											
						1.5			1.50m			
									TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP019

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered		1				FILL: Silty CLAY, low plasticity, dark brown, with fine to coarse angular to sub-angular gravel, trace cobbles	M (<PL)		FILL
									0.15m			
	E				2				Silty Clayey SAND, fine to medium grained, pale grey mottled brown, trace organics	M	L	COLLUVIUM
									0.30m			
	F				4				Silty CLAY, high plasticity, brown mottled grey and pale brown, trace fine grained sand, trace organics	M (>PL)	St	RESIDUAL SOIL
					4	0.5						
					4							
					5							
					6	1.0						
	F-H				9						VSt	
					/100mm VR							
					15							
	H								Silty Sandy CLAY, medium plasticity, mottled pale grey orange and brown, fine to medium grained sand	M (<PL)	H	EXTREMELY WEATHERED
						1.5			1.50m			
									TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP020

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered		1 2 3				FILL: Clayey SILT, low plasticity, dark brown, trace organics	M (<PL)		FILL
									0.30m FILL: Silty CLAY, medium to high plasticity, brown mottled orange and grey, trace rootlets	M (>PL)		
				ES 0.50 - 0.60 m	4 4	0.5			0.45m Silty CLAY, medium to high plasticity, orange brown mottled pale grey, with fine to medium angular to sub-angular gravel	M (>PL)	St	RESIDUAL SOIL
					6 6 6	1.0			As above, Pale grey mottled orange and brown		VSt	
					7 8				1.40m Silty CLAY, low plasticity, pale grey/ white, mottled orange	M (<PL)	VSt	EXTREMELY WEATHERED
						1.5			1.50m TERMINATED AT 1.50 m Target depth			
					13 13 13	2.0						
					14 15 15							
					/100mm VR							

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP021

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		2 3				FILL: Silty CLAY/ Clayey SILT, low plasticity, dark brown, trace organics	M (<PL)		FILL
									0.25m			
					2 3	0.5			Silty CLAY, high plasticity, brown mottled grey and pale brown, trace fine grained sand, trace organics		St	RESIDUAL SOIL
	F				3 4				As above, Mottled grey and pale red, no organics	M (>PL)		
					7	1.0					VSt to H	
					15							
					VR				1.20m			
	F-H								Silty CLAY, low to medium plasticity, red mottled pale grey	M (<PL)	H	EXTREMELY WEATHERED
						1.5			1.50m			
									TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP022

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		2 2				FILL: Clayey SILT, low plasticity, dark brown, trace organics, trace fine to medium, angular to sub-rounded gravel	M (<PL)		FILL
				ES 0.30 - 0.50 m	3				0.30m FILL: Sandy SILT, low plasticity, pale grey, mottled pale brown, trace organics	M (<PL)		
					5	0.5			0.50m Silty CLAY, high plasticity, grey mottled brown to light brown, trace organics, trace medium to coarse rounded gravel	M (>PL)	VSt	COLLUVIUM
				ES 0.60 - 0.80 m	7 9 11	1.0			1.05m Silty CLAY, high plasticity, mottled grey and dark red, trace fine grained sand	M (>PL)	H	RESIDUAL SOIL
	F			ES 1.20 - 1.40 m	VR 17	1.5			1.60m TERMINATED AT 1.60 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP023

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket					2				FILL: Silty CLAY, low to medium plasticity, dark brown with fine to coarse angular to sub-rounded gravel, trace organics	M (<PL)		FILL
									0.15m			
					3				CLAY, high plasticity, brown mottled grey and pale brown, trace fine grained sand, trace organics			RESIDUAL SOIL
					4						St	
						0.5						
				B 0.55 - 0.90 m	9				As above, Grey mottled dark red		VSt	
	F	Stable	Not Encountered		8					M (>PL)		
					13						H	
					14	1.0						
					/75mm VR							
									1.25m			
	F-H								Silty Sandy CLAY, low to medium plasticity, grey mottled dark red	M (<PL)	H	EXTREMELY WEATHERED
						1.5			1.50m			
									TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
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St - Stiff
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RELATIVE DENSITY
VL - Very Loose
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MD - Medium Dense
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Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP024

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		2				FILL: Clayey SILT, low plasticity, dark brown, trace organics, trace fine to coarse angular to sub-angular gravel	M (<PL)		FILL
	E			ES 0.20 - 0.40 m	3 5				0.20m Silty CLAY, medium to high plasticity, brown mottled grey and red, with fine to coarse angular to sub-rounded gravel, trace organics	M (>PL)	St	RESIDUAL SOIL
					6	0.5			0.45m Silty Gravelly CLAY, medium to high plasticity, red mottled grey, fine to coarse sub-rounded to rounded gravel, trace rootlets	M (>PL)	VSt	
	F				19				0.60m SILTSTONE, grey, dark blue mottled orange, very low strength		H	WEATHERED ROCK
	H				13				0.85m			
					/50mm VR	1.0			TERMINATED AT 0.85 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP025

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		2	0.0			TOPSOIL: Clayey SILT, low plasticity, brown orange	M (>PL)		TOPSOIL
	E				3 4	0.20m			Silty CLAY, medium to high plasticity, brown orange mottled grey, trace fine grained sand, trace rootlets		St	RESIDUAL SOIL
					9	0.5			As above, Orange mottled brown	M (>PL)	VSt	
	F				9 18	0.80m			Silty CLAY, low plasticity, brown orange mottled grey, with lenses of pale grey	M (<PL)	H	EXTREMELY WEATHERED
						1.0						
						1.30m			Clayey SAND, fine to medium grained, brown orange mottled grey, with fine to coarse angular to sub-angular gravel	D	VD	
						1.5			TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP026

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.3-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		1 2 2 4 5 19 VR	0.5 1.0 1.5			TOPSOIL: Clayey SILT, low plasticity, dark brown trace organics 0.15m	M (<PL)		TOPSOIL
									Clayey GRAVEL, fine to coarse angular to sub-rounded, pale brown mottled pale grey 0.30m	M - W	L	COLLUVIUM
	E								Silty CLAY, high plasticity, brown to orange mottled pale grey, trace fine grained sand, trace rootlets 0.80m	M (>PL)	St	RESIDUAL SOIL
	F								Silty Sandy CLAY, low plasticity, orange brown mottled pale grey, fine to coarse grained sand, with fine to medium, angular to sub-angular sandstone fragments 1.20m	M (<PL)	H	EXTREMELY WEATHERED
	H								SANDSTONE, fine to medium grained, grey mottled dark purple, very low strength, highly weathered 1.50m			WEATHERED ROCK
									TERMINATED AT 1.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP027

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket		Stable	Not Encountered		1 1 3 5 8 VR	0.5 1.0 1.5			TOPSOIL: Clayey SILT, low plasticity, brown	M (<PL)		TOPSOIL
									0.15m Clayey Sandy SILT, low plasticity, pale brown	M (<PL)	S	COLLUVIUM
	E								0.30m Silty CLAY, high plasticity, brown mottled grey and pale brown, trace fine grained sand, trace organics		St	RESIDUAL SOIL
									Pale brown mottled pale grey and orange	M (>PL)	VSt to H	
	F								1.15m Silty CLAY, low to medium plasticity, pale grey mottled orange and red	M (<PL)	H	EXTREMELY WEATHERED
									1.60m TERMINATED AT 1.60 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP028

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 12/10/22 **Logged By:** JH **Checked By:** KS

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
600mm toothed bucket	E	Stable	Not Encountered	ES 0.05 - 0.10 m	3	0.0			TOPSOIL: Sandy SILT, low plasticity, brown, fine to medium grained sand	M (<PL)		TOPSOIL
				ES 0.20 - 0.35 m	4				0.15m Silty CLAY, medium to high plasticity, brown to orange mottled grey and red, trace fine to medium grained sand, trace rootlets	M (>PL)	St	RESIDUAL SOIL
				B 0.30 - 0.45 m	6							
	F				12	0.5					H	
					/100mm VR				0.70m Clayey SAND, medium to coarse grained, brown to orange mottled pale grey, with fine to coarse angular sandstone fragments	D	VD	EXTREMELY WEATHERED
				ES 1.00 - 1.20 m		1.0						
	H								1.40m TERMINATED AT 1.40 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

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TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP101

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)	Depth (m)	Graphic Log	Classification	Material Description: SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX					2 2 5 13 HB	0.5			TOPSOIL: Sandy SILT: low plasticity, dark brown, with clay, trace fine rounded gravel, trace rootlets	M (<PL)		TOPSOIL
	E	Stable	Not Encountered						0.25m Clayey SILT: low plasticity, grey, with fine to medium rounded gravel, trace rootlets	M (<PL)		COLLUVIUM
									0.45m Silty CLAY: medium to high plasticity, red mottled grey and brown	M (>PL)	H	RESIDUAL SOIL
	F-H								0.65m Silty Sandy CLAY: medium plasticity, orange mottled pale grey	M (≈PL)	H	EXTREMELY WEATHERED
	H								0.80m SANDSTONE: fine to medium grained, grey, low strength, highly weathered			WEATHERED ROCK
						1.0			0.90m TERMINATED AT 0.90 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP102

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	E	Stable	Not Encountered		3 2 5 5 16	0.5			FILL: Silty SAND: fine to coarse grained, dark brown, with foreign building waste inclusions	D		FILL 0.00 m: Distinct ground disturbance in the form of uneven surfaces surrounding TP 0.25 m: Bricks, ceramic tiles, timber fragments, Coal Wash Reject fragments Composition: Approx. 25% Foreign, 75% Soil.
					HB (16/125m)				0.70m Silty CLAY: high plasticity, red mottled pale grey and orange	M (>PL)	St	RESIDUAL SOIL
	F-H					1.0			1.00m Silty CLAY: low plasticity (friable), pale grey mottled brown, trace rootlets	M (<PL)	VSt	EXTREMELY WEATHERED
	H								1.25m TERMINATED AT 1.25 m Refusal on Weathered Rock			
						1.5						

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP103

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	E-F	Stable	Not Encountered		5 6 8 5 5 12 12 VR (12/50mm)	0.5 1.0 1.5			FILL: Silty SAND: fine to coarse grained, dark brown, with fine to coarse angular gravels, trace rootlets	D		FILL
									0.25m FILL: Gravelly SAND: fine to coarse grained, grey, fine to coarse angular to sub-angular gravel, trace rounded to sub-rounded cobbles, trace plastic wrap fragments	D		
									0.40m Silty CLAY: high plasticity, red mottled pale grey and brown, trace fine grained sand	M (>PL)	St	RESIDUAL SOIL
	F								0.75m Sandy CLAY: low to medium plasticity, orange mottled red and brown, fine to medium grained sand	M (<PL)	VSt - H	EXTREMELY WEATHERED
	H								1.20m TERMINATED AT 1.20 m Refusal on Weathered Rock			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
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SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP104

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	F	Stable	Not Encountered		2 2 2				FILL: Clayey SILT: low plasticity, dark brown-black, with fine to medium grained sand, trace rootlets, trace glass fragments	M (<PL)		FILL
						0.25m			Clayey SILT: low plasticity, grey, with fine to coarse rub-rounded to sub-angular gravels	M (<PL)		COLLUVIUM
						0.40m			Silty CLAY: high plasticity, red mottled pale grey and brown, trace fine grained sand	M (>PL)	St	RESIDUAL SOIL
				B 0.50 - 0.70 m	3 4 5	0.5						
	F-H			B 1.00 - 1.30 m	6 8 8	1.0						
					10	1.5			Silty CLAY: low to medium plasticity (friable), pale grey mottled orange, with fine grained sand	M (<PL)	St - VSt	EXTREMELY WEATHERED
	H				14							
					VR (14/75mm)							
						1.60m			TERMINATED AT 1.60 m Refusal on Weathered Rock			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Hole No: TP105

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX		Stable	Not Encountered		5	0.0			TOPSOIL: Silty SAND: fine to medium grained, dark brown, with fine to medium rounded gravel, trace organics	D		TOPSOIL
					4	0.30m						
	E			B 0.50 - 0.80 m	3 3 4 5	0.5			Silty CLAY: high plasticity, dark grey mottled orange and brown, trace fine to medium rounded gravels, trace rootlets	M (>PL)	St	Probably COLLUVIUM
					4	1.00m						
					3 3 3	1.0			Silty CLAY: high plasticity, red mottled pale grey and brown, trace fine grained sand	M (≈PL)	St - VSt	RESIDUAL SOIL
					7	1.60m						
	F-H				9 10 11	1.5			Silty CLAY: low plasticity (friable), mottled pale grey and red	M (<PL)	VSt - H	EXTREMELY WEATHERED
					15	2.0						
					HB (15/75mm)	2.50m						
						2.5			TERMINATED AT 2.50 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP106

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	F	Stable	Not Encountered		3 4	0			TOPSOIL: Silty SAND: fine to medium grained, dark brown, with fine to medium rounded gravel, trace organics	D		TOPSOIL
						0.20m			Sandy GRAVEL: fine to coarse rounded to sub-rounded, grey, fine to medium grained sand, trace rootlets	D		COLLUVIUM
	F-H				3 4	0.35m			Silty CLAY: high plasticity, red mottled brown, trace fine grained sand	M (>PL)		RESIDUAL SOIL
						0.5						
					4				As Above, orange-brown mottled grey		St	
	H				5 6	1.0				M (≈PL)		
					15 15	1.05m			Silty CLAY: low to medium plasticity, mottled pale grey and red-orange, with fine grained sand			EXTREMELY WEATHERED
	F-H				VR (15/75mm)	1.5				M (<PL)	VSt - H	
						2.00m			As Above, with parent rock fragments			
						2.0			TERMINATED AT 2.00 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP107

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	E	Stable	Not Encountered		3, 4, 3, 2	0.5			FILL: Sandy CLAY: low plasticity, dark brown-black, with fine to coarse angular to sub-angular gravel	M (<PL)		FILL
									0.60m			
	F-H				3, 3, 4	1.0			Silty CLAY: high plasticity, dark grey mottled dark red, trace fine to coarse sub-rounded to angular gravels, trace rounded cobbles	M (>PL)	St	COLLUVIUM
												1.20 m: Minor olfactory odour
									1.30m			
	H				11, 7, 15, 23, VH	1.5			Silty CLAY: high plasticity, dark red mottled brown with orange staining, with fine to coarse sub-rounded to sub-angular gravel, trace fine grained sand	M (>PL)	VSt - H	RESIDUAL SOIL
												1.50 m: Possible jarosite staining
									2.20m			
									Silty CLAY: low plasticity (friable), mottled pale grey and red	M (<PL)	H	EXTREMELY WEATHERED
									2.30m			
									TERMINATED AT 2.30 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP108

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	F-H	Stable	Not Encountered		4 4 8 9 6 5 5 6 5 9 17 VR	0.5 1.0 1.5 2.0			TOPSOIL: Clayey SILT: low plasticity, dark brown, trace organics	M (<PL)		TOPSOIL 0.00 m: Within gully line
									0.25m Silty CLAY: high plasticity, grey mottled pale brown, trace fine to medium rounded gravels, trace rootlets	M (>PL)	St - VSt	COLLUVIUM
									0.80m Silty CLAY: high plasticity, mottled pale grey and orange-brown	M (>PL)	St - VSt	RESIDUAL SOIL
									1.60m Silty CLAY: low plasticity, mottled pale grey and red	M (<PL)	H	EXTREMELY WEATHERED
									1.90m SILTSTONE: pale grey and dark red, very low to low strength, highly weathered			WEATHERED ROCK
									2.20m TERMINATED AT 2.20 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP109

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket
Excavation Dimensions: **Contractor:** Stantec Pty Ltd
Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	F	Stable	Not Encountered		4 2				TOPSOIL: Sandy SILT: low plasticity, brown, trace organics	M (<PL)		TOPSOIL
									0.25m			
	F-H				3 3	0.5			Silty CLAY: high plasticity, brown-grey mottled red, with fine to medium rounded gravel, trace fine grained sand, trace roolets	M (>PL)		COLLUVIUM
					4				0.75m		St	
	H				5 5	1.0			Silty CLAY: high plasticity, grey mottled red, with fine to medium rounded gravel, trace fine grained sand	M (>PL)		RESIDUAL SOIL
					4 6 7	1.5					VSt	
					8 13				1.80m			
	F-H			B 1.80 - 2.00 m	10 VR (10/75mm)	2.0			Sandy CLAY: low plasticity, pale grey mottled orange-brown, fine to medium grained	M (<PL)	H	EXTREMELY WEATHERED
									2.30m			
									TERMINATED AT 2.30 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP110

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	F	Stable	Not Encountered		4 3	0			TOPSOIL: Clayey SILT: low plasticity, dark brown, trace rootlets	M (<PL)		TOPSOIL
						0.25m						
	F-H				4 3	0.5			Silty CLAY: high plasticity, brown-grey mottled red, with fine to medium rounded gravel, trace fine grained sand, trace roolets	M (>PL)	St	RESIDUAL SOIL
					5 4							
					17	1.0						
					10 HB (10/25mm)				Silty Gravelly CLAY: medium to high plasticity, red mottled grey-brown, fine to coarse rounded to sub-rounded, trace fine grained sand	M (≈PL)	VSt - H	EXTREMELY WEATHERED
						1.25m						
	H								CONGLOMERATE: medium to coarse grained sand, fine to coarse rounded to sub-rounded gravels, orange-brown and red, very low strength, highly weathered			WEATHERED ROCK
						1.40m						
						1.5			TERMINATED AT 1.40 m Refusal on Weathered Rock			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP111

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	F	Stable	▶		3 4 5 7	0.5			FILL: Silty SAND: fine to medium grained, dark brown, with fine to medium rounded gravel, trace organics	D		FILL
									0.20m FILL: Silty Gravelly CLAY: medium plasticity, pale grey, brown red and orange, fine to coarse angular to sub-angular, with fine to medium grained sand, trace angular cobbles	M (>PL)		
	H				15 VR	1.0			0.50m Silty Gravelly CLAY: medium to high plasticity, pale grey mottled brown-orange, fine to coarse angular to sub-angular, with fine to medium grained sand	M (>PL)	VSt	RESIDUAL SOIL
									0.65m SILTSTONE: pale grey and dark red, highly fractured, very low to low strength, highly weathered			WEATHERED ROCK 0.70 m: Water inflow
						1.5			1.30m TERMINATED AT 1.30 m Refusal on Weathered Rock			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
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SOIL CONSISTENCY
VS - Very Soft
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RELATIVE DENSITY
VL - Very Loose
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Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

Stantec

TEST PIT LOG SHEET

Client: Walker Gillieston Heights Pty Ltd
Project: Geotechnical Investigation
Location: 457-527 Cessnock Road, Gillieston Heights

Hole No: TP112

Job No: 304100964 **Sheet:** 1 of 1

Position: Refer to Site Plan **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 5 tonne Excavator **Excavation Method:** 600mm Toothed Bucket

Excavation Dimensions: **Contractor:** Stantec Pty Ltd

Date Excavated: 19/4/23 **Logged By:** JH **Checked By:**

Excavation			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
EX	F	Stable	Not Encountered		7, 5, 3, 5, 17	0.5			FILL: Silty Gravelly SAND: fine to medium grained, dark brown, fine to coarse rounded to angular	D		FILL
									0.25m Silty CLAY: high plasticity, red mottled pale grey and brown, trace fine grained sand	M (>PL)	St	RESIDUAL SOIL
					HB (17/125mm)	1.0			0.50m Silty Gravelly CLAY: medium plasticity, brown-orange mottled grey and pale grey, fine to coarse angular to sub-angular	M (<PL)	St - VSt	EXTREMELY WEATHERED
	H								0.90m SILTSTONE: brown-orange mottled grey and pale grey, highly fractured, very low to low strength, highly weathered			WEATHERED ROCK
						1.5			1.10m TERMINATED AT 1.10 m Refusal on Weathered Rock			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
HP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
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M - Moist
W - Wet
PL - Plastic limit
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w - Moisture content

SOIL CONSISTENCY
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RELATIVE DENSITY
VL - Very Loose
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D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

STANTEC AUSTRALIA PTY LTD

APPENDIX

C

LABORATORY TEST RESULTS

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Stantec

Laboratory Chain of Custody

Client Name	Stantec	**Sampler**	Jack Hanlon	**Contact**	Jack Hanlon
Client Address	Suite 2, Level 2, 22 Honeysuckle Drive Newcastle	**Method**	Test Pit	**Mobile**	0422206115
Project Ref	304100808	**Request by**	Jack Hanlon	**Email**	jack.hanlon@cardno.com.au
Project Name	South Gillieston Heights GI	**Date**	7/10/2022	**Special Requirements / Comments**	
Site Location	Gillieston Heights	**Results by**	Standard TAT		
Component/Stage		**Sample Hold**			

						Tests Required				
						Soil				
						California Bearing Ratio				
						AS				
Sample #	**Location**	**Depth**	**Date**	**Type**	**Material Description**	1289 6.1.1				
	TP02	0.4-0.6	5/10/22	Bulk Bag	Silty CLAY t gravel	✓				
	TP04	0.5-0.65	5/10/22	Bulk Bag	Silty Sandy CLAY t gravel	✓				
	TP06	1.1-1.4	5/10/22	Bulk Bag	Silty Sandy CLAY	✓				
	TP09	0.3-0.6	5/10/22	Bulk Bag	Silty CALY t sand t gravel	✓				
	TP10	0.6-0.8	5/10/22	Bulk Bag	Silty CLAY t gravel	✓				
	TP11	0.6-0.9	5/10/22	Bulk Bag	Silty Sandy CLAY	✓				

Material Test Report

Report Number: **PRJ771047-1**
Issue Number: 1
Date Issued: 25/10/2022
Client: Stantec Pty Ltd

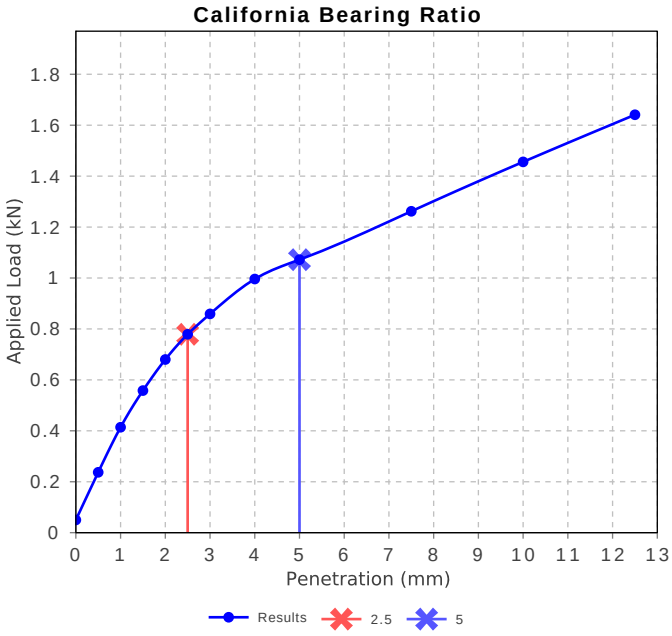
Contact: Ian Piper
Project Number: PRJ771047
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd, Gillieston Heights NSW
Work Request: 4652
Sample Number: M22-4652A
Date Sampled: 07/10/2022
Dates Tested: 11/10/2022 - 20/10/2022
Sample Location: **TP02, Depth: 0.4 - 0.6m**

Intrax Consulting Engineers Pty Ltd
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0499 779 118
Email: james.obrien@intrax.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James O'Brien
Laboratory Manager
NATA Accredited Laboratory Number: 19862

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 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		
Maximum Dry Density (t/m^3)	1.60		
Optimum Moisture Content (%)	22.5		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.59		
Field Moisture Content (%)	23.5		
Moisture Content at Placement (%)	22.1		
Moisture Content Top 30mm (%)	24.8		
Moisture Content Rest of Sample (%)	23.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	145.2		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: **PRJ771047-1**
Issue Number: 1
Date Issued: 25/10/2022
Client: Stantec Pty Ltd

Contact: Ian Piper
Project Number: PRJ771047
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd, Gillieston Heights NSW
Work Request: 4652
Sample Number: M22-4652B
Date Sampled: 07/10/2022
Dates Tested: 11/10/2022 - 20/10/2022
Sample Location: **TP04, Depth: 0.5 - 0.65m**

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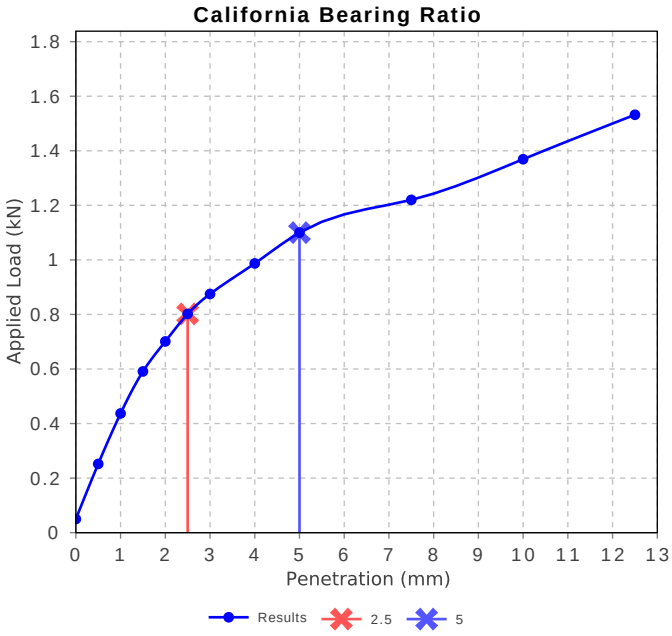
Approved Signatory: James O'Brien
Laboratory Manager
NATA Accredited Laboratory Number: 19862

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 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		
Maximum Dry Density (t/m^3)	1.64		
Optimum Moisture Content (%)	20.0		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	98.0		
Dry Density after Soaking (t/m^3)	1.64		
Field Moisture Content (%)	22.8		
Moisture Content at Placement (%)	19.4		
Moisture Content Top 30mm (%)	24.7		
Moisture Content Rest of Sample (%)	21.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	139.7		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: **PRJ771047-1**
Issue Number: 1
Date Issued: 25/10/2022
Client: Stantec Pty Ltd

Contact: Ian Piper
Project Number: PRJ771047
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd, Gillieston Heights NSW
Work Request: 4652
Sample Number: M22-4652C
Date Sampled: 07/10/2022
Dates Tested: 11/10/2022 - 24/10/2022
Sample Location: **TP06, Depth: 1.1 - 1.4m**

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Morisset Laboratory
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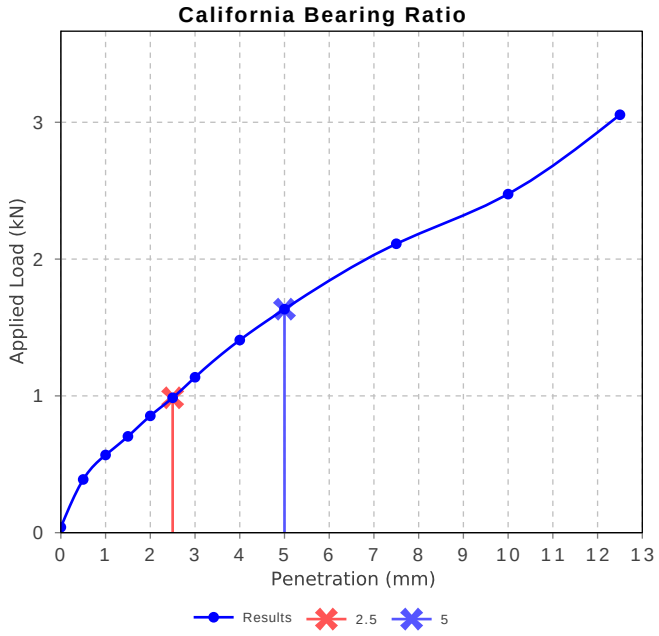
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James O'Brien
Laboratory Manager
NATA Accredited Laboratory Number: 19862

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	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		
Maximum Dry Density (t/m^3)	1.93		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	98.0		
Dry Density after Soaking (t/m^3)	1.90		
Field Moisture Content (%)	14.9		
Moisture Content at Placement (%)	12.3		
Moisture Content Top 30mm (%)	16.9		
Moisture Content Rest of Sample (%)	13.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	148.5		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Report Number: **PRJ771047-1**
Issue Number: 1
Date Issued: 25/10/2022
Client: Stantec Pty Ltd

Contact: Ian Piper
Project Number: PRJ771047
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd, Gillieston Heights NSW
Work Request: 4652
Sample Number: M22-4652D
Date Sampled: 07/10/2022
Dates Tested: 11/10/2022 - 24/10/2022
Sample Location: **TP09, Depth: 0.3 - 0.6m**

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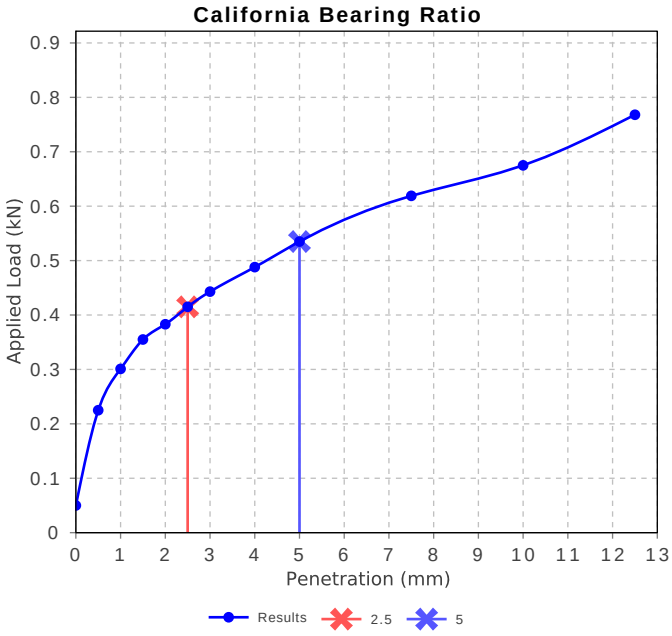
Approved Signatory: James O'Brien
Laboratory Manager
NATA Accredited Laboratory Number: 19862

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		
Maximum Dry Density (t/m^3)	1.50		
Optimum Moisture Content (%)	25.5		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.48		
Field Moisture Content (%)	32.5		
Moisture Content at Placement (%)	25.1		
Moisture Content Top 30mm (%)	30.9		
Moisture Content Rest of Sample (%)	25.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	153.2		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Report Number: **PRJ771047-1**
Issue Number: 1
Date Issued: 25/10/2022
Client: Stantec Pty Ltd

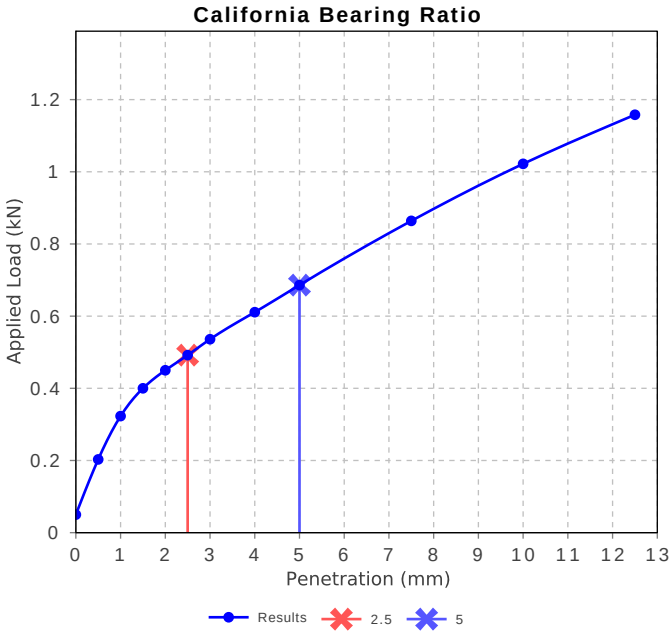
Contact: Ian Piper
Project Number: PRJ771047
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd, Gillieston Heights NSW
Work Request: 4652
Sample Number: M22-4652E
Date Sampled: 07/10/2022
Dates Tested: 11/10/2022 - 20/10/2022
Sample Location: **TP10, Depth: 0.6 - 0.8m**

Intrax Consulting Engineers Pty Ltd
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0499 779 118
Email: james.obrien@intrax.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James O'Brien
Laboratory Manager
NATA Accredited Laboratory Number: 19862

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**3.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.51		
Optimum Moisture Content (%)	26.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.49		
Field Moisture Content (%)	28.7		
Moisture Content at Placement (%)	26.4		
Moisture Content Top 30mm (%)	30.7		
Moisture Content Rest of Sample (%)	27.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	140.8		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: **PRJ771047-1**
Issue Number: 1
Date Issued: 25/10/2022
Client: Stantec Pty Ltd

Contact: Ian Piper
Project Number: PRJ771047
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd, Gillieston Heights NSW
Work Request: 4652
Sample Number: M22-4652F
Date Sampled: 07/10/2022
Dates Tested: 11/10/2022 - 20/10/2022
Sample Location: **TP11, Depth: 0.6 - 0.9m**

Intrax Consulting Engineers Pty Ltd
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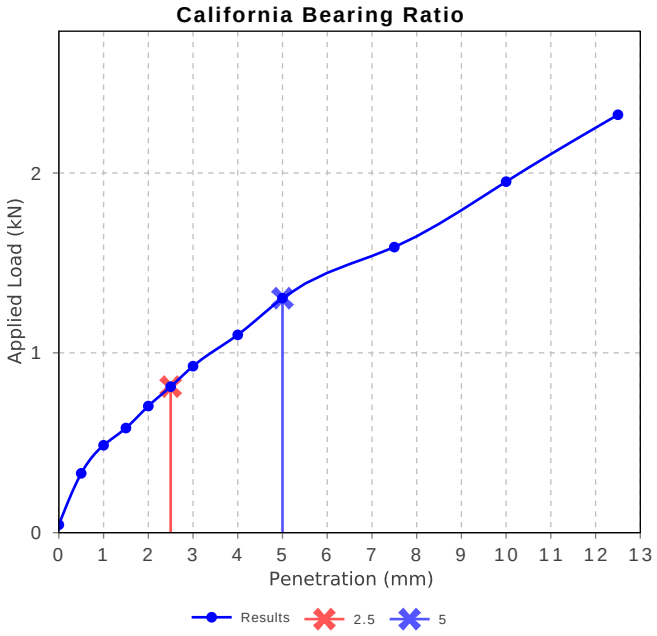
Email: james.obrien@intrax.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James O'Brien
Laboratory Manager
NATA Accredited Laboratory Number: 19862

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	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		
Maximum Dry Density (t/m^3)	1.83		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.81		
Field Moisture Content (%)	17.1		
Moisture Content at Placement (%)	14.3		
Moisture Content Top 30mm (%)	19.1		
Moisture Content Rest of Sample (%)	15.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	139.8		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Laboratory Chain of Custody

Client Name	Stantec	**Sampler**	Jack Hanlon	**Contact**	Jack Hanlon
Client Address	Suite 2, Level 2, 22 Honeysuckle Drive Newcastle	**Method**	Test Pit	**Mobile**	0422206115
Project Ref	304100964	**Request by**	Jack Hanlon	**Email**	jack.hanlon@cardno.com.au
Project Name	South Gillieston Heights GI	**Date**	19/04/2023	**Special Requirements / Comments**	
Site Location	507 Main Road, Gillieston Heights	**Results by**	Standard TAT		
Component/Stage		**Sample Hold**			

						Tests Required					**Notes**
						Soil	Soil	Soil	Soil		
						California Bearing Ratio	Atterberg Limits	Emerson Class Number	Permeability (Constant)		
						AS	AS	AS	AS		
Sample #	**Location**	**Depth**	**Date**	**Type**	**Material Description**	1289 6.1.1	1289 3.3.1	1289 3.8.1	1289 6.7.1		
	TP104	0.5-0.7	19/04/23	Bulk Bag	Silty CLAY (RS)						
	TP104	1.0-1.3	19/04/23	Bulk Bag	Silty CLAY (EWM)						
	TP105	0.5-0.8	19/04/23	Bulk Bag	Silty CLAY (ALV)	✓					
	TP109	1.8-2.0	19/04/23	Bulk Bag	Sandy CLAY (EWM)	✓					

Material Test Report

QUALITY GEOTECHNICAL SERVICES

Trading as QGS Quality Geotechnical Services Pty Ltd
Intrax Consulting Engineers Pty Ltd
8/34 Alliance Avenue Morisset NSW 2264
Phone: 0475 008 651
Email: steve.waugh@qgs.com

Accredited for compliance with ISO/IEC 17025 - Testing

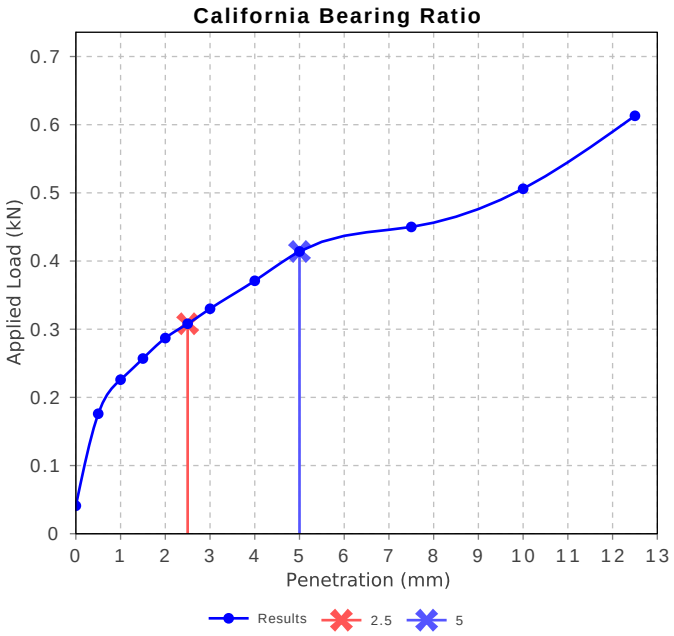
NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Steve Waugh
Managing Director
NATA Accredited Laboratory Number: 19862

Report Number: **PRJ914989-1**
Issue Number: 1
Date Issued: 11/05/2023
Client: Stantec Pty Ltd

Contact: Jack Hanlon
Project Number: PRJ914989
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd - Gillieston Heights
Client Reference: 304100964
Work Request: 5865
Sample Number: M23-5865A
Date Sampled: 19/04/2023
Dates Tested: 01/05/2023 - 05/05/2023
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **TP105 (0.5-0.8m)**
Material: Refer to Client logs
Material Source: insitu

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 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		
Maximum Dry Density (t/m^3)	1.49		
Optimum Moisture Content (%)	27.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.44		
Field Moisture Content (%)	28.1		
Moisture Content at Placement (%)	27.9		
Moisture Content Top 30mm (%)	36.0		
Moisture Content Rest of Sample (%)	30.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.0		
Swell (%)	3.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Trading as QGS Quality Geotechnical Services Pty Ltd
Intrax Consulting Engineers Pty Ltd
8/34 Alliance Avenue Morisset NSW 2264
Phone: 0475 008 651
Email: steve.waugh@qgs.com

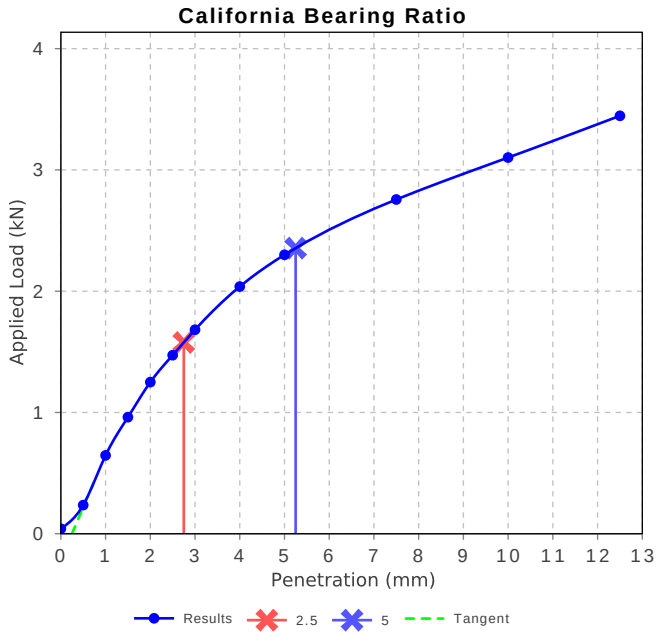
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Steve Waugh
Managing Director
NATA Accredited Laboratory Number: 19862

Report Number: **PRJ914989-1**
Issue Number: 1
Date Issued: 11/05/2023
Client: Stantec Pty Ltd

Contact: Jack Hanlon
Project Number: PRJ914989
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd - Gillieston Heights
Client Reference: 304100964
Work Request: 5865
Sample Number: M23-5865B
Date Sampled: 19/04/2023
Dates Tested: 01/05/2023 - 05/05/2023
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Site Selection: Selected by Client
Sample Location: **TP109 (1.8-2.0m)**
Material: Refer to Client logs
Material Source: insitu

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 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		
Maximum Dry Density (t/m^3)	1.83		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	101.0		
Laboratory Moisture Ratio (%)	93.0		
Dry Density after Soaking (t/m^3)	1.82		
Field Moisture Content (%)	15.1		
Moisture Content at Placement (%)	14.4		
Moisture Content Top 30mm (%)	17.0		
Moisture Content Rest of Sample (%)	16.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	97.0		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



CHAIN OF CUSTODY - Stantec

Client: Stantec	**Project Number - task : 304100808**
Contact Person: Kosta Sykiotis and Jack Hanlon	**Project Name / Site etc (ie report title):** South Gillieston Heights
Project Mgr: Kosta Sykiotis	
Sampler: Jack Hanlon	**Quote No. :**
Address: Suite 2, Level 2, 22 Honeysuckle Drive Newcastle NSW	**Date results required:** **Or choose: standard / same day / 1 day / 2 day / 3 day** *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: **Mob:** 0422 206 115 (Jack)	**Report format: esdat / equis /**
Results and Invoice: kosta.sykiotis@cardno.com.au jack.hanlon@cardno.com.au	**Please hold Non testing samples until our review of initial results**

Sample information					Tests Required						
Sample ID	**Client Sample ID or information**	**Depth**	**Date sampled**	**Type of sample**	Salinity Suite (CEC, ESP, Chloride, Sulfate, pH, EC, Resistivity and Sodicity)	Acid Sulfate - pH Field Screen	EC	Hold			
	TP001 / ES:	0.05 - 0.10	5/10/2022	Soil				X			
	TP001 / ES:	0.10 - 0.20	5/10/2022	Soil				X			
	TP001 / ES:	0.25 - 0.35	5/10/2022	Soil				X			
	TP001 / ES:	0.85 - 0.90	5/10/2022	Soil				X			
	TP001 / ES:	1.00 - 1.15	5/10/2022	Soil				X			
	TP001 / ES:	1.25 - 1.30	5/10/2022	Soil				X			
	TP002 / ES:	0.05 - 0.10	5/10/2022	Soil				X			
	TP002 / ES:	0.20 - 0.30	5/10/2022	Soil			X				
	TP002 / ES:	1.20 - 1.40	5/10/2022	Soil			X				
	TP004 / ES:	0.05 - 0.10	5/10/2022	Soil		X					
	TP005 / ES:	0.20 - 0.40	5/10/2022	Soil		X	X				
	TP005 / ES:	0.50 - 0.60	5/10/2022	Soil		X					
	TP005 / ES:	1.40 - 1.50	5/10/2022	Soil				X			
	TP006 / ES:	1.20 - 1.30	5/10/2022	Soil			X				
	TP007 / ES:	0.05 - 0.10	5/10/2022	Soil			X				
	TP007 / ES:	0.65 - 0.80	5/10/2022	Soil			X				
	TP007 / ES:	1.30 - 1.40	5/10/2022	Soil			X				
	TP008 / ES:	0.10 - 0.25	5/10/2022	Soil		X					
	TP011 / ES:	0.05 - 0.10	5/10/2022	Soil				X			
	TP011 / ES:	0.45 - 0.55	5/10/2022	Soil		X					

Relinquished by (Company):	Stantec Pty Ltd	**Received by (Company):**	
ABN:	17 007 820 322		
Print Name:	Jack Hanlon	**Print Name:**	
Date & Time:	7/10/2022	**Date & Time:**	
Signature:		**Signature:**	

White - Lab copy / Blue - Client copy / Pink - Retain in Book

Date/Time: 7/10/22 3:00pm
Chilled: (Yes) No
Temp: 16.7 +0.3 17.0 corr.
Correction:
Final Temp:

#930290

1/2

CHAIN OF CUSTODY - Stantec

Client: Stantec	**Project Number - task : 304100808**
Contact Person: Kosta Sykiotis and Jack Hanlon	**Project Name / Site etc (le report title):**
Project Mgr: Kosta Sykiotis	South Gillieston Heights
Sampler: Jack Hanlon	**Quote No. :**
Address: Suite 2, Level 2, 22 Honeysuckle Drive Newcastle NSW	**Date results required:**
	Or choose: standard / same day / 1 day / 2 day / 3 day
Phone: **Mob:** 0422 206 115 (Jack)	*Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
	Report format: esdat / equis /
Results and Invoice: kosta.sykiotis@cardno.com.au jack.hanlon@cardno.com.au	**Please hold Non testing samples until our review of initial results**

Sample Information					Tests Required						
Sample ID	**Client Sample ID or information**	**Depth**	**Date sampled**	**Type of sample**	Salinity Suite (CEC, ESP, Chloride, Sulfate, pH, EC, Resistivity and Sodicity)	Acid Sulfate - pH Field Screen	EC		Hold		
	TP001 / ES:	0.05 - 0.10	5/10/2022	Soil					x		
	TP001 / ES:	0.10 - 0.20	5/10/2022	Soil					x		
	TP001 / ES:	0.25 - 0.35	5/10/2022	Soil					x		
	TP001 / ES:	0.85 - 0.90	5/10/2022	Soil					x		
	TP001 / ES:	1.00 - 1.15	5/10/2022	Soil					x		
	TP001 / ES:	1.25 - 1.30	5/10/2022	Soil	x						
	TP002 / ES:	0.05 - 0.10	5/10/2022	Soil					x		
	TP002 / ES:	0.20 - 0.30	5/10/2022	Soil					x		
	TP002 / ES:	1.20 - 1.40	5/10/2022	Soil					x		
	TP004 / ES:	0.05 - 0.10	5/10/2022	Soil					x		
	TP005 / ES:	0.20 - 0.40	5/10/2022	Soil					x		
	TP005 / ES:	0.50 - 0.60	5/10/2022	Soil					x		
	TP005 / ES:	1.40 - 1.50	5/10/2022	Soil					x		
	TP006 / ES:	1.20 - 1.30	5/10/2022	Soil	x						
	TP007 / ES:	0.05 - 0.10	5/10/2022	Soil					x		
	TP007 / ES:	0.65 - 0.80	5/10/2022	Soil					x		
	TP007 / ES:	1.30 - 1.40	5/10/2022	Soil					x		
	TP008 / ES:	0.10 - 0.25	5/10/2022	Soil					x		
	TP011 / ES:	0.05 - 0.10	5/10/2022	Soil					x		
	TP011 / ES:	0.45 - 0.55	5/10/2022	Soil					x		
	TP014	0.05-0.1	12/10/2022	Soil					x		
	TP014	0.25-0.35	12/10/2022	Soil					x		
	TP014	0.45-0.6	12/10/2022	Soil	x	x					
	TP014	0.9-1.0	12/10/2022	Soil			x				
	TP014	1.1-1.2	12/10/2022	Soil		x					
	TP014	1.4-1.5	12/10/2022	Soil		x					
	TP016	0.3-0.4	12/10/2022	Soil					x		
	TP018	0.3-0.6	12/10/2022	Soil					x		
	TP018	0.9-1.0	12/10/2022	Soil					x		
	TP018	1.2-1.3	12/10/2022	Soil			x				

2.5°C

Jaidyn Slowgrove

18/10/22

9:41 AM

2/2

	TP020	0.5-0.6	12/10/2022	Soil					X		
	TP022	0.3-0.5	12/10/2022	Soil		X	X				
	TP022	0.6-0.8	12/10/2022	Soil	X	X					
	TP022	1.2-1.4	12/10/2022	Soil		X					
	TP024	0.2-0.4	12/10/2022	Soil		X					
	TP028	0.05-0.1	12/10/2022	Soil		X					
	TP028	0.2-0.35	12/10/2022	Soil		X					
	TP028	1.0-1.2	12/10/2022	Soil	X	X					

Relinquished by (Company):	Stantec Pty Ltd	**Received by (Company):**	
ABN:	17 007 820 322		
Print Name:	Jack Hanlon	**Print Name:**	Jaidyn Slowgrove
Date & Time:	13/10/2022	**Date & Time:**	18/10/22 9:41 AM
Signature:		**Signature:**	

White - Lab copy / Blue - Client copy / Pink - Retain in Book

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Level 22, 570 Bourke Street
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NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Kosta Sykiotis**

Report **930290-S**
Project name SOUTH GILLIESTON HEIGHTS
Project ID 304100808
Received Date Oct 07, 2022

Client Sample ID			**TP002 / ES: 0.20 - 0.30**	**TP002 / ES: 1.20 - 1.40**	**TP004 / ES: 0.05 - 0.10**	**TP005 / ES: 0.20 - 0.40**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**B22-Oc0017051**	**B22-Oc0017052**	**B22-Oc0017053**	**B22-Oc0017054**
Date Sampled			**Oct 05, 2022**	**Oct 05, 2022**	**Oct 05, 2022**	**Oct 05, 2022**
Test/Reference	LOR	Unit				
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	16	79	-	< 10
% Moisture	1	%	13	6.7	-	15
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	-	6.2	6.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	-	3.3	4.1
Reaction Ratings*[S05]	0	-	-	-	4.0	2.0

Client Sample ID			**TP005 / ES: 0.50 - 0.60**	**TP006 / ES: 1.20 - 1.30**	**TP007 / ES: 0.05 - 0.10**	**TP007 / ES: 0.65 - 0.80**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**B22-Oc0017055**	**B22-Oc0017056**	**B22-Oc0017057**	**B22-Oc0017058**
Date Sampled			**Oct 05, 2022**	**Oct 05, 2022**	**Oct 05, 2022**	**Oct 05, 2022**
Test/Reference	LOR	Unit				
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	-	56	12	41
% Moisture	1	%	-	12	14	14
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.1	-	-	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.5	-	-	-
Reaction Ratings*[S05]	0	-	2.0	-	-	-

Client Sample ID			TP007 / ES: 1.30 - 1.40	TP008 / ES: 0.10 - 0.25	TP011 / ES: 0.45 - 0.55	TP014_0.45-0.6
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			B22-Oc0017059	B22-Oc0017060	B22-Oc0017061	B22-Oc0039040
Date Sampled			Oct 05, 2022	Oct 05, 2022	Oct 05, 2022	Oct 12, 2022
Test/Reference	LOR	Unit				
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	48	-	-	34
% Moisture	1	%	15	-	-	-
Chloride	5	mg/kg	-	-	-	6.0
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	-	-	-	7.0
Resistivity*	0.5	ohm.m	-	-	-	120
Sulphate (as SO4)	30	mg/kg	-	-	-	92
Exchangeable Sodium Percentage (ESP)	0.1	%	-	-	-	0.2
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	6.2	6.1	6.7
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	2.9	4.7	4.6
Reaction Ratings*[S05]	0	-	-	3.0	3.0	3.0
Cation Exchange Capacity						
Cation Exchange Capacity	0.05	meq/100g	-	-	-	33

Client Sample ID			TP014_0.9-1.0	TP014_1.1-1.2	TP014_1.4-1.5	TP018_1.2-1.3
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			B22-Oc0039041	B22-Oc0039042	B22-Oc0039043	B22-Oc0039047
Date Sampled			Oct 12, 2022	Oct 12, 2022	Oct 12, 2022	Oct 12, 2022
Test/Reference	LOR	Unit				
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	94	-	-	110
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	5.2	5.7	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	4.3	4.5	-
Reaction Ratings*[S05]	0	-	-	2.0	1.0	-

Client Sample ID			TP022_0.3-0.5	TP022_0.6-0.8	TP022_1.2-1.4	TP024_0.2-0.4
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			B22-Oc0039049	B22-Oc0039050	B22-Oc0039051	B22-Oc0039052
Date Sampled			Oct 12, 2022	Oct 12, 2022	Oct 12, 2022	Oct 12, 2022
Test/Reference	LOR	Unit				
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	< 10	780	-	-
Chloride	5	mg/kg	-	270	-	-
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	-	5.4	-	-
Resistivity*	0.5	ohm.m	-	13	-	-
Sulphate (as SO4)	30	mg/kg	-	56	-	-
Exchangeable Sodium Percentage (ESP)	0.1	%	-	19	-	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.5	5.2	5.4	6.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.4	4.0	3.9	3.8
Reaction Ratings*[S05]	0	-	3.0	2.0	1.0	2.0
Cation Exchange Capacity						
Cation Exchange Capacity	0.05	meq/100g	-	19	-	-

Client Sample ID			TP028_0.05-0.1	TP028_1.0-1.2	TP028_0.2-0.35
Sample Matrix			Soil	Soil	Soil
Eurofins Sample No.			B22-Oc0039053	B22-Oc0039055	B22-Oc0039129
Date Sampled			Oct 12, 2022	Oct 12, 2022	Oct 12, 2022
Test/Reference	LOR	Unit			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	-	130	-
Chloride	5	mg/kg	-	< 5	-
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	-	8.0	-
Resistivity*	0.5	ohm.m	-	79	-
Sulphate (as SO4)	30	mg/kg	-	< 30	-
Exchangeable Sodium Percentage (ESP)	0.1	%	-	3.5	-
Acid Sulfate Soils Field pH Test					
pH-F (Field pH test)*	0.1	pH Units	6.1	8.4	6.4
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.3	8.8	4.6
Reaction Ratings*[S05]	0	-	4.0	4.0	4.0
Cation Exchange Capacity					
Cation Exchange Capacity	0.05	meq/100g	-	21	-

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Melbourne	Oct 27, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
Exchangeable Sodium Percentage (ESP)	Melbourne	Oct 27, 2022	28 Days
- Method: LTM-MET-3060 - Cation Exchange Capacity (CEC) & Exchangeable Sodium Percentage (ESP)			
% Moisture	Brisbane	Oct 11, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			
Chloride	Melbourne	Oct 27, 2022	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
pH (1:5 Aqueous extract at 25 °C as rec.)	Brisbane	Oct 25, 2022	7 Days
- Method: APHA 4500-H+ B. Electrometric Method			
Sulphate (as SO4)	Melbourne	Oct 27, 2022	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Acid Sulfate Soils Field pH Test	Brisbane	Oct 25, 2022	7 Days
- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests			
Cation Exchange Capacity	Melbourne	Oct 27, 2022	28 Days
- Method: LTM-MET-3060 Cation Exchange Capacity by bases & Exchangeable Sodium Percentage			

Repeat Samples

Description	Testing Site	Extracted	Holding Time
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Melbourne	Oct 27, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
Exchangeable Sodium Percentage (ESP)	Melbourne	Oct 27, 2022	28 Days
- Method: LTM-MET-3060 - Cation Exchange Capacity (CEC) & Exchangeable Sodium Percentage (ESP)			
% Moisture	Brisbane	Oct 11, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			
Chloride	Melbourne	Oct 27, 2022	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
pH (1:5 Aqueous extract at 25 °C as rec.)	Brisbane	Oct 25, 2022	7 Days
- Method: APHA 4500-H+ B. Electrometric Method			
Sulphate (as SO4)	Melbourne	Oct 27, 2022	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Acid Sulfate Soils Field pH Test	Brisbane	Oct 25, 2022	7 Days
- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests			
Cation Exchange Capacity	Melbourne	Oct 27, 2022	28 Days
- Method: LTM-MET-3060 Cation Exchange Capacity by bases & Exchangeable Sodium Percentage			

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Company Name: Stantec Australia Pty Ltd (NSW/ACT)
Address: Level 22, 570 Bourke Street
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VIC 3000

Project Name: SOUTH GILLIESTON HEIGHTS
Project ID: 304100808

Order No.:
Report #: 930290
Phone:
Fax:

Received: Oct 7, 2022 3:00 PM
Due: Oct 25, 2022
Priority: 5 Day
Contact Name: Kosta Sykiotis

Eurofins Analytical Services Manager : Hannah Mawbey

Sample Detail						Chloride	Conductivity (1:5 aqueous extract at 25 °C as rec.)	HOLD	pH (1:5 Aqueous extract at 25 °C as rec.)	Resistivity*	Sulphate (as SO4)	Acid Sulfate Soils Field pH Test	Moisture Set	Cation Exchange Capacity	Exchangeable Sodium Percentage (ESP)
Melbourne Laboratory - NATA # 1261 Site # 1254						X				X	X			X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							X	X	X			X	X	X	X
External Laboratory															
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**										
1	TP002 / ES: 0.20 - 0.30	Oct 05, 2022		Soil	B22-Oc0017051		X						X		
2	TP002 / ES: 1.20 - 1.40	Oct 05, 2022		Soil	B22-Oc0017052		X						X		
3	TP004 / ES: 0.05 - 0.10	Oct 05, 2022		Soil	B22-Oc0017053							X			
4	TP005 / ES: 0.20 - 0.40	Oct 05, 2022		Soil	B22-Oc0017054		X					X	X		
5	TP005 / ES: 0.50 - 0.60	Oct 05, 2022		Soil	B22-Oc0017055							X			
6	TP006 / ES: 1.20 - 1.30	Oct 05, 2022		Soil	B22-Oc0017056		X						X		
7	TP007 / ES: 0.05 - 0.10	Oct 05, 2022		Soil	B22-Oc0017057		X						X		

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Project Name: SOUTH GILLIESTON HEIGHTS
Project ID: 304100808

Order No.:
Report #: 930290
Phone:
Fax:

Received: Oct 7, 2022 3:00 PM
Due: Oct 25, 2022
Priority: 5 Day
Contact Name: Kosta Sykiotis

Eurofins Analytical Services Manager : Hannah Mawbey

Sample Detail						Chloride	Conductivity (1:5 aqueous extract at 25 °C as rec.)	HOLD	pH (1:5 Aqueous extract at 25 °C as rec.)	Resistivity*	Sulphate (as SO4)	Acid Sulfate Soils Field pH Test	Moisture Set	Cation Exchange Capacity	Exchangeable Sodium Percentage (ESP)
Melbourne Laboratory - NATA # 1261 Site # 1254						X				X	X			X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							X	X	X			X	X	X	X
8	TP007 / ES: 0.65 - 0.80	Oct 05, 2022		Soil	B22-Oc0017058		X						X		
9	TP007 / ES: 1.30 - 1.40	Oct 05, 2022		Soil	B22-Oc0017059		X						X		
10	TP008 / ES: 0.10 - 0.25	Oct 05, 2022		Soil	B22-Oc0017060							X			
11	TP011 / ES: 0.45 - 0.55	Oct 05, 2022		Soil	B22-Oc0017061							X			
12	TP001 / ES: 0.05 - 0.10	Oct 05, 2022		Soil	B22-Oc0017062			X							
13	TP001 / ES: 0.10 - 0.20	Oct 05, 2022		Soil	B22-Oc0017063			X							
14	TP001 / ES: 0.25 - 0.35	Oct 05, 2022		Soil	B22-Oc0017064			X							
15	TP001 / ES: 0.85 - 0.90	Oct 05, 2022		Soil	B22-Oc0017065			X							
16	TP001 / ES: 1.00 - 1.15	Oct 05, 2022		Soil	B22-Oc0017066			X							

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Project Name: SOUTH GILLIESTON HEIGHTS
Project ID: 304100808

Order No.:
Report #: 930290
Phone:
Fax:

Received: Oct 7, 2022 3:00 PM
Due: Oct 25, 2022
Priority: 5 Day
Contact Name: Kosta Sykiotis

Eurofins Analytical Services Manager : Hannah Mawbey

Sample Detail						Chloride	Conductivity (1:5 aqueous extract at 25 °C as rec.)	HOLD	pH (1:5 Aqueous extract at 25 °C as rec.)	Resistivity*	Sulphate (as SO4)	Acid Sulfate Soils Field pH Test	Moisture Set	Cation Exchange Capacity	Exchangeable Sodium Percentage (ESP)
Melbourne Laboratory - NATA # 1261 Site # 1254						X				X	X			X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							X	X	X			X	X	X	X
17	TP001 / ES: 1.25 - 1.30	Oct 05, 2022		Soil	B22-Oc0017067			X							
18	TP002 / ES: 0.05 - 0.10	Oct 05, 2022		Soil	B22-Oc0017068			X							
19	TP005 / ES: 1.40 - 1.50	Oct 05, 2022		Soil	B22-Oc0017069			X							
20	TP011 / ES: 0.05 - 0.10	Oct 05, 2022		Soil	B22-Oc0017070			X							
21	TP014_0.05-0.1	Oct 12, 2022		Soil	B22-Oc0039038			X							
22	TP014_0.25-0.35	Oct 12, 2022		Soil	B22-Oc0039039			X							
23	TP014_0.45-0.6	Oct 12, 2022		Soil	B22-Oc0039040	X			X	X	X	X		X	X
24	TP014_0.9-1.0	Oct 12, 2022		Soil	B22-Oc0039041		X								
25	TP014_1.1-1.2	Oct 12, 2022		Soil	B22-Oc0039042							X			
26	TP014_1.4-1.5	Oct 12, 2022		Soil	B22-Oc0039043							X			

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IANZ# 1290

Company Name: Stantec Australia Pty Ltd (NSW/ACT)
Address: Level 22, 570 Bourke Street
Melbourne
VIC 3000

Project Name: SOUTH GILLIESTON HEIGHTS
Project ID: 304100808

Order No.:
Report #: 930290
Phone:
Fax:

Received: Oct 7, 2022 3:00 PM
Due: Oct 25, 2022
Priority: 5 Day
Contact Name: Kosta Sykiotis

Eurofins Analytical Services Manager : Hannah Mawbey

Sample Detail						Chloride	Conductivity (1:5 aqueous extract at 25 °C as rec.)	HOLD	pH (1:5 Aqueous extract at 25 °C as rec.)	Resistivity*	Sulphate (as SO4)	Acid Sulfate Soils Field pH Test	Moisture Set	Cation Exchange Capacity	Exchangeable Sodium Percentage (ESP)
Melbourne Laboratory - NATA # 1261 Site # 1254						X				X	X			X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							X	X	X			X	X	X	X
27	TP016_0.3-0.4	Oct 12, 2022		Soil	B22-Oc0039044			X							
28	TP018_0.3-0.6	Oct 12, 2022		Soil	B22-Oc0039045			X							
29	TP018_0.9-1.0	Oct 12, 2022		Soil	B22-Oc0039046			X							
30	TP018_1.2-1.3	Oct 12, 2022		Soil	B22-Oc0039047		X								
31	TP020_0.5-0.6	Oct 12, 2022		Soil	B22-Oc0039048			X							
32	TP022_0.3-0.5	Oct 12, 2022		Soil	B22-Oc0039049		X					X			
33	TP022_0.6-0.8	Oct 12, 2022		Soil	B22-Oc0039050	X			X	X	X	X		X	X
34	TP022_1.2-1.4	Oct 12, 2022		Soil	B22-Oc0039051							X			
35	TP024_0.2-0.4	Oct 12, 2022		Soil	B22-Oc0039052							X			
36	TP028_0.05-0.1	Oct 12, 2022		Soil	B22-Oc0039053							X			
37	TP028_1.0-1.2	Oct 12, 2022		Soil	B22-Oc0039055	X			X	X	X	X		X	X
38	TP028_0.2-0.35	Oct 12, 2022		Soil	B22-Oc0039129							X			
Test Counts						3	10	15	3	3	3	15	7	3	3

Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

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

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

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

Units

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

Terms

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

QC - Acceptance Criteria

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

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

Results <10 times the LOR: No Limit

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

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

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

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

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

.

QC Data General Comments

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

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/kg	< 5			5	Pass	
Sulphate (as SO4)	mg/kg	< 30			30	Pass	
Method Blank							
Cation Exchange Capacity							
Cation Exchange Capacity	meq/100g	< 0.05			0.05	Pass	
LCS - % Recovery							
Chloride	%	111			70-130	Pass	
Sulphate (as SO4)	%	110			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	B22-Oc0017054	CP	uS/cm	< 10	< 10	<1	30%	Pass	
% Moisture	B22-Oc0017054	CP	%	15	15	<1	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B22-Oc0017060	CP	pH Units	6.2	6.2	pass	20%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Exchangeable Sodium Percentage (ESP)	B22-Oc0039040	CP	%	0.2	< 0.1	95	30%	Fail	Q15
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B22-Oc0039040	CP	pH Units	6.7	6.9	pass	20%	Pass	
Duplicate									
Cation Exchange Capacity				Result 1	Result 2	RPD			
Cation Exchange Capacity	B22-Oc0039040	CP	meq/100g	33	33	1.3	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Exchangeable Sodium Percentage (ESP)	B22-Oc0039050	CP	%	19	19	1.0	30%	Pass	
Duplicate									
Cation Exchange Capacity				Result 1	Result 2	RPD			
Cation Exchange Capacity	B22-Oc0039050	CP	meq/100g	19	17	11	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B22-Oc0039055	CP	pH Units	8.4	8.3	pass	20%	Pass	

Comments

Sample Integrity

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

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised by:

Hannah Mawbey	Analytical Services Manager
Jonathon Angell	Senior Analyst-Inorganic
Jonathon Angell	Senior Analyst-Sample Properties
Mary Makarios	Senior Analyst-Inorganic
Mary Makarios	Senior Analyst-Metal
Myles Clark	Senior Analyst-SPOCAS
Scott Beddoes	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

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

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

From: Jack Hanlon <jack.hanlon@cardno.com.au>
Sent: Tuesday, 18 October 2022 10:29 AM
To: Roberto Biviano <RobertoBiviano@eurofins.com>
Cc: Kostandreas Sykiotis <Kosta.Sykiotis@cardno.com.au>
Subject: RE: Eurofins Test Results, Invoice - Report 930290 : Site SOUTH GILLIESTON HEIGHTS (304100808)

Hi Roberto thank you for the results,

Could I please request detailed ASS testing (Chromium Reducible Sulfur Scr Suite) on the following samples;

TP004 / ES: 0.05 – 0.10 m OC00170053 DHOC007, BSOC101

TP008 / ES: 0.10 – 0.25 m OC00170060

Kind regards,

Jack Hanlon
Graduate Engineer

jack.hanlon@cardno.com.au

Stantec Australia
Suite 22, Level 2, 22 Honeysuckle Drive Newcastle New South Wales 2300 Australia

Cardno now Stantec

Stantec acknowledges the Traditional Owners of Country throughout Australia and recognises their continuing connection to lands, waters and communities. We pay our respect to Aboriginal and Torres Strait Islander cultures and to Elders past and present.

From: RobertoBiviano@eurofins.com <RobertoBiviano@eurofins.com>
Sent: Friday, 14 October 2022 5:56 PM
To: Kostandreas Sykiotis <Kosta.Sykiotis@cardno.com.au>
Cc: Jack Hanlon <jack.hanlon@cardno.com.au>
Subject: Eurofins Test Results, Invoice - Report 930290 : Site SOUTH GILLIESTON HEIGHTS (304100808)

#934161

Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne
VIC 3000

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Jack Hanlon**

Report **934161-S**
Project name SOUTH GILLIESTON HEIGHTS
Project ID 304100808
Received Date Oct 18, 2022

Client Sample ID			**TP004 / ES: 0.05 - 0.10**	**TP008 / ES: 0.10 - 0.25**
Sample Matrix			**Soil**	**Soil**
Eurofins Sample No.			**B22-Oc0047111**	**B22-Oc0047112**
Date Sampled			**Oct 05, 2022**	**Oct 05, 2022**
Test/Reference	LOR	Unit		
Actual Acidity (NLM-3.2)				
pH-KCL (NLM-3.1)	0.1	pH Units	5.6	5.0
Titratable Actual Acidity (NLM-3.2)	0.003	% pyrite S	0.013	0.024
Titratable Actual Acidity (NLM-3.2)	2	mol H+/t	8.3	15
Potential Acidity - Chromium Reducible Sulfur				
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)[S04]	0.005	% S	< 0.005	< 0.005
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	3	mol H+/t	< 3	< 3
Extractable Sulfur				
Sulfur - KCl Extractable	0.005	% S	N/A	N/A
HCl Extractable Sulfur	0.005	% S	N/A	N/A
Retained Acidity (S-NAS)				
Net Acid soluble sulfur (SNAS) NLM-4.1	0.02	% S	N/A	N/A
Net Acid soluble sulfur (s-SNAS) NLM-4.1[S02]	0.02	% S	N/A	N/A
Net Acid soluble sulfur (a-SNAS) NLM-4.1	10	mol H+/t	N/A	N/A
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0
Acid Neutralising Capacity (ANCbt)				
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	0.01	% CaCO3	N/A	N/A
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)[S03]	0.02	% S	N/A	N/A
Acid Neutralising Capacity - (a-ANCbt) (NLM-5.2)	2	mol H+/t	N/A	N/A
ANC Fineness Factor		factor	1.5	1.5
Net Acidity (Including ANC)				
CRS Suite - Net Acidity - NASSG (Including ANC)	0.02	% S	< 0.02	0.02
CRS Suite - Net Acidity - NASSG (Including ANC)	10	mol H+/t	< 10	15
CRS Suite - Liming Rate - NASSG (Including ANC)[S01]	1	kg CaCO3/t	< 1	1.1
Extraneous Material				
<2mm Fraction	0.005	g	44	47
>2mm Fraction	0.005	g	< 0.005	< 0.005
Analysed Material	0.1	%	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1
% Moisture	1	%	9.5	9.4

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	Oct 27, 2022	6 Week
- Method: LTM-GEN-7070 Chromium Reducible Sulfur Suite			
Extraneous Material	Brisbane	Oct 27, 2022	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Oct 24, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins

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NATA# 1261 Site# 20794

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Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

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Company Name: Stantec Australia Pty Ltd (NSW/ACT)
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Project Name: SOUTH GILLIESTON HEIGHTS
Project ID: 304100808

Order No.:
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Phone:
Fax:

Received: Oct 18, 2022 10:29 AM
Due: Oct 25, 2022
Priority: 5 Day
Contact Name: Jack Hanlon

Eurofins Analytical Services Manager : Hannah Mawbey

Sample Detail						Chromium Reducible Sulfur Suite	Moisture Set
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	TP004 / ES: 0.05 - 0.10	Oct 05, 2022		Soil	B22-Oc0047111	X	X
2	TP008 / ES: 0.10 - 0.25	Oct 05, 2022		Soil	B22-Oc0047112	X	X
Test Counts						2	2

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Results <10 times the LOR: No Limit

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

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

.

QC Data General Comments

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4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery							
Actual Acidity (NLM-3.2)							
pH-KCL (NLM-3.1)	%	97			80-120	Pass	
Titratable Actual Acidity (NLM-3.2)	%	100			80-120	Pass	
LCS - % Recovery							
Potential Acidity - Chromium Reducible Sulfur							
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)	%	100			80-120	Pass	
LCS - % Recovery							
Extractable Sulfur							
HCl Extractable Sulfur	%	113			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Actual Acidity (NLM-3.2)				Result 1	Result 2	RPD			
pH-KCL (NLM-3.1)	L22-Oc0051820	NCP	pH Units	8.9	8.9	<1	20%	Pass	
Titratable Actual Acidity (NLM-3.2)	L22-Oc0051820	NCP	% pyrite S	< 0.003	< 0.003	<1	30%	Pass	
Titratable Actual Acidity (NLM-3.2)	L22-Oc0051820	NCP	mol H+/t	< 2	< 2	<1	20%	Pass	
Duplicate									
Potential Acidity - Chromium Reducible Sulfur				Result 1	Result 2	RPD			
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)	L22-Oc0051820	NCP	% S	0.19	0.19	<1	20%	Pass	
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	L22-Oc0051820	NCP	mol H+/t	120	120	<1	30%	Pass	
Duplicate									
Extractable Sulfur				Result 1	Result 2	RPD			
Sulfur - KCl Extractable	L22-Oc0051820	NCP	% S	N/A	N/A	N/A	30%	Pass	
HCl Extractable Sulfur	L22-Oc0051820	NCP	% S	N/A	N/A	<1	20%	Pass	
Duplicate									
Retained Acidity (S-NAS)				Result 1	Result 2	RPD			
Net Acid soluble sulfur (SNAS) NLM-4.1	L22-Oc0051820	NCP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur (s-SNAS) NLM-4.1	L22-Oc0051820	NCP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur (a-SNAS) NLM-4.1	L22-Oc0051820	NCP	mol H+/t	N/A	N/A	N/A	30%	Pass	
Duplicate									
Acid Neutralising Capacity (ANCbt)				Result 1	Result 2	RPD			
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	L22-Oc0051820	NCP	% CaCO3	1.4	1.2	14	20%	Pass	
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)	L22-Oc0051820	NCP	% S	0.44	0.38	14	30%	Pass	
ANC Fineness Factor	L22-Oc0051820	NCP	factor	1.5	1.5	<1	30%	Pass	
Duplicate									
Net Acidity (Including ANC)				Result 1	Result 2	RPD			
CRS Suite - Net Acidity - NASSG (Including ANC)	L22-Oc0051820	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
CRS Suite - Net Acidity - NASSG (Including ANC)	L22-Oc0051820	NCP	mol H+/t	< 10	< 10	<1	30%	Pass	
CRS Suite - Liming Rate - NASSG (Including ANC)	L22-Oc0051820	NCP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B22-Oc0047649	NCP	%	8.9	8.5	5.1	30%	Pass	

Comments

Sample Integrity

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

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised by:

Bonnie Pu	Analytical Services Manager
Jonathon Angell	Senior Analyst-Sample Properties
Jonathon Angell	Senior Analyst-SPOCAS
Myles Clark	Senior Analyst-SPOCAS

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

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

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

From: Jack Hanlon
Sent: Thursday, 27 October 2022 5:08 PM
To: BonniePu@eurofins.com; Kostandreas Sykiotis
Subject: RE: Eurofins Test Results, Invoice - Report 930290 : Site SOUTH GILLIESTON HEIGHTS (304100808)

Hi Bonnie thank you for the results,

Could I please request detailed ASS testing (Chromium Reducible Sulfur Scr Suite) on the following samples;

TP022 / ES: 0.30 – 0.50 m

TP022 / ES: 0.60 – 0.80 m

TP024 / ES: 0.20 – 0.40 m

TP028 / ES: 0.05 – 0.10 m

Standard 5 day TAT is fine.

Kind regards,

Jack Hanlon
Graduate Engineer

jack.hanlon@cardno.com.au

Stantec Australia
Suite 22, Level 2, 22 Honeysuckle Drive Newcastle New South Wales 2300 Australia

Stantec acknowledges the Traditional Owners of Country throughout Australia and recognises their continuing connection to lands, waters and communities. We pay our respect to Aboriginal and Torres Strait Islander cultures and to Elders past and present.

From: BonniePu@eurofins.com <BonniePu@eurofins.com>
Sent: Thursday, 27 October 2022 4:16 PM
To: Kostandreas Sykiotis <Kosta.Sykiotis@cardno.com.au>
Cc: Jack Hanlon <jack.hanlon@cardno.com.au>
Subject: Eurofins Test Results, Invoice - Report 930290 : Site SOUTH GILLIESTON HEIGHTS (304100808)

Hi Kostandreas

Please find the attached draft report as discussed

Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne
VIC 3000

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Kosta Sykiotis**

Report **936167-S**
Project name SOUTH GILLIESTON HEIGHTS
Project ID 304100808
Received Date Oct 27, 2022

Client Sample ID			**TP022 / ES: 0.30 - 0.50 M**	**TP022 / ES: 0.60 - 0.80 M**	**TP024 / ES: 0.20 - 0.40 M**	**TP028 / ES: 0.05 - 0.10 M**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**B22-Oc0063190**	**B22-Oc0063191**	**B22-Oc0063192**	**B22-Oc0063193**
Date Sampled			**Oct 05, 2022**	**Oct 05, 2022**	**Oct 05, 2022**	**Oct 05, 2022**
Test/Reference	LOR	Unit				
Actual Acidity (NLM-3.2)						
pH-KCL (NLM-3.1)	0.1	pH Units	5.1	4.4	4.5	6.5
Titratable Actual Acidity (NLM-3.2)	0.003	% pyrite S	0.020	0.12	0.095	< 0.003
Titratable Actual Acidity (NLM-3.2)	2	mol H+/t	12	74	59	< 2
Potential Acidity - Chromium Reducible Sulfur						
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	3	mol H+/t	< 3	< 3	< 3	< 3
Extractable Sulfur						
Sulfur - KCl Extractable	0.005	% S	N/A	0.023	< 0.005	N/A
HCl Extractable Sulfur	0.005	% S	N/A	0.031	N/A	N/A
Retained Acidity (S-NAS)						
Net Acid soluble sulfur (SNAS) NLM-4.1	0.02	% S	N/A	< 0.02	N/A	N/A
Net Acid soluble sulfur (s-SNAS) NLM-4.1[S02]	0.02	% S	N/A	< 0.02	N/A	N/A
Net Acid soluble sulfur (a-SNAS) NLM-4.1	10	mol H+/t	N/A	< 10	N/A	N/A
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0	2.0	2.0
Acid Neutralising Capacity (ANCbt)						
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	0.01	% CaCO3	N/A	N/A	N/A	0.24
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)[S03]	0.02	% S	N/A	N/A	N/A	0.08
Acid Neutralising Capacity - (a-ANCbt) (NLM-5.2)	2	mol H+/t	N/A	N/A	N/A	47
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Including ANC)						
CRS Suite - Net Acidity - NASSG (Including ANC)	0.02	% S	< 0.02	0.13	0.10	< 0.02
CRS Suite - Net Acidity - NASSG (Including ANC)	10	mol H+/t	12	82	59	< 10
CRS Suite - Liming Rate - NASSG (Including ANC)[S01]	1	kg CaCO3/t	< 1	6.1	4.5	< 1
Extraneous Material						
<2mm Fraction	0.005	g	51	27	33	28
>2mm Fraction	0.005	g	< 0.005	3.5	5.1	< 0.005
Analysed Material	0.1	%	100	88	87	100
Extraneous Material	0.1	%	< 0.1	12	13	< 0.1
% Moisture	1	%	14	22	19	19

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	Nov 03, 2022	6 Week
- Method: LTM-GEN-7070 Chromium Reducible Sulfur Suite			
Extraneous Material	Brisbane	Nov 02, 2022	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Oct 28, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins

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Christchurch 7675
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IANZ# 1290

Company Name: Stantec Australia Pty Ltd (NSW/ACT)
Address: Level 22, 570 Bourke Street
Melbourne
VIC 3000

Project Name: SOUTH GILLIESTON HEIGHTS
Project ID: 304100808

Order No.:
Report #: 936167
Phone:
Fax:

Received: Oct 27, 2022 4:13 PM
Due: Nov 3, 2022
Priority: 5 Day
Contact Name: Kosta Sykiotis

Eurofins Analytical Services Manager : Hannah Mawbey

Sample Detail						Moisture Set	Chromium Suite - NASSG (Excluding ANC)
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	TP022 / ES: 0.30 - 0.50 M	Oct 05, 2022		Soil	B22-Oc0063190	X	X
2	TP022 / ES: 0.60 - 0.80 M	Oct 05, 2022		Soil	B22-Oc0063191	X	X
3	TP024 / ES: 0.20 - 0.40 M	Oct 05, 2022		Soil	B22-Oc0063192	X	X
4	TP028 / ES: 0.05 - 0.10 M	Oct 05, 2022		Soil	B22-Oc0063193	X	X
Test Counts						4	4

Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

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

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

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

Units

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

Terms

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

QC - Acceptance Criteria

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

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

Results <10 times the LOR: No Limit

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

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

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

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

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

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QC Data General Comments

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

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery							
Actual Acidity (NLM-3.2)							
pH-KCL (NLM-3.1)	%	97			80-120	Pass	
Titratable Actual Acidity (NLM-3.2)	%	95			80-120	Pass	
LCS - % Recovery							
Potential Acidity - Chromium Reducible Sulfur							
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)	%	104			80-120	Pass	
LCS - % Recovery							
Extractable Sulfur							
HCl Extractable Sulfur	%	106			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Actual Acidity (NLM-3.2)				Result 1	Result 2	RPD			
pH-KCL (NLM-3.1)	B22-Oc0060392	NCP	pH Units	4.3	4.3	<1	20%	Pass	
Titratable Actual Acidity (NLM-3.2)	B22-Oc0060392	NCP	% pyrite S	0.15	0.14	1.7	30%	Pass	
Titratable Actual Acidity (NLM-3.2)	B22-Oc0060392	NCP	mol H+/t	92	90	1.7	20%	Pass	
Duplicate									
Potential Acidity - Chromium Reducible Sulfur				Result 1	Result 2	RPD			
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)	B22-Oc0060392	NCP	% S	0.045	0.043	3.6	20%	Pass	
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	B22-Oc0060392	NCP	mol H+/t	28	27	3.6	30%	Pass	
Duplicate									
Extractable Sulfur				Result 1	Result 2	RPD			
Sulfur - KCl Extractable	B22-Oc0060392	NCP	% S	0.005	0.006	9.7	30%	Pass	
HCl Extractable Sulfur	B22-Oc0060392	NCP	% S	0.006	0.006	<1	20%	Pass	
Duplicate									
Retained Acidity (S-NAS)				Result 1	Result 2	RPD			
Net Acid soluble sulfur (SNAS) NLM-4.1	B22-Oc0060392	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acid soluble sulfur (s-SNAS) NLM-4.1	B22-Oc0060392	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acid soluble sulfur (a-SNAS) NLM-4.1	B22-Oc0060392	NCP	mol H+/t	< 10	< 10	<1	30%	Pass	
Duplicate									
Acid Neutralising Capacity (ANCbt)				Result 1	Result 2	RPD			
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	B22-Oc0060392	NCP	% CaCO3	N/A	N/A	N/A	20%	Pass	
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)	B22-Oc0060392	NCP	% S	N/A	N/A	N/A	30%	Pass	
ANC Fineness Factor	B22-Oc0060392	NCP	factor	1.5	1.5	<1	30%	Pass	
Duplicate									
Net Acidity (Including ANC)				Result 1	Result 2	RPD			
CRS Suite - Net Acidity - NASSG (Including ANC)	B22-Oc0060392	NCP	% S	0.19	0.19	2.5	30%	Pass	
CRS Suite - Net Acidity - NASSG (Including ANC)	B22-Oc0060392	NCP	mol H+/t	120	120	2.5	30%	Pass	
CRS Suite - Liming Rate - NASSG (Including ANC)	B22-Oc0060392	NCP	kg CaCO3/t	9.1	8.8	2.5	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B22-Oc0065294	NCP	%	6.2	5.9	4.4	30%	Pass	

Comments

Sample Integrity

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

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised by:

Hannah Mawbey	Analytical Services Manager
Jonathon Angell	Senior Analyst-Sample Properties
Jonathon Angell	Senior Analyst-SPOCAS

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

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

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

#AU03_EnviroSampleBris

From: Hannah Mawbey
Sent: Thursday, 17 November 2022 1:17 PM
To: #AU03_EnviroSampleBris
Subject: FW: Eurofins Test Results, Invoice - Report 930290 : Site SOUTH GILLIESTON HEIGHTS (304100808)

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: Awaiting Action

Hi Team,

Analysis was not added to the following samples: TP001 / 1.25-1.30 and TP006 / 1.20-1.30, can analysis please be added and the samples pushed into the lab? Oc0017067 Oc0017056

BSOC103 BSOC101

Kind Regards,
Hannah Mawbey
Analytical Services Manager

Salinity suite = CEC, ESP, Chloride, Sulfate, pH, EC, Resistivity ~~& Sodicity~~

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#942316

eurofins | Environment Testing

Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne
VIC 3000

Attention: **Jack Hanlon**

Report **942316-S**
Project name SOUTH GILLIESTON HEIGHTS
Project ID 304100808
Received Date Nov 17, 2022

Client Sample ID			**TP001 / ES: 1.25 - 1.30**	**TP006 / ES: 1.20 - 1.30**
Sample Matrix			**Soil**	**Soil**
Eurofins Sample No.			**B22-No0043695**	**B22-No0043696**
Date Sampled			**Oct 05, 2022**	**Oct 05, 2022**
Test/Reference	LOR	Unit		
Chloride	5	mg/kg	< 5	11
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	74	50
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	8.9	8.1
Resistivity*	0.5	ohm.m	140	200
Sulphate (as SO4)	30	mg/kg	< 30	< 30
Exchangeable Sodium Percentage (ESP)	0.1	%	4.2	15
% Moisture	1	%	8.8	11
Cation Exchange Capacity				
Cation Exchange Capacity	0.05	meq/100g	27	5.0

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
Chloride	Melbourne	Nov 21, 2022	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
pH (1:5 Aqueous extract at 25 °C as rec.)	Melbourne	Nov 21, 2022	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Melbourne	Nov 21, 2022	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Melbourne	Nov 21, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
Exchangeable Sodium Percentage (ESP)	Melbourne	Nov 22, 2022	28 Days
- Method: LTM-MET-3060 - Cation Exchange Capacity (CEC) & Exchangeable Sodium Percentage (ESP)			
% Moisture	Melbourne	Nov 18, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			
Cation Exchange Capacity	Melbourne	Nov 22, 2022	28 Days
- Method: LTM-MET-3060 Cation Exchange Capacity by bases & Exchangeable Sodium Percentage			

eurofins

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NATA# 1261 Site# 20794

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NZBN: 9429046024954

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IANZ# 1327

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43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: Stantec Australia Pty Ltd (NSW/ACT)
Address: Level 22, 570 Bourke Street
Melbourne
VIC 3000

Project Name: SOUTH GILLIESTON HEIGHTS
Project ID: 304100808

Order No.:
Report #: 942316
Phone:
Fax:

Received: Nov 17, 2022 1:17 PM
Due: Nov 24, 2022
Priority: 5 Day
Contact Name: Jack Hanlon

Eurofins Analytical Services Manager : Hannah Mawbey

Sample Detail						Chloride	pH (1:5 Aqueous extract at 25 °C as rec.)	Resistivity*	Sulphate (as SO4)	Moisture Set	Cation Exchange Capacity	Exchangeable Sodium Percentage (ESP)
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	TP001 / ES: 1.25 - 1.30	Oct 05, 2022		Soil	B22-No0043695	X	X	X	X	X	X	X
2	TP006 / ES: 1.20 - 1.30	Oct 05, 2022		Soil	B22-No0043696	X	X	X	X	X	X	X
Test Counts						2	2	2	2	2	2	2

Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

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

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

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

Units

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

Terms

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

QC - Acceptance Criteria

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

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

Results <10 times the LOR: No Limit

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

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

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

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

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

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QC Data General Comments

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

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/kg	< 5			5	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	uS/cm	< 10			10	Pass	
Sulphate (as SO4)	mg/kg	< 30			30	Pass	
LCS - % Recovery							
Chloride	%	120			70-130	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	%	96			70-130	Pass	
Sulphate (as SO4)	%	123			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	M22-No0043087	NCP	uS/cm	220	230	4.0	30%	Pass	
pH (1:5 Aqueous extract at 25 °C as rec.)	M22-No0043087	NCP	pH Units	8.4	8.3	pass	30%	Pass	
Resistivity*	M22-No0043087	NCP	ohm.m	45	43	4.0	30%	Pass	
% Moisture	B22-No0043695	CP	%	8.8	8.0	9.3	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Chloride	B22-No0043696	CP	mg/kg	11	5.7	61	30%	Fail	Q15
Sulphate (as SO4)	B22-No0043696	CP	mg/kg	< 30	< 30	<1	30%	Pass	

Comments

Sample Integrity

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

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised by:

Bonnie Pu	Analytical Services Manager
Mary Makarios	Senior Analyst-Metal
Linda Chouman	Senior Analyst-Sample Properties
Mary Makarios	Senior Analyst-Inorganic

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

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

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

Laboratory Chain of Custody

Client Name	Stantec	**Sampler**	Jack Hanlon	**Contact**	Jack Hanlon
Client Address	Suite 2, Level 2, 22 Honeysuckle Drive Newcastle	**Method**	Test Pit	**Mobile**	0422206115
Project Ref	304100808	**Request by**	Jack Hanlon	**Email**	jack.hanlon@cardno.com.au
Project Name	South Gillieston Heights GI	**Date**	7/10/2022	**Special Requirements / Comments**	
Site Location	507 Main Road, Gillieston Heights	**Results by**	Standard TAT		
Component/Stage		**Sample Hold**			

						Tests Required					**Notes**
						Soil	Soil	Soil	Soil		
						California Bearing Ratio	Atterberg Limits	Emerson Class Number	Permeability (Constant)		
						AS	AS	AS	AS		
Sample #	**Location**	**Depth**	**Date**	**Type**	**Material Description**	1289 6.1.1	1289 3.3.1	1289 3.8.1	1289 6.7.1		
	TP014	0.6-0.7	12/10/22	Bulk Bag	Silty CLAY t gravel			✓			
	TP014	1.0-1.2	12/10/22	Bulk Bag	Silty CLAY t sand						
	TP023	0.55-0.90	12/10/22	Bulk Bag	Silty CLAY t sand			✓	✓		These two bags are the same if you require more material
	TP023	0.55-0.90	12/10/22	Bulk Bag	Silty CLAY t sand						
	TP028	0.3-0.45	12/10/22	Bulk Bag	Silty CLAY t sand						

Sydney Laboratory
Unit 5/43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Material Test Report

Report No: SYD2202616
Issue No: 1

Client: Intrax Consulting Engineers Pty Ltd
U2, 50 Alliance Ave
Morisset NSW 2264

Project: 12534258

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 11/11/2022

Sample Details

GHD Sample No	SYD22-0493-01
Client Sample ID	4682B
Date Sampled	07/10/2022
Sampled By	Supplied by Client
	Gillieston Heights, NSW
Client Location	TP23 (0.55-0.90m)
	CLAY with sand; brown

Test Results

Description	Method	Result	Limits
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.62**	
Standard OMC (%)		**22.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		66	
Date Tested		2/11/2022	
Coef of Permeability (m/s)	AS 1289.6.7.3	2 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		74.4	
Diameter (mm)		64.0	
Length/Diameter Ratio		1.16	
Laboratory Moisture Ratio (%)		99.0	
Laboratory Density Ratio (%)		100.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (kg)		0.0	
Pressure Applied (kPa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		0.0	
Moisture Content (%)		25.0	
Date Tested		4/11/2022	

Comments

N/A

Material Test Report

Report Number: **PRJ771047-2**
Issue Number: 1
Date Issued: 25/10/2022
Client: Stantec Pty Ltd

Contact: Ian Piper
Project Number: PRJ771047
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd, Gillieston Heights NSW
Work Request: 4682
Sample Number: M22-4682A
Date Sampled: 18/10/2022
Dates Tested: 18/10/2022 - 24/10/2022
Sample Location: **TP014 , Depth: 0.6m - 0.7m**

Intrax Consulting Engineers Pty Ltd
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0499 779 118
Email: james.obrien@intrax.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James O'Brien
Laboratory Manager
NATA Accredited Laboratory Number: 19862

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description	Sandy CLAY, red / brown.		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	16		
* Mineral Present	Carbonate and Gypsum		

Material Test Report

Report Number: **PRJ771047-2**
Issue Number: 1
Date Issued: 25/10/2022
Client: Stantec Pty Ltd

Contact: Ian Piper
Project Number: PRJ771047
Project Name: South Gillieston Heights GI
Project Location: 507 Main Rd, Gillieston Heights NSW
Work Request: 4682
Sample Number: M22-4682B
Date Sampled: 18/10/2022
Dates Tested: 18/10/2022 - 24/10/2022
Sample Location: **TP023, Depth: 0.55m - 0.9m**

Intrax Consulting Engineers Pty Ltd
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0499 779 118
Email: james.obrien@intrax.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James O'Brien
Laboratory Manager
NATA Accredited Laboratory Number: 19862

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**8**		
Soil Description	CLAY, dark brown.		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	16		

APPENDIX

D

AUSTRALIAN GEOGUIDE (LR8)
HILLSIDE CONSTRUCTION PRACTICE

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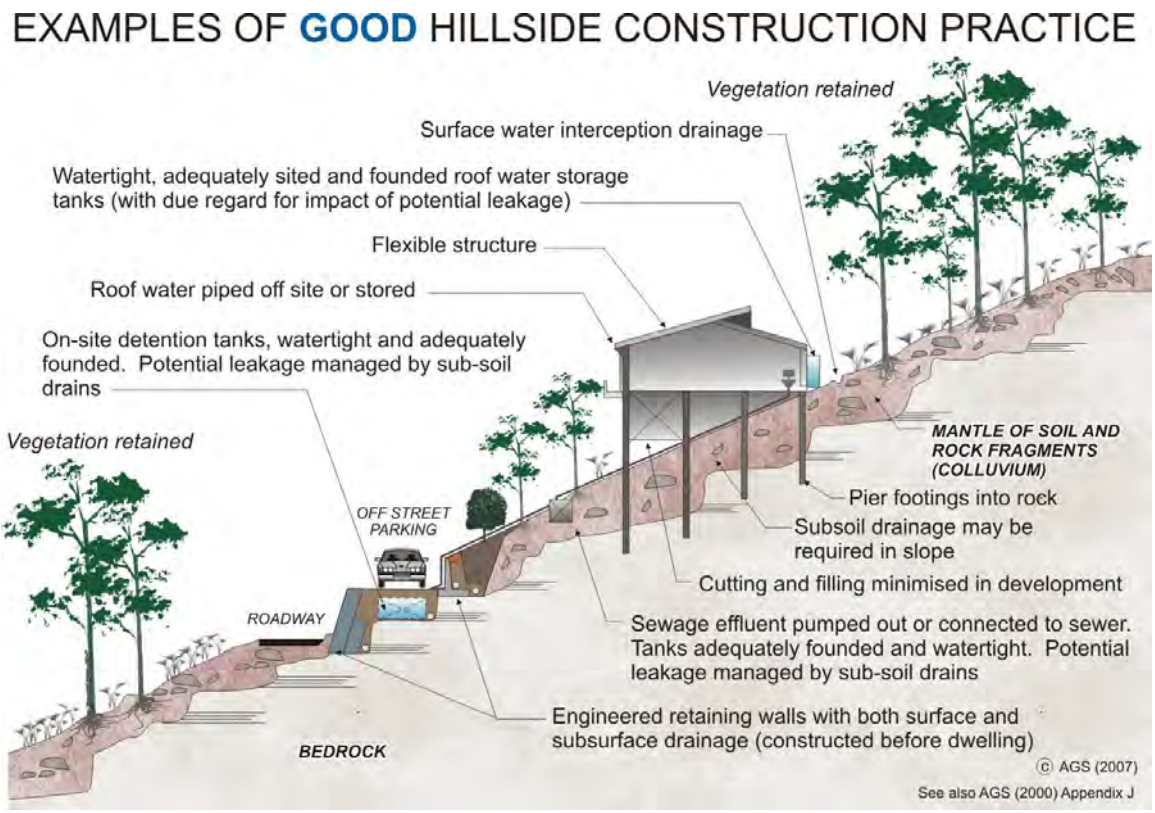
Stantec

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

HILLSIDE CONSTRUCTION PRACTICE

Sensible development practices are required when building on hillsides, particularly if the hillside has more than a low risk of instability (GeoGuide LR7). Only building techniques intended to maintain, or reduce, the overall level of landslide risk should be considered. Examples of good hillside construction practice are illustrated below.



WHY ARE THESE PRACTICES GOOD?

Roadways and parking areas - are paved and incorporate kerbs which prevent water discharging straight into the hillside (GeoGuide LR5).

Cuttings - are supported by retaining walls (GeoGuide LR6).

Retaining walls - are engineer designed to withstand the lateral earth pressures and surcharges expected, and include drains to prevent water pressures developing in the backfill. Where the ground slopes steeply down towards the high side of a retaining wall, the disturbing force (see GeoGuide LR6) can be two or more times that in level ground. Retaining walls must be designed taking these forces into account.

Sewage - whether treated or not is either taken away in pipes or contained in properly founded tanks so it cannot soak into the ground.

Surface water - from roofs and other hard surfaces is piped away to a suitable discharge point rather than being allowed to infiltrate into the ground. Preferably, the discharge point will be in a natural creek where ground water exits, rather than enters, the ground. Shallow, lined, drains on the surface can fulfil the same purpose (GeoGuide LR5).

Surface loads - are minimised. No fill embankments have been built. The house is a lightweight structure. Foundation loads have been taken down below the level at which a landslide is likely to occur and, preferably, to rock. This sort of construction is probably not applicable to soil slopes (GeoGuide LR3). If you are uncertain whether your site has rock near the surface, or is essentially a soil slope, you should engage a geotechnical practitioner to find out.

Flexible structures - have been used because they can tolerate a certain amount of movement with minimal signs of distress and maintain their functionality.

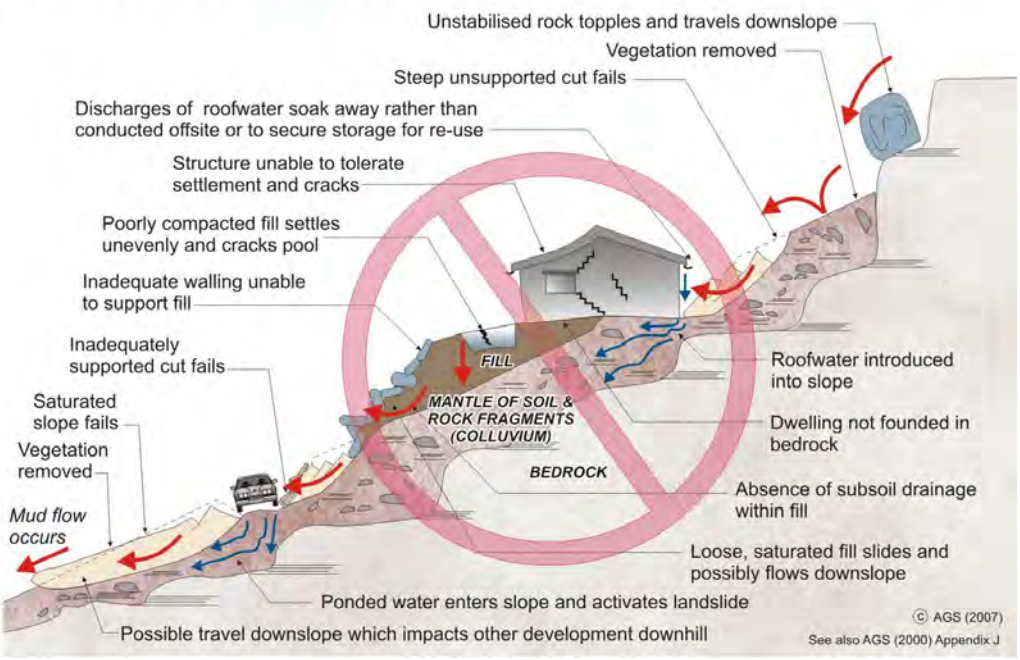
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing can result in a rise in water table with a consequent increase in the likelihood of a landslide (GeoGuide LR5). An exception may have to be made to this rule on steep rock slopes where trees have little effect on the water table, but their roots pose a landslide hazard by dislodging boulders.

Possible effects of ignoring good construction practices are illustrated on page 2. Unfortunately, these poor construction practices are not as unusual as you might think and are often chosen because, on the face of it, they will save the developer, or owner, money. You should not lose sight of the fact that the cost and anguish associated with any one of the disasters illustrated, is likely to more than wipe out any apparent savings at the outset.

ADOPT GOOD PRACTICE ON HILLSIDE SITES

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

EXAMPLES OF **POOR** HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES POOR?

Roadways and parking areas - are unsurfaced and lack proper table drains (gutters) causing surface water to pond and soak into the ground.

Cut and fill - has been used to balance earthworks quantities and level the site leaving unstable cut faces and added large surface loads to the ground. Failure to compact the fill properly has led to settlement, which will probably continue for several years after completion. The house and pool have been built on the fill and have settled with it and cracked. Leakage from the cracked pool and the applied surface loads from the fill have combined to cause landslides.

Retaining walls - have been avoided, to minimise cost, and hand placed rock walls used instead. Without applying engineering design principles, the walls have failed to provide the required support to the ground and have failed, creating a very dangerous situation.

A heavy, rigid, house - has been built on shallow, conventional, footings. Not only has the brickwork cracked because of the resulting ground movements, but it has also become involved in a man-made landslide.

Soak-away drainage - has been used for sewage and surface water run-off from roofs and pavements. This water soaks into the ground and raises the water table (GeoGuide LR5). Subsoil drains that run along the contours should be avoided for the same reason. If felt necessary, subsoil drains should run steeply downhill in a chevron, or herring bone, pattern. This may conflict with the requirements for effluent and surface water disposal (GeoGuide LR9) and if so, you will need to seek professional advice.

Rock debris - from landslides higher up on the slope seems likely to pass through the site. Such locations are often referred to by geotechnical practitioners as "debris flow paths". Rock is normally even denser than ordinary fill, so even quite modest boulders are likely to weigh many tonnes and do a lot of damage once they start to roll. Boulders have been known to travel hundreds of metres downhill leaving behind a trail of destruction.

Vegetation - has been completely cleared, leading to a possible rise in the water table and increased landslide risk (GeoGuide LR5).

DON'T CUT CORNERS ON HILLSIDE SITES - OBTAIN ADVICE FROM A GEOTECHNICAL PRACTITIONER

More information relevant to your particular situation may be found in other Australian GeoGuides:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR9 - Effluent & Surface Water Disposal

GeoGuide LR10 - Coastal Landslides

- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.