# Report on Preliminary Geotechnical Investigation

259 Windermere Road, Windermere NSW

81022070

Prepared for

Newpro27 Pty Ltd

14 December 2022

Cardno

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Stantec

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# 1 Introduction

This report presents the findings of a preliminary geotechnical investigation undertaken by Cardno, now Stantec Australia Pty Ltd (Stantec) for the proposed residential development located at 259 Windermere Road, Windermere NSW (the site). The investigation was commissioned by Mr Tom Goold of Newpro27 Pty Ltd via email confirmation. The current subject site is a proposed extension to the existing DA approved 48 Windermere Road development and the report has been prepared as a preliminary concept report to inform likely design issues based on the abutting development.

Stantec have been provided with the following design plans:

- Concept design plans titled “Proposed Subdivision – 259 Windermere Road, Lochinvar – Lot Layout Plan”, referenced 21460DA, revision 7, dated 27/07/2022.
- Civil design plans titled “Proposed Subdivision – 259 Windermere Road – Development Application Plans, referenced 21460C, revision 2, dated October 2022 [1].

Based on the supplied plans, the proposed residential development comprises the following:

- The creation of 96 residential allotments (Lot 101-196).
- Construction of utilities and ancillary infrastructure (sewer, electrical services etc.).
- Internal subdivision pavements (Road 2, Road 3, Road 11-14) and associated stormwater infrastructure.
- Construction of a basin in the south-east portion of the site, to be connected to the proposed basin associated with the 48 Windermere Road residential subdivision.
- Widening of Windermere Road.

The geotechnical investigation was undertaken in conjunction with a Preliminary Site Investigation (PSI) undertaken by Stantec prepared under cover “Report on Preliminary Site Investigation – 259 Windermere Road, Windermere NSW”, referenced 81022070-001, dated 7/10/2022 [2].

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

- Advice and recommendations for basin construction.
- Comment on earthwork conditions and suitability of site won material for reuse.
- Recommendations for earthworks procedures and guidelines.
- Retaining wall design parameters.
- Requirements for de-commissioning of existing dam farms.
- Comment on founding conditions and footing design recommendations.
- Pavement design for the proposed internal roads.

Relevant data from a geotechnical investigation undertaken by Stantec to the south of the subject site has been included within this report. The report was prepared under cover “Report on Geotechnical Investigation – 48 Windermere Road, Lochinvar NSW”, referenced 81021034-002.5”, dated 29/11/2022 [3].

# 2 Previous Investigation

Stantec have previously undertaken geotechnical report for the proposed residential development to the south to provide geotechnical comment and recommendation. The investigation was reported under cover "Report on Geotechnical Investigation – 48 Windermere Road, Lochinvar NSW", referenced 81021034-002.5", dated 29/11/2022 [3].

The investigation comprised the excavation of 30 test pits within the proposed pavement and residential allotments with a 3.5t excavator fitted with a 450 mm tooth bucket, with dynamic cone penetrometer (DCP) testing was undertaken at test pit locations. Subsurface conditions encountered during the investigation comprised:

- FILL: Silty CLAY / Sandy GRAVEL to depths in the range of 0-0.3 m BGL. Filling was typically associated with existing farm dams, existing access tracks/horse training tracks, and previous structures noted across the site.
- ALLUVIAL: Silty CLAY of low plasticity with varying fractions of gravel and sand were towards the eastern boundary of the site, associated with Lochinvar Creek.
- COLLUVIUM: Silty CLAY of varying plasticity encountered at depths of 0.10-0.45 m BGL. Colluvium soils were observed to have a moisture content greater than plastic limit and were of stiff consistency.
- RESIDUAL: Silty CLAYs of pale to reddish brown colour were encountered to depths of 0.6 to 2.0 m BGL. Residual clays were typically of medium to high plasticity and ranged from firm to hard consistency. Moisture was observed to range from above to below plastic limit across the site.
- EXTREMELY WEATHERED MATERIAL (EWM): Silty / Sandy CLAY and Clayey SAND of brown - yellow, pale brown mottled red and reddish brown, encountered to depths of 1.3 to 2.0 m BGL. EWM was typically of medium plasticity clays and fine to coarse sand, and of generally hard consistency or dense density. Moisture was observed to be below the plastic limit or dry to moist.
- WEATHERED ROCK: SANDSTONE, fine to medium grained and reddish brown in colour, encountered in one test pit at a depth of 0.9 m BGL.

Laboratory testing undertaken on recovered samples comprised CBR, shrink swell, Emerson Class, Atterberg limits, and permeability testing. Laboratory testing previously undertaken has been included within this report.

Site plan and logs from the previous report have been included in Appendix D.

# 3 Site Identification

The site is a rectangular parcel of land identified as a portion of 259 Windermere Road, Windermere NSW, situated within the southern portion of Lot 1902 DP1112961. The subject site is highlighted in Figure 1 attached in Appendix A, and is bounded by:

- The remaining portion of 259 Windermere Road to the north.
- Rural residential property to the south, DA approved residential development.
- Lochinvar Creek along the eastern boundary of the site, with residential properties further to the east.
- Windermere Road long the western boundary with rural residential properties further to the west.

Topographically the site is located within gently sloping, undulating terrain. The local topography is characterised by gentle slopes falling from the northwest corner of the site to the south-east. Drainage is expected to comprise surface runoff towards Lochinvar Creek towards the east of the Site.

Vegetation generally comprises open pasture with a concentration of mature trees along the eastern boundary, associated with Lochinvar Creek.

The following features were observed at the time of site investigation:

- An overland flow path was noted running from the northwest portion of the site through the middle of the site to a dam on the adjacent property to the south.
- The southwest corner of the site had been stripped with a gravel hard stand formed.
- Rutting was noted during tracking of a 5t excavator during the investigation works due to softening of surficial soils from sustained periods of rain in the lead up to the investigation.
- Surficial topsoil was noted to be virtually saturated during the investigation.

# 4 Investigation Methodology

## 4.1 Subsurface Investigation

As part of the PSI investigation [2] intrusive investigation was undertaken on 13th April 2022 by Stantec, and comprised the following:

- A site walkover and visual inspection by a geotechnical consultant from Stantec including logging of significant site features.
- Excavation of seven (7) test pits (TP001-TP007) targeted within proposed pavements and residential lots with a 5t excavator fitted with 450 mm toothed bucket. Test pits were advanced to a maximum depth of 2.0 m below ground level (BGL).
- All test pits were backfilled with excavated spoil on completion.
- Dynamic Cone Penetrometer (DCP) testing was undertaken at each test pit to assess subsurface strength properties.
- Bulk, disturbed and thin walled (U50 tubes) samples were taken for subsequent laboratory assessment.

Field investigation including logging of subsurface profiles and collection of samples was carried out a geotechnical consultant from Stantec. Test pits were located using site boundaries and features. The location of the test pits are shown on Figure 1, attached in Appendix A. Subsurface conditions are summarised below and detailed in the engineering logs attached in Appendix B with explanatory notes.

It should be noted that access to the eastern portion of the site was restricted due to an exclusion zone associated with Aboriginal Heritage Potential Archaeological Deposits (PADs) in the area. As such, no sampling or excavation was undertaken within the nominated exclusion zone, however the area was still subject to inspection.

## 4.2 Laboratory Testing

While no specific geotechnical laboratory testing was undertaken during the current assessment, testing from previous investigation to the south has been adopted for the purpose of this report. Results are considered relevant based on the test pitting and classification of the encountered subsurface profile. Testing on selected samples recovered during the geotechnical investigation for 48 Windermere Road [3] comprised the following:

- Two (2) California Bearing Ratio (CBR) tests to assess proposed subgrade strength.
- Five (5) Shrink Swell tests to measure soil volume change over an extreme soil moisture content range.
- Two (2) Emerson Class tests to measure soil dispersion.
- One (1) Atterberg Limits test to assist in material classification.
- One (1) Permeability test to determine site soil permeability.

The previous geotechnical laboratory testing was conducted at NATA accredited construction materials testing laboratory. Results of laboratory testing are detailed in the report sheets attached in Appendix C and summarised in Section 5.3 below.

# 5 Investigation Findings

## 5.1 Published Data

### 5.1.1 Regional Geology

Reference to the NSW Seamless Geology dataset [4] indicates that the Site is underlain by the Lochinvar Formation of the Dalwood Group **(Pdal)** known to comprise of Early Permian deposits of basalt, siltstone, sandstone and residual soils derived from the weathering of these deposits.

### 5.1.2 Acid Sulfate Soils

Review of the Maitland Local Environmental Plan (LEP) 2011 Acid Sulfate Soils Risk Map indicates the Site is situated within Class 5 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 water table is likely to be lowered below 1 metres AHD on adjacent Class 1, 2, 3 or 4 land, present an environmental risk*

Further review of the NSW Government Planning, Industry & Environment eSPADE v2.2 mapping system (eSPADE) [5] indicates that the Site not situated within an area of known occurrence.

### 5.1.3 Soil Landscape Maps

A review of eSPADE [5] indicates that the investigation site is situated within the Lochinvar (NKB-1v) soil landscape – comprising in situ weathered parent rock and derived alluvium from the Lochinvar formation. These rocks comprise siltstone, sandstone, basalt and tuff. The mapping indicates site soil salinity is low to moderate with localised salinity hazards.

## 5.2 Subsurface Conditions

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

- TOPSOIL: Clayey/Sandy SILT was encountered in all test pits, except for TP006. The depth of topsoil ranged from 0.1 -0.15 m below ground level (BGL).
- COLLUVIAL: Clayey SAND/ Silty, Sandy CLAY and Gravelly, Sandy SILT were encountered in TP001, TP003-TP007, to depths in the range of 0.25–0.9 m BGL. The colluvial soils encountered ranged in plasticity from medium to high, with fine to coarse grained sand and traces of fine to coarse gravel. Granular colluvial soils were observed to be wet, with cohesive soils of moisture content greater than plastic limit and were of very loose to loose density and soft to firm consistency respectively.
- RESIDUAL: Sandy/Silty CLAY were encountered in all test pits to depths ranging from 1.0 m to investigation limits of 2.0 m BGL. Residual clays were typically of medium to high plasticity and ranged from firm to hard consistency. Residual clays had observed moisture content ranging from equal to greater than plastic limit. Varying fractions of sand and gravel were encountered in the residual soils.
- EXTREMELY WEATHERED MATERIAL (EWM): Clayey SAND of brown and grey mottled yellow colour were encountered in TP001, TP003 and TP005 to depths of 1.4 m to investigation limits of 2 m BGL. The Sand was typically fine to coarse grained and was generally dense to very dense. Moisture was observed to be moist to dry.

Groundwater was not observed at the time of the investigation; however, inflow was noted from ponded water due to recent inclement weather. It should be noted that groundwater is likely to fluctuate with variations in climatic and site conditions particularly after sustained periods of inclement weather.

Test pit logs attached in Appendix B should be referenced for full details of the subsurface profile encountered.

## 5.3 Laboratory Results

The results of the geotechnical testing undertaken during the previous 48 Windermere Road investigation [3] has been summarised below, with the laboratory report sheets attached in Appendix C.

### 5.3.1 Shrink Swell Testing

The results of the laboratory shrink swell tests undertaken on the adjacent site are summarised below in Table 5-1 with the test report sheets attached in Appendix C.

Table 5-1 Summary of Shrink Swell Test Results

| Pit ID | Depth (m) | Sample Type | Soil Type | Swelling Strain (Esw %) | Shrinkage Strain (Esh %) | Shrink/Swell Index (Iss %) |
|---|---|---|---|---|---|---|
| TP002 | 0.35-0.58 | U50 | CLAY: brown | 1.2 | 11.2 | 6.6 |
| TP004 | 1.60-1.85 | U50 | Silty CLAY: pale grey | 5.7 | 2.9 | 3.2 |
| TP011 | 1.50-1.63 | U50 | Silty CLAY: red-brown | 4.0 | 2.8 | 2.7 |
| TP026 | 0.95-1.35 | U50 | CLAY: pale brown | 0.4 | 7.0 | 4.0 |
| TP030 | 0.20-0.40 | U50 | Silty CLAY: reddish brown | 0.7 | 6.1 | 3.6 |

Notes to table:
U50: Testing undertaken on thin walled 50mm diameter tube

### 5.3.2 California Bearing Ratio Test Results

The results of the standard compaction CBR testing undertaken on the adjacent site 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 (%) |
|---|---|---|---|---|---|---|---|
| TP003 | 0.3-0.5 | CLAY: pale brown | 29.0 | 26.5 | 1.53 | 2.0 | 3.0 |
| TP010 | 0.5-0.6 | CLAY: brown | 24.9 | 26.0 | 1.56 | 1.0 | 4.0 |

Notes to table:
W: Field Moisture Content
SOMC: Standard Optimum Moisture Content
SMDD: Standard Maximum Dry Density

### 5.3.3 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 |
|---|---|---|---|---|
| TP015 | 0.9-1.1 | CLAY: brown | 6 | No Dispersion |
| TP016 | 0.8-0.9 | Silty CLAY: dark brown | 6 | No Dispersion |

### 5.3.4 Atterberg Limits Test Results

The results of the laboratory Atterberg Limits tests undertaken on cohesive soils on the adjacent site are summarised below in Table 5-4 with the test report sheets attached in Appendix C.

Table 5-4 Summary of Atterberg Limits Test Results

| Test Pit ID | Depth (m) | Sample Type | Soil Type | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) |
|---|---|---|---|---|---|---|
| TP015 | 0.9-1.1 | D | CLAY: brown | 85 | 23 | 62 |

Notes to table:
D: Testing on disturbed sample

### 5.3.5 Permeability Test Results

The results of the permeability test undertaken on a selected samples from the adjacent site are summarised below in Table 5-5.

Table 5-5 Summary of Permeability Test Results

| Pit ID | Depth (m) | Soil Type | Sample Compaction (%) | Coefficient of Permeability (m/sec) |
|---|---|---|---|---|
| TP015 | 0.9-1.1 | CLAY: Brown | 99.0 | $1\times10^{10}$ |

# 6 Geotechnical Comment and Recommendation

## 6.1 Earthworks

Based on the supplied civil plans [1], earthworks for the proposed development are to comprise excavations and filling ranging up to approximately 1.0 m. Filling is predominately associated with filing of the existing gully line through Lots 161-169 and the southern portion of Road 2, and the eastern boundary of Road 11, associated with the Lochinvar Creek embankment. Deeper cuts and fill in the order of 2.5 m are proposed associated with the proposed basin in the southeast portion of the site.

It should be noted localised softening and rutting of surficial soils was noted at the time of investigation due to inclement weather in the lead up to the investigation. Trafficability issues may be encountered due to saturation of topsoil and colluvial soils following periods of inclement weather and should be considered during construction. Groundwater was noted encountered during the investigation however seepage was noted in TP006 associated with saturated colluvial soils.

### 6.1.1 Excavations

Considering the proposed depth of excavations and the site investigation findings, excavations into the topsoil, colluvial and residual soils are expected to be readily undertaken using conventional earthmoving equipment. Given refusal was encountered during the investigation on extremely/very weathered SANDSTONE with a 5t excavator, for any excavations that exceed the depth of investigation, assistance by hydraulic rock hammers may be required.

Particular allowance should be made for confined trenching into the rock profile, such as sewer and stormwater excavations, and in deeper cuts associated with the proposed basin.

Excavations or trenches in the residual stiff or better soils and the weathered rock profile would be expected to stand close to vertical in the short-term. 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.

### 6.1.2 Filling

Earthworks for the development are expected to comprise minor cut and fill. Fill should be placed and compacted in accordance with AS 3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments* [6].

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

- Removal of any existing fill, topsoil, slopewash 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.
- 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 must be blended with other site soils to be used as fill.
- Fill should not comprise material with particle sizes of greater than 100mm or 2/3 of the compacted layer thickness.
- Benching of the slopes where fill is to be placed with slopes steeper than 8H:1V will be required.
- Placement of fill 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.
- Within the road alignments, subgrade formation moisture specification will need to be maintain at -2 to 0% of OMC.
- Prior to filling works in existing dam footprints, the decommissioning methodology below must be undertaken.

Filling materials are expected to comprise clays and extremely weathered rock won during bulk earthworks. Where possible, highly plastic surficial site won clays are proposed to be used as filling should be placed as deep as possible to reduce negative impacts on site classifications. It is suggested that where possible this

material is used where filling >1.0m is required, where the top portion of lot & pavement fill consists of less reactive material such as site won 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.

Fill materials are expected to comprise of the following:

- Site won alluvial, colluvial, residual & extremely weathered clay materials: Generally, soils excavated on site with the exception of topsoil and soils of high silt content are considered suitable for reuse as engineering fill. Sandy colluvial soils may require blending with cohesive soils prior to reuse.
- Where excavations extend into the weathered rock profile, site won ripped sandstone / siltstone would be considered suitable for the development. Generally, all site won ripped rock would be suitable for re-use following reconditions and grading for particle size requirements.

### 6.1.3 Existing Overland Flow Path

Filling of the existing gully traversing from the western to the southeast portion of the site is proposed as part of the bulk earthworks. As the gully has been subject to overland flows, additional stripping may be required to remove silt build-up and material with elevated moisture. Earthworks for the existing drainage line would comprise the following:

- Removal of any topsoil, slop-wash / colluvium, over-wet, organic, or deleterious materials from the areas where fill is to be placed.
- Stripping of all sediment and moisture impacted material.
- 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. Filling is to be undertaken as detailed in Section 6.1.2 above.
- Consideration should be made to diverting surface flows during earthworks within the existing drainage line.

## 6.2 Basin Construction

Based on the provided civil design plans [1], a stormwater detention basin is proposed to be constructed in the southeast corner of the development. The basin is to be constructed such that it forms a larger basin with the proposed basin for the 48 Windermere Road residential development.

### 6.2.1 Proposed Earthworks

The existing basin in the northeast of the 48 Windermere Road development is to be augmented with additional wall support in the form of filling proposed around the dam to form a permanent basin. The basin is then proposed to be extended to the north during the 259 Windermere Road development. Earthworks for the proposed basin extension comprises excavations ranging up to 2.5 m BGL to form the western and northern walls, and impoundment area, with filling in the order of 2.5 m proposed to form the eastern wall. Filling is proposed to be placed to extend the existing Lochinvar Creek embankment along the eastern boundary of the Site.

Filling works associated with the eastern wall will required benching into the existing embankment slopes such that additional fill is keyed into the natural soil profile. Appropriate sediment and erosion control should be provided prior to earthworks to protect Lochinvar Creek.

No test pitting was undertaken within the proposed basin extension due to Potential Archaeological Deposits (PADs) being present in the area. Based on test pitting undertaken during the previous 48 Windemere investigation [3], founding conditions for the walls and impoundment area are expected to comprise firm to stiff alluvial & residual Silty CLAY profiles. Alluvial clays encountered from approximately 0.55-0.75 m below ground levels were consistent in strength with underlying residual clay. This indicates that additional excavation may be required however the stiff alluvial Silty CLAY will be acceptable as a foundation for the basin. This will be subject to inspections by a suitably qualified geotechnical consultant.

### 6.2.2 Embankment Requirements

Table 6-1 below provides general material requirements and compaction specifications for the construction of a zoned embankment for temporary and permanent basins.

Table 6-1 Embankment Material Specification

| Specifications | Zone 1 – Clay Core Material | Zone 2 – Embankment Fill |
|---|---|---|
| **Material Property** | | |
| Material Description | CLAY, sandy/silty CLAYs with minor gravel content | |
| 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

Subsurface profiles encountered during the investigation comprise Silty SAND overlying highly plastic clay, overlying medium plastic clays then grading to weathered rock. Based on testing undertaken, it is considered the highly plastic surficial clays may require amelioration prior to use in basin wall construction.

It is expected the foundation for the clay core would comprise alluvial and residual soils. Stiff alluvial and residual clays are expected to be suitable for clay core foundation, however, will be subject to inspection during construction. All batter slopes within the impoundment area should be 1V:5H or flatter.

### 6.2.3 Embankment Foundation Treatment

Based on the subsurface conditions encountered during the previous investigation [3] and earthworks shown in the provided civil design plans [1], embankment foundation conditions are expected to comprise residual & alluvial clays for the basin walls, and a combination of residual/alluvial soil and weathered rock for the impoundment area.

The following general foundation preparation requirements must be adopted:

- Removal of all uncontrolled filling or topsoil material.
- 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 below the invert of the basin.
- Inspection of clay or controlled filling foundation and key by an experienced geotechnical consultant to assess potential defects and potential seepage.
- Where weathered rock is encountered within the impoundment area, ripping and recompacting or the application of a clay liner may be required. This would be subject to inspection by a suitably qualified geotechnical consultant.

### 6.2.4 Keyway Construction

The basin will consist of a keyway location subject to founding conditions during construction. The basin walls are likely to be founded in stiff alluvial / residual clay/extremely weathered rock. The location of the keyway subject to inspection by a suitably qualified geotechnical consultant. Keyway construction is to comply with material specifications as per Table 6-2 and general filling methodology outlined in Section 6.1.2.

### 6.2.5 Stormwater Outlets and Seepage Collars

A seepage collar will be required to be constructed along stormwater pipes proposed to traverse the basin embankment 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.

### 6.2.6 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.

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.

Rock rip rap scour protection shall be included for erosion control at all inlet and outlet points including emergency spillways.

### 6.2.7 Embankment Construction and 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 6-1. 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. Emergency spillways are to be included in the construction of the basins as per the provided drawings

# 7 Pavement Thickness Design

Pavement thickness design has been undertaken based on the findings of the geotechnical investigation and 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 [7].
- Maitland City Council (MCC) Manual of Engineering Standards, Chapter 5: Road Pavement Design [8].

## 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 [9] and Chapter 5: Pavement Design [8] based on the road type designations specified by lot serviceability. Pavement design traffic loading has also been cross referenced with requirements for the proposed adjoining development to the south. Table 7-1 below provides a summary of the proposed internal road traffic loading.

Table 7-1 Design Traffic Loading (Roads 2, 3, 11-14)

| Road | Road Designation | Design Equivalent Standard Axles (DESA) |
|---|---|---|
| Road 2, Road 11-14 | Local – Secondary | $2 \times 10^5$ |
| Road 3 | Collector – Primary (Bus Route) | $2 \times 10^6$ |

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

### 7.1.2 Design Subgrade

Based on the supplied plans [3], earthworks comprise cut and fill in the order of 1.0 m across the proposed pavements, with the majority of the proposed fill associated with the filling of the existing gully line. Filling is also proposed along the northeast boundary of Road 11.

It should be noted colluvial soils will likely be encountered at proposed subgrade level. Colluvial soils may require excavation and replacement subject to inspection by a suitably qualified geotechnical consultant. Colluvial soils were generally wet at the time of investigation and as such, allowance should be made for excavation and moisture conditioning.

Subgrade conditions along the proposed internal roads are expected to generally comprise a mixture of residual clays, extremely weathered rock and site won fill. The road alignment should be considered during the bulk earthworks, with better quality material placed in proposed road alignments. Additional fill subgrade may be required in portions of road and where over excavation takes place and as such, the design subgrade CBR would be dependent on the material being utilised.

The results of the CBR tests undertaken during the previous investigation [3] on potential subgrade material indicate that CBR values for residual silty clay soils encountered within the test pits produced CBR values between 3-4%. A design CBR of 3% for residual soils and general fill has been adopted to accommodate for the use of site won residual clays.

It is understood that it is MCC's preference that a 300 mm select layer is adopted to reduce the effect of reactive subgrades on pavement performance. Allowance for a minimum 300 mm select layer with CBR≥15% can increase overall CBR value to 8%, which has been adopted for the pavement design. Proposed imported select material will need to be confirmed for its quality by a suitably qualified geotechnical consultant.

With reference to above, the following design CBR's have been adopted for design:

- CBR = 8%: Residual clays & General fill with 300 mm of select fill.

Confirmatory CBR testing shall be undertaken during construction to confirm design assumptions.

### 7.1.3 Reactivity

The subsurface conditions encountered in the test pits across the site generally comprised of topsoil / colluvium overlying natural clays of generally higher plasticity and moisture before grading to less plastic clays and weathered rock with depth. Based on swell values from CBR testing, clays are moderately expansive.

Where pavement is founded on highly plastic 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 [7]. The specific considerations in relation to expansive 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.

Assessment of the subgrade materials is to be undertaken during the construction phase by an on-site experienced geotechnical consultant/engineer. Where expansive exposed subgrade is identified, suitable measures should be undertaken to mitigate the potential for volume change including those abovementioned. It is understood that over excavation and placement of a 300 mm low reactive select fill layer is a preference of Maitland City Council. This has been adopted in pavement design below.

Due to experience in nearby projects, this may need to be augmented pending inspection by a suitably qualified geotechnical consultant and the use of additional select or site won fill may be required. It should also be ensured that any reactive clays utilised as fill are placed lower where possible in road alignments.

## 7.2 Pavement Design

Based on the results of the test pitting and CBR testing, flexible unbound granular pavement would be the most cost-effective option for the construction of the internal roads. Pavement design thicknesses calculated for internal pavements are summarised below.

Table 7-2 Pavement Thickness Design for Road 2, 11-14 (DESA = $2x10^5$)

| | Thickness | Recommended Material Type (1) |
|---|---|---|
| Wearing Course(2) | 30mm | AC10 |
| Base Course (3) | 160mm | DGB20, GMB20, NGB20-2c |
| Subbase Course | 125mm(4) | DGS20/40, GMS40, NGS20/40 |
| Select Material | Min 300mm | CBR ≥ 15% |
| Total Thickness(5) | 615mm (6) | Total Thickness |
| Select Material | SELECT FILL overlying Silty CLAY | Select Material |
| Subgrade CBR | 3% | Subgrade CBR |
| Design traffic | $2 \times 10^5$ DESA | |
| Design Life | 30 years | |

Notes to table:
(1) Refer to Section 7.3.2 for material specifications.
(2) 10 mm Primer Seal required.
(3) 160mm basecourse has been selected for tie in with 190mm kerb and gutter. Minimum 140mm base material as per Figure 8.4 of Austroads [7] has been neglected for constructability purposes.
(4) Minimum subbase thickness of 125mm as per MCC Guidelines.
(5) Include 300 mm select layer as per MCC requirements.
(6) 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 3 (DESA = $2x10^6$)

| | Thickness | Recommended Material Type (1) |
|---|---|---|
| Wearing Course(2) | 40mm | AC10 |
| Base Course (3) | 150mm | DGB20, GMB20 |
| Subbase Course | 130mm | DGS20/40, GMS40 |
| Select Material | Min 300mm | CBR ≥ 15% |
| Total Thickness (4) | 620mm | Total Thickness |
| Subgrade Material | SELECT FILL overlying Silty CLAY | Subgrade Material |
| Subgrade CBR | 3% | Subgrade CBR |
| Design traffic | $2 \times 10^6$ DESA | |
| Design Life | 30 years | |

Notes to table:
(1) Refer to Section 7.3.2 for material specifications.
(2) 10 mm primer seal required.
(3) 150mm basecourse has been selected for tie in with 190mm kerb and gutter. Minimum 145mm base material as per Figure 8.4 of Austroads [7] has been neglected for constructability purposes.
(4) Includes 300 mm select layer as per MCC requirements.

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 [8] Chapter 5.1 states that AC wearing course for flexible pavements may be included in total pavement thickness, and have been undertaken by reducing the subbase thickness where possible to limit pavement depths. Where additional pavements 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

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.

- Excavation to design subgrade level, with the stockpiling of the excavated material for reuse (if acceptable) following the reconditioning. Material to be removed offsite for disposal or recycling where not required or not acceptable as fill.
- 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.
- Identification of the need for removal and replacement of any potential higher reactive clays and replacement with site won or select fill. Depth of replacement would be subject to visual inspection by suitably qualified geotechnical consultant.
- 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.
- 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.
- Where filling or subgrade replacement is required, the materials employed should be free of organics or other deleterious material and could compromise the existing site-won ripped sandstone material or stockpile. The material should also have a maximum particle size of 100mm or one third of the layer thickness, with a soaked CBR > 15%.
- Compaction of the subgrade, filling or select should be to a minimum 100% of SMDD (or 70% Density Index for non-cohesive materials) in layers of not greater than 250mm loose thickness. Moisture contents should be within 70% to 90% of SOMC.

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 and Compaction Requirements

Pavement materials and compaction requirements for the new pavement construction should conform to Maitland City Council specifications and the following requirements.

Table 7-4 Material Specification and Compaction Requirements

| Pavement Course | Material Specification | Compaction Requirements |
|---|---|---|
| **Road 2, Road 11-14** | | |
| **Base Course**<br>High quality crushed rock | Material complying with RMS QA Specifications 3051 Category D [10] | Min 98% Modified (AS 1289 5.2.1) |
| **Subbase**<br>Subbase quality crushed rock | Material complying with RMS QA Specifications 3051 Category D [10] | Min 95% Modified (AS 1289 5.2.1) |
| **Road 3** | | |
| **Base Course**<br>High quality crushed rock | Material complying with RMS QA Specifications 3051 Category C [10] | Min 98% Modified (AS 1289 5.2.1) |
| **Subbase**<br>Subbase quality crushed rock | Material complying with RMS QA Specifications 3051 Category C [10] | Min 95% Modified (AS 1289 5.2.1) |
| **All Pavements** | | |
| **Select**<br>Crushed rock or gravel, generally consistent with a subbase type material | CBR ≥ 15% | Min 100% Standard (AS 1289 5.1.1) |
| **Subgrade**<br>or replacement | Minimum CBR 3% | Min 100% Standard (AS 1289 5.1.1) |

All granular pavement material quality should be in general accordance with RMS QA Specification 3051 [10].

Minimum testing on all potential imported pavement materials should be to RMS QA Specification 3051 [10] 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 with consideration to RMS QA Specifications R116 [11] and Austroads AGPT04B-07 Guide to Pavement Technology, Part 4B: Asphalt [12].

The design and construction of wearing courses should be in in consultation with the preferred supplier considering traffic volume and type. All pavement surfaces should be primed, or primer sealed prior to the application of bituminous spayed 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.

Based on 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 [7] taking into consideration the presence of moderately 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 consider the presence of moderately expansive soils where encountered. Provision of adequate cross fall to direct runoff from the pavement to drainage lines should be achieved as a result of reconstruction and possibly rehabilitation.

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

The proposed development is to be constructed such that pavements tie in with the 48 Windermere Road development to the south. 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* [6] where not otherwise specified.

# 8 Limitations

Stantec have 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 Newpro27 Pty Ltd and Maitland City Council. Any reliance assumed by other parties on this report shall be at such parties own risk.

# 9 References

[1] GCA Engineering Solutions, “Proposed Subdivision 259 Winderemere Road - Development Application Plans - 21460C, Revision 2,” October 2022.

[2] Cardno, now Stantec Australia Pty Ltd, “Report on Preliminary Site Investigation – 259 Windermere Road, Windermere NSW,” October 2022.

[3] Cardno, now Stanec Australia Pty Ltd, “Report on Geotechnical Investigation – 48 Windermere Road, Lochinvar NSW,” November 2022.

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

[5] NSW office of Environment and Heritage, “eSPADE v2.2,” 2022.

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

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

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

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

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

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

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

# APPENDIX A

## FIGURES

DATE PLOTTED: 14 December 2022 10:32 AM BY : KOSTANDREAS SYKIOTIS

NOTES:

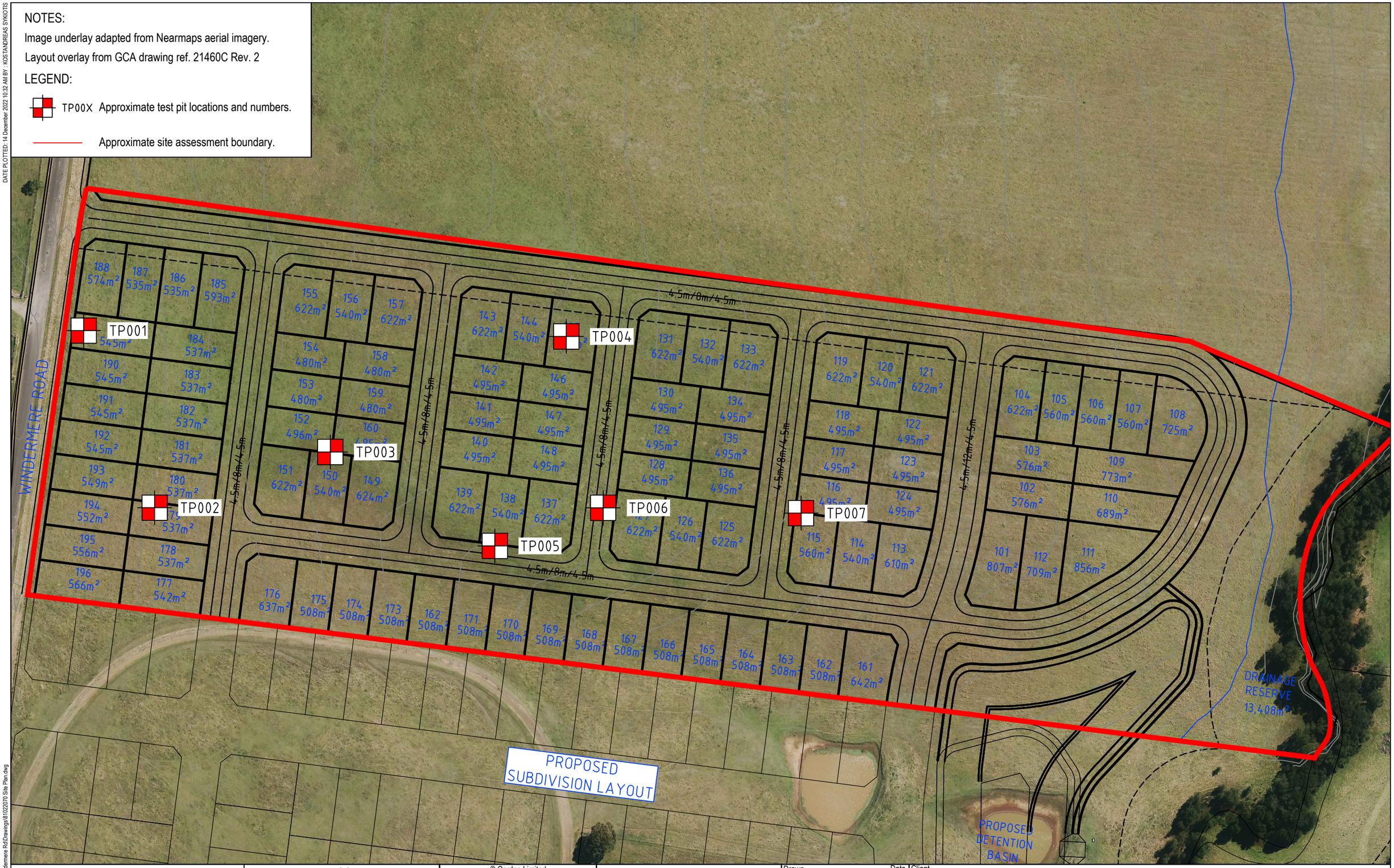
Image underlay adapted from Nearmaps aerial imagery.

Layout overlay from GCA drawing ref. 21460C Rev. 2

LEGEND:

TP00X Approximate test pit locations and numbers.

Approximate site assessment boundary.




0 50m

SCALE 1:1500 @A3

NORTH



Cardno
Shaping the Future
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Unit 1, 10 Denney Street
Broadmeadow, NSW 2292
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.cardno.com.au

| | | |
|---|---|---|
| Drawn | KS | Date 7/12/2022 |
| Checked | IGP | Date 7/12/2022 |
| Designed | | Date |
| Verified | | Date |
| Approved | | |

Client: Newpro 27 Pty Ltd

Project: Geotechnical Investigation
259 Windermere Road
Windermere, NSW

Title: Geotechnical Investigation
Site Plan

Status: FOR CONCEPT APPROVAL
NOT TO BE USED FOR CONSTRUCTION PURPOSES

| Project Number | Scale | Size |
|---|---|---|
| 81022070 | 1:1500 | A3 |

Figure Number: Figure 1

Revision: A

XREFs:
CAD File: A:\Projects\81\0\FY22\070_259 Windermere Rd\Drawings\81022070 Site Plan.dwg
=

APPENDIX

# B

ENGINEERING LOGS

Cardno

# TEST PIT LOG SHEET

**Client:** Newpro27 Pty Ltd
**Project:** 259 Windermere Road - PSI
**Location:** Lochinvar

# Hole No: TP001

**Job No:** 81022070 **Sheet:** 1 of 1

**Position:** See attached site plan **Angle from Horizontal:** 90° **Surface Elevation:**

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

**Excavation Dimensions:** **Contractor:** Tommy Gunn Earthmoving

**Date Excavated:** 13/4/22 **Logged By:** GE **Checked By:** KS

| Excavation | | | | Sampling & Testing | | | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 12 | Depth (m) | 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 | | | | | | | | | TOPSOIL: Clayey Sandy SILT; low plasticity, dark brown, fine to medium grained sand, with rootlet | W | S | TOPSOIL |
| | | | | ES 0.05 - 0.10 m Duplicate | | | | | 0.10m<br>Clayey SAND; fine to coarse grained, light brown, with fine to coarse gravel | W | VL | COLLUVIUM |
| | | | | ES 0.40 - 0.50 m | | 0.5 | | | 0.50m<br>Sandy CLAY; medium to high plasticity, brown mottled yellow, fine to coarse sand, trace fine to medium gravel | M (>PL) | St | RESIDUAL SOIL |
| | E | Stable | Not Encountered | ES 0.50 - 0.60 m Duplicate | | 1.0 | | | | | | |
| | | | | | | 1.5 | | | 1.30m<br>Silty CLAY; medium to high plasticity, brown mottled grey/yellow | M (>PL) | H | |
| | | | | | | | | | 1.50m<br>Sandy Silty CLAY; low to medium plasticity, dark brown, fine to coarse sand, trace fine gravel | M | H | |
| | E-F | | | | | | | | 1.80m<br>Clayey SAND; fine to coarse grained, brown, with fine to coarse gravel (Sandstone fragments) | D | H | EXTREMELY WEATHERED |
| | | | | | | 2.0 | | | 2.00m<br>TERMINATED AT 2.00 m<br>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

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# TEST PIT LOG SHEET

**Client:** Newpro27 Pty Ltd
**Project:** 259 Windermere Road - PSI
**Location:** Lochinvar

# Hole No: TP002

**Job No:** 81022070 **Sheet:** 1 of 1

**Position:** See attached site plan **Angle from Horizontal:** 90° **Surface Elevation:**

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

**Excavation Dimensions:** **Contractor:** Tommy Gunn Earthmoving

**Date Excavated:** 13/4/22 **Logged By:** GE **Checked By:** KS

| Excavation | | | | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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-F | Stable | Not Encountered | B 0.20 - 0.50 m | | 0.5 | | | TOPSOIL: Sandy SILT; low plasticity, dark brown, fine to medium grained sand, trace fine to medium gravel, with rootlet | W | S | TOPSOIL |
| | | | | | | | | | 0.15m<br>Silty CLAY; medium to high plasticity, brown, trace fine to medium sand | M (>PL) | F | RESIDUAL SOIL |
| | | | | | | 1.0 | | | 1.00m<br>Silty CLAY; medium plasticity, grey mottled yellow, trace fine to coarse sand, trace fine gravel | M (≈PL) | St to VSt<br>H | |
| | | | | | | 1.5 | | | | M (<PL) | | |
| | | | | | | 2.0 | | | 2.00m<br>TERMINATED AT 2.00 m<br>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

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# TEST PIT LOG SHEET

**Client:** Newpro27 Pty Ltd
**Project:** 259 Windermere Road - PSI
**Location:** Lochinvar

# Hole No: TP003

**Job No:** 81022070 **Sheet:** 1 of 1

**Position:** See attached site plan **Angle from Horizontal:** 90° **Surface Elevation:**

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

**Excavation Dimensions:** **Contractor:** Tommy Gunn Earthmoving

**Date Excavated:** 13/4/22 **Logged By:** GE **Checked By:** KS

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | | | 0.5 | | | TOPSOIL: Sandy SILT; low plasticity, dark brown, fine to medium grained sand, with rootlet | W | S | TOPSOIL |
| | | | | | | | | | 0.10m<br>Clayey SAND; fine to coarse grained, light brown, with fine to coarse gravel | W | VL | COLLUVIUM |
| | E | | | | | | | | 0.50m<br>Sandy CLAY; medium plasticity, grey mottled yellow, fine to medium sand | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | 1.00m<br>Clayey SAND; fine to medium grained, grey mottled yellow, with fine to medium gravel (Sandstone fragments) | M | H | EXTREMELY WEATHERED |
| | F | | | | | | | | 1.30m<br>TERMINATED AT 1.30 m<br>Refusal | | | |
| | | | | | | 1.5 | | | | | | |
| | | | | | | 2.0 | | | | | | |

**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

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# TEST PIT LOG SHEET

**Client:** Newpro27 Pty Ltd
**Project:** 259 Windermere Road - PSI
**Location:** Lochinvar

# Hole No: TP004

**Job No:** 81022070 **Sheet:** 1 of 1

**Position:** See attached site plan **Angle from Horizontal:** 90° **Surface Elevation:**

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

**Excavation Dimensions:** **Contractor:** Tommy Gunn Earthmoving

**Date Excavated:** 13/4/22 **Logged By:** GE **Checked By:** KS

| Excavation | | | | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | | | | | TOPSOIL: Sandy SILT; low plasticity, dark brown, fine to medium grained sand, with rootlet | W | S | TOPSOIL |
| | | | | | | | | | 0.10m<br>Silty Sandy CLAY; medium plasticity, brown, fine to coarse grained sand, trace fine to medium gravel | M (>PL) | S | COLLUVIUM |
| | | | | B 0.30 - 0.40 m<br>ES 0.30 - 0.40 m | | 0.5 | | | 0.30m<br>Sandy CLAY; medium to high plasticity, brown mottled yellow, fine to coarse sand, trace fine to medium gravel | | F to St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | | M (>PL) | H | |
| | | | | | | 1.5 | | | 1.70m<br>Silty CLAY; medium plasticity, grey mottled orange, trace fine to medium sand, trace fine to medium gravel | M (≈PL) | H | |
| | | | | | | 2.0 | | | 2.00m<br>TERMINATED AT 2.00 m<br>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

CARDNO (NSW/ACT) PTY LTD

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# TEST PIT LOG SHEET

**Client:** Newpro27 Pty Ltd
**Project:** 259 Windermere Road - PSI
**Location:** Lochinvar

## Hole No: TP005

**Job No:** 81022070 **Sheet:** 1 of 1

**Position:** See attached site plan **Angle from Horizontal:** 90° **Surface Elevation:**

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

**Excavation Dimensions:** **Contractor:** Tommy Gunn Earthmoving

**Date Excavated:** 13/4/22 **Logged By:** GE **Checked By:** KS

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | | 0 | | | TOPSOIL: Sandy SILT; low plasticity, dark brown, fine to medium grained sand, with rootlet | W | S | TOPSOIL |
| | | | | | | | | | 0.10m<br>Clayey SAND; fine to coarse grained, light brown, with fine to coarse gravel | W | L | COLLUVIUM |
| | | | | ES 0.40 - 0.50 m | | | | | 0.50m<br>Sandy CLAY; medium plasticity, grey mottled yellow, fine to medium sand | M (>PL) | St | RESIDUAL SOIL |
| | | | | B 0.60 - 0.70 m<br>ES 0.60 - 0.70 m | | 0.5 | | | | | | |
| | F-H | | | | | 1.0 | | | 1.00m<br>Clayey SAND; fine to medium grained, grey mottled yellow, with fine to medium gravel (Sandstone fragments) | M | H | EXTREMELY WEATHERED |
| | | | | | | | | | 1.40m<br>TERMINATED AT 1.40 m<br>Refusal | | | |
| | | | | | | 1.5 | | | | | | |
| | | | | | | 2.0 | | | | | | |

**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
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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

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# TEST PIT LOG SHEET

**Client:** Newpro27 Pty Ltd
**Project:** 259 Windermere Road - PSI
**Location:** Lochinvar

## Hole No: TP006

**Job No:** 81022070 **Sheet:** 1 of 1

**Position:** See attached site plan **Angle from Horizontal:** 90° **Surface Elevation:**

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

**Excavation Dimensions:** **Contractor:** Tommy Gunn Earthmoving

**Date Excavated:** 13/4/22 **Logged By:** GE **Checked By:** KS

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Major spalling | Surface Water | ES 0.05 - 0.10 m | | 0.5 | | | Silty SAND; fine to coarse grained, brown, trace fine gravel | W | L | COLLUVIUM<br>0.00 m: Possible rabbit warren with water inflow from surface holes filled with recent rain |
| | | | | ES 0.30 - 0.40 m | | | | | 0.90m | | | |
| | | | | ES 0.90 - 1.00 m | | 1.0 | | | Sandy CLAY: medium plasticity, brown mottled yellow, fine to medium sand | M (>PL) | F | RESIDUAL SOIL |
| | | | | | | | | | 1.20m | | | |
| | | | | | | 1.5 | | | Sandy CLAY: medium to high plasticity, brown mottled yellow, fine to medium sand | M (>PL) | VSt to H | |
| | | | | | | 2.0 | | | 2.00m | | | |
| | | | | | | | | | TERMINATED AT 2.00 m<br>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

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# TEST PIT LOG SHEET

**Client:** Newpro27 Pty Ltd
**Project:** 259 Windermere Road - PSI
**Location:** Lochinvar

# Hole No: TP007

**Job No:** 81022070 **Sheet:** 1 of 1

**Position:** See attached site plan **Angle from Horizontal:** 90° **Surface Elevation:**

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

**Excavation Dimensions:** **Contractor:** Tommy Gunn Earthmoving

**Date Excavated:** 13/4/22 **Logged By:** GE **Checked By:** KS

| Excavation | | | | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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-F | Stable | Not Encountered | 0.05 m | | | | | TOPSOIL: Sandy SILT; low plasticity, dark brown, fine to medium grained sand, with rootlet | W | S | TOPSOIL |
| | | | | ES 0.10 - 0.20 m | | | | | 0.10m<br>Gravelly, Sandy SILT; low plasticity, brown/grey, fine to coarse grained sand, fine gravel | W | S | COLLUVIUM |
| | | | | ES 0.30 - 0.35 m | | 0.5 | | | 0.30m<br>Sandy CLAY; medium to high plasticity, brown mottled yellow, fine to coarse grained sand, trace fine gravel | M (>PL) | F<br>VSt to H | RESIDUAL SOIL |
| | | | | | | 1.0 | | | | | | |
| | | | | | | 1.5 | | | 1.30m<br>Silty CLAY; medium plasticity, grey mottled yellow | M (≈PL) | H | |
| | | | | | | 2.0 | | | 2.00m<br>TERMINATED AT 2.00 m<br>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
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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
VSt - Very Stiff
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**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

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# 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 (%)<br>(length of core recovered divided by the length of core run) |
| RQD | Rock Quality Designation (%)<br>(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

PEAT, highly organic soil

TOPSOIL

FILL

FILL: Asphalt or Bituminous Seal

FILL: Ballast

FILL: Concrete

FILL: Roadbase

Sedimentary rock: fine, mostly clay (CLAYSTONE)

Sedimentary rock: fine, mostly silt (SILTSTONE)

Sedimentary rock: fine, silt and clay (MUDSTONE, SHALE, LAMINITE)

Sedimentary rock: medium (SANDSTONE, GREYWACKE)

Sedimentary rock: fine to coarse, angular (BRECCIA)

Sedimentary rock: coarse, rounded (CONGLOMERATE)

Sedimentary rock: Organic (COAL)

Sedimentary rock: Carbonate (LIMESTONE, DOLOMITE)

Sedimentary rock: Volcanic (TUFF, VOLCANIC BRECCIA, AGGLOMERATE)

Igneous rock: Felsic, fine (RHYOLITE)

Igneous rock: Felsic, coarse (GRANITE)

Igneous rock: Mafic, fine to medium (BASALT, DOLERITE)

Igneous rock: Mafic, coarse (GABBRO)

Metamorphic rock: Foliated, fine to medium (SLATE, PHYLLITE, SHIST)

Metamorphic rock: Foliated, coarse (GNEISS)

Metamorphic rock: Non-foliated (QUARTZITE, HORNFELS, MARBLE)

# APPENDIX

# C

## LABORATORY TEST RESULTS

# Material Test Report

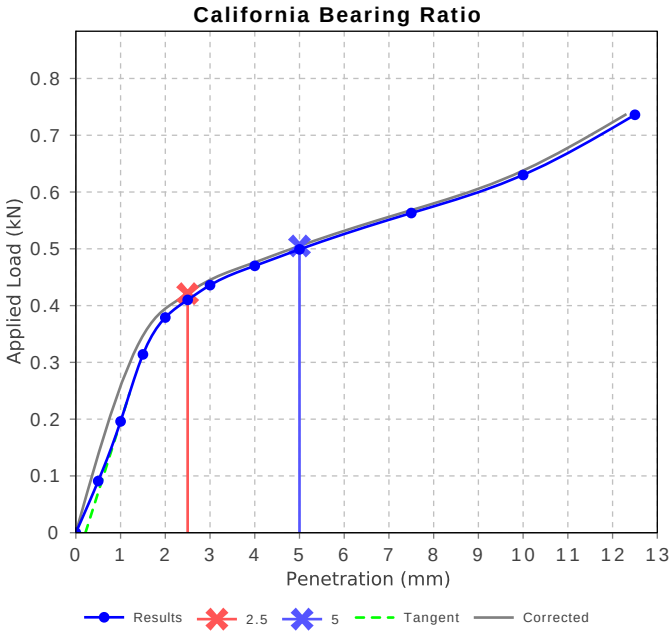
**Report Number:** **PRJ360637-1**
**Issue Number:** 1
**Date Issued:** 13/10/2020
**Client:** Cardno NSW
Unit 1, 10 Denny Street, Broadmeadow NSW 2292
**Contact:** Ian Piper
**Project Number:** PRJ360637
**Project Name:** Materials Testing
**Project Location:** S#152064 48 Windermere Rd, Lochinvar, Nsw, 2321
**Work Request:** 656
**Sample Number:** SO20-656F
**Date Sampled:** 23/09/2020
**Dates Tested:** 23/09/2020 - 29/09/2020
**Sampling Method:** Sampled by Client - Tested as Received
*The results apply to the sample as received*
**Site Selection:** Selected by Client
**Sample Location:** **TP003, Depth: 0.3 - 0.5**
**Material:** Silty CLAY, pale brown


Intrax Consulting Engineers Pty Ltd
Branch Site of Deer Park Laboratory Site no. 23209
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0477 6611 753
Email: steve.waugh@intrax.com.au


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Steve Waugh
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$^3$) | 1.53 | | |
| Optimum Moisture Content (%) | 26.5 | | |
| Laboratory Density Ratio (%) | 99.5 | | |
| Laboratory Moisture Ratio (%) | 99.5 | | |
| Dry Density after Soaking (t/m$^3$) | 1.50 | | |
| Field Moisture Content (%) | 29.0 | | |
| Moisture Content at Placement (%) | 26.4 | | |
| Moisture Content Top 30mm (%) | 33.5 | | |
| Moisture Content Rest of Sample (%) | 28.6 | | |
| Mass Surcharge (kg) | 4.5 | | |
| Soaking Period (days) | 4 | | |
| Curing Hours | 102 | | |
| Swell (%) | 2.0 | | |
| Oversize Material (mm) | 19 | | |
| Oversize Material Included | Excluded | | |
| Oversize Material (%) | 0 | | |



# Material Test Report

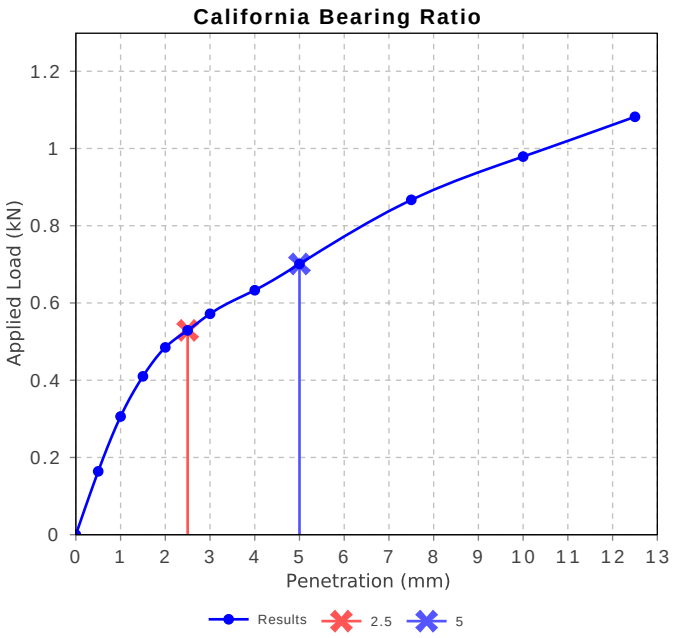
**Report Number:** **PRJ360637-1**
**Issue Number:** 1
**Date Issued:** 13/10/2020
**Client:** Cardno NSW
Unit 1, 10 Denny Street, Broadmeadow NSW 2292
**Contact:** Ian Piper
**Project Number:** PRJ360637
**Project Name:** Materials Testing
**Project Location:** S#152064 48 Windermere Rd, Lochinvar, Nsw, 2321
**Work Request:** 656
**Sample Number:** SO20-656G
**Date Sampled:** 23/09/2020
**Dates Tested:** 23/09/2020 - 29/09/2020
**Sampling Method:** Sampled by Client - Tested as Received
*The results apply to the sample as received*
**Site Selection:** Selected by Client
**Sample Location:** **TP010, Depth: 0.5 - 0.6**
**Material:** Silty CLAY, brown


Intrax Consulting Engineers Pty Ltd
Branch Site of Deer Park Laboratory Site no. 23209
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0477 6611 753
Email: steve.waugh@intrax.com.au


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Steve Waugh
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 % | **4.0** | | |
| Method of Compactive Effort | Standard | | |
| Method used to Determine MDD | AS 1289 5.1.1 & 2.1.1 | | |
| Method used to Determine Plasticity | visual | | |
| Maximum Dry Density (t/m$^3$) | 1.56 | | |
| Optimum Moisture Content (%) | 26.0 | | |
| Laboratory Density Ratio (%) | 99.5 | | |
| Laboratory Moisture Ratio (%) | 97.5 | | |
| Dry Density after Soaking (t/m$^3$) | 1.54 | | |
| Field Moisture Content (%) | 24.9 | | |
| Moisture Content at Placement (%) | 25.4 | | |
| Moisture Content Top 30mm (%) | 30.1 | | |
| Moisture Content Rest of Sample (%) | 27.9 | | |
| Mass Surcharge (kg) | 4.5 | | |
| Soaking Period (days) | 4 | | |
| Curing Hours | 101 | | |
| Swell (%) | 1.0 | | |
| Oversize Material (mm) | 19 | | |
| Oversize Material Included | Excluded | | |
| Oversize Material (%) | 0 | | |



# Material Test Report

**Report Number:** **PRJ360637-1**
**Issue Number:** 1
**Date Issued:** 13/10/2020
**Client:** Cardno NSW
Unit 1, 10 Denny Street, Broadmeadow NSW 2292
**Contact:** Ian Piper
**Project Number:** PRJ360637
**Project Name:** Materials Testing
**Project Location:** S#152064 48 Windermere Rd, Lochinvar, Nsw, 2321
**Work Request:** 656
**Sample Number:** SO20-656H
**Date Sampled:** 23/09/2020
**Dates Tested:** 23/09/2020 - 06/10/2020
**Sampling Method:** Sampled by Client - Tested as Received
*The results apply to the sample as received*
**Site Selection:** Selected by Client
**Sample Location:** **TP015, Depth: 0.9 - 1.1**
**Material:** Silty CLAY, brown


Intrax Consulting Engineers Pty Ltd
Branch Site of Deer Park Laboratory Site no. 23209
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0477 6611 753
Email: steve.waugh@intrax.com.au


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Steve Waugh
Laboratory Manager
NATA Accredited Laboratory Number: 19862

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|---|---|---|---|
| Sample History | Oven Dried | | |
| Preparation Method | Dry Sieve | | |
| Liquid Limit (%) | 85 | | |
| Plastic Limit (%) | 23 | | |
| **Plasticity Index (%)** | **62** | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---|---|---|---|
| Moisture Condition Determined By | AS 1289.3.1.2 | | |
| Linear Shrinkage (%) | 21.5 | | |
| Cracking Crumbling Curling | Curling | | |

| Emerson Class Number of a Soil (AS 1289 3.8.1) | | Min | Max |
|---|---|---|---|
| Emerson Class | **6** | | |
| Soil Description | | | |
| Nature of Water | Distilled | | |
| Temperature of Water ($^{o}$C) | 21 | | |

# Material Test Report

**Report Number:** **PRJ360637-1**
**Issue Number:** 1
**Date Issued:** 13/10/2020
**Client:** Cardno NSW
Unit 1, 10 Denny Street, Broadmeadow NSW 2292
**Contact:** Ian Piper
**Project Number:** PRJ360637
**Project Name:** Materials Testing
**Project Location:** S#152064 48 Windermere Rd, Lochinvar, Nsw, 2321
**Work Request:** 656
**Sample Number:** SO20-656I
**Date Sampled:** 23/09/2020
**Dates Tested:** 23/09/2020 - 06/10/2020
**Sampling Method:** Sampled by Client - Tested as Received
*The results apply to the sample as received*
**Site Selection:** Selected by Client
**Sample Location:** **TP016, Depth: 0.8 - 0.9**
**Material:** Silty CLAY, dark brown

Intrax Consulting Engineers Pty Ltd
Branch Site of Deer Park Laboratory Site no. 23209
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0477 6611 753
Email: steve.waugh@intrax.com.au
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Steve Waugh
Laboratory Manager
NATA Accredited Laboratory Number: 19862

| Emerson Class Number of a Soil (AS 1289 3.8.1) | | Min | Max |
|---|---|---|---|
| Emerson Class | **6** | | |
| Soil Description | | | |
| Nature of Water | distilled | | |
| Temperature of Water ($^{o}$C) | 21 | | |

# Material Test Report

**Report Number:** **PRJ360637-1**
**Issue Number:** 1
**Date Issued:** 13/10/2020
**Client:** Cardno NSW
Unit 1, 10 Denny Street, Broadmeadow NSW 2292
**Contact:** Ian Piper
**Project Number:** PRJ360637
**Project Name:** Materials Testing
**Project Location:** S#152064 48 Windermere Rd, Lochinvar, Nsw, 2321
**Work Request:** 656
**Dates Tested:** 22/09/2020 - 30/09/2020

Intrax Consulting Engineers Pty Ltd
Branch Site of Deer Park Laboratory Site no. 23209
Morisset Laboratory
Unit 2, 50 Alliance Avenue Morisset NSW 2264
Phone: 0477 6611 753
Email: steve.waugh@intrax.com.au
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Steve Waugh
Laboratory Manager
NATA Accredited Laboratory Number: 19862

| Shrink Swell Index AS 1289 7.1.1 & 2.1.1 | | | | | |
|---|---|---|---|---|---|
| Sample Number | SO20-656A | SO20-656B | SO20-656C | SO20-656D | SO20-656E |
| Date Sampled | 21/09/2020 | 21/09/2020 | 21/09/2020 | 21/09/2020 | 21/09/2020 |
| Date Tested | 23/09/2020 | 22/09/2020 | 28/09/2020 | 28/09/2020 | 30/09/2020 |
| Material Source | insitu | insitu | insitu | insitu | insitu |
| Sample Location | TP002 (0.35-0.58m) | TP004 (1.6-1.85m) | TP011 (1.5-1.63m) | TP026 (0.95-1.35m) | TP030 (0.2 - 0.4m) |
| Inert Material Estimate (%) | 0 | 5 | 0 | 2 | 0 |
| Pocket Penetrometer before (kPa) | ** | ** | ** | ** | ** |
| Pocket Penetrometer after (kPa) | ** | ** | ** | ** | ** |
| Shrinkage Moisture Content (%) | 37.7 | 22.5 | 19.0 | 29.2 | 32.1 |
| Shrinkage (%) | **11.2** | **2.9** | **2.8** | **7.0** | **6.1** |
| Swell Moisture Content Before (%) | 37.1 | 27.6 | 17.9 | 30.1 | 26.6 |
| Swell Moisture Content After (%) | 39.3 | 34.2 | 23.0 | 30.8 | 29.5 |
| Swell (%) | **1.2** | **5.7** | **4.0** | **0.4** | **0.7** |
| Shrink Swell Index Iss (%) | **6.6** | **3.2** | **2.7** | **4.0** | **3.6** |
| Visual Description | Silty CLAY, brown | Silty CLAY, pale grey mottled brown | Sandy CLAY, red-brown | Silty CLAY, pale brown | Refer to Client Borehole logs |
| Cracking | SC | MC | MC | MC | MC |
| Crumbling | ** | ** | ** | ** | ** |
| Remarks | ** | ** | ** | ** | ** |

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

**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: SYD2002387**
**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: 13/10/2020



## Sample Details

| | |
|---|---|
| **GHD Sample No** | SYD20-0441-01 |
| **Client Sample ID** | SO20-656H |
| **Date Sampled** | 16/09/2020 |
| **Sampled By** | Supplied by Client |
| **Location** | S#152064 |
| **Client Location** | 48 Winderemere Rd<br>Lochinvar, NSW |
| **BH / TP No.** | TP015 |
| **Depth (m)** | 0.9 - 1.1m |
| **Soil Description** | CLAY with sand; brown |

## Test Results

| Description | Method | Result | Limits |
|---|---|---|---|
| **Standard MDD (t/m³)** | AS 1289.5.1.1 - 2017 | **1.51** | |
| **Standard OMC (%)** | | **29.0** | |
| Retained Sieve (mm) | | 19 | |
| Oversize Material (%) | | 0 | |
| Curing Time (h) | | 72 | |
| Date Tested | | 1/10/2020 | |
| Coef of Permeability (m/s) | AS 1289.6.7.3 | 1 E-10 | |
| Mean Stress Level (kPa) | | 30 | |
| Permeant Used | | Syd tap water | |
| Length (mm) | | 76.4 | |
| Diameter (mm) | | 63.6 | |
| Length/Diameter Ratio | | 1.20 | |
| Laboratory Moisture Ratio (%) | | 101.0 | |
| Laboratory Density Ratio (%) | | 99.0 | |
| 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 (%) | | 35.3 | |
| Date Tested | | 2/10/2020 | |

## Comments

N/A

# APPENDIX

# D

## 48 WINDERMERE ROAD
## INVESTIGAITON PLANS AND LOGS

48 Windermere Road
Geotechnical Investigation

# APPENDIX A

## FIGURES

NOTES:

Image underlay adapted from nearmaps aerial imagery.

Lot layout provided by GCA referenced 20300LD-LD02 r3.

LEGEND:

TPXXX Approximate Test Pit locations and numbers.

EXISTING 20m WINDERMERE ROAD RESERVE. PROVIDE UPRIGHT KERB AND GUTTER 7.5m FROM CENTER OF EXISTING ROAD RESERVE ALONG FULL FRONTAGE

2.5m SHARED CONCRETE PATHWAY WITHIN 5.5m VERGE ALONG FULL FRONTAGE

3.0m ROAD WIDENING ALONG FULL FRONTAGE

ELECTRICAL KIOSK EASEMENT

ELECTRICAL KIOSK EASEMENT

ELECTRICAL KIOSK EASEMENT

DETENTION BASIN 1.14 ha

DRAINAGE RESERVE 0.49 ha

HUNTER RIVER 1% AEP 26.0m AHD

R1/ENVIRONMENTAL ZONE (E3) ZONE BOUNDARY

POSSIBLE FUTURE SCHOOL ON NEIGHBORING SITE

KICK AROUND AREA & PLAY EQUIPMENT 1.40 ha

PROPOSED BUS STOPS SPACED AT APPROX 380m. EXACT LOCATIONS TO BE DETERMINED AT CC STAGE

DRAINAGE RESERVE 0.22 ha

PROPOSED SUBDIVISION LAYOUT - DA APPROVED

WINDERMERE

LUSKINTYRE ROAD

CAPP STREET

TP001 TP002 TP003 TP004 TP005 TP006 TP007 TP008 TP009 TP010 TP011 TP012 TP013 TP014 TP015 TP016 TP017 TP018 TP019 TP020 TP021 TP022 TP023 TP024 TP025 TP026 TP027 TP028 TP029 TP030

0 50 100m

SCALE 1:2500 @A4

NORTH



Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Unit 1, 10 Denney Street
Broadmeadow, NSW 2292
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.cardno.com.au

| | | |
|---|---|---|
| Drawn | KS | Date 7/09/2021 |
| Checked | IGP | Date 7/09/2021 |
| Designed | | Date |
| Verified | | Date |
| Approved | | |

Client: Newpro20

Project: 48 Windermere Road, Lochinvar, NSW

Title: Geotechnical Investigation, Site Plan

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

| Project Number | Scale | Size |
|---|---|---|
| 81021034-002 | 1:2500 | A3 |

Figure Number: Figure 1

Revision: 003

DATE PLOTTED: 7 September 2021 4:33 PM BY : KOSTANDREAS SYKIOTIS

XREFs:
CAD File: N:\PY\21034_48 Windermere Road\Drawings\81021034 - 48 Windermere Road Site Plan.dwg

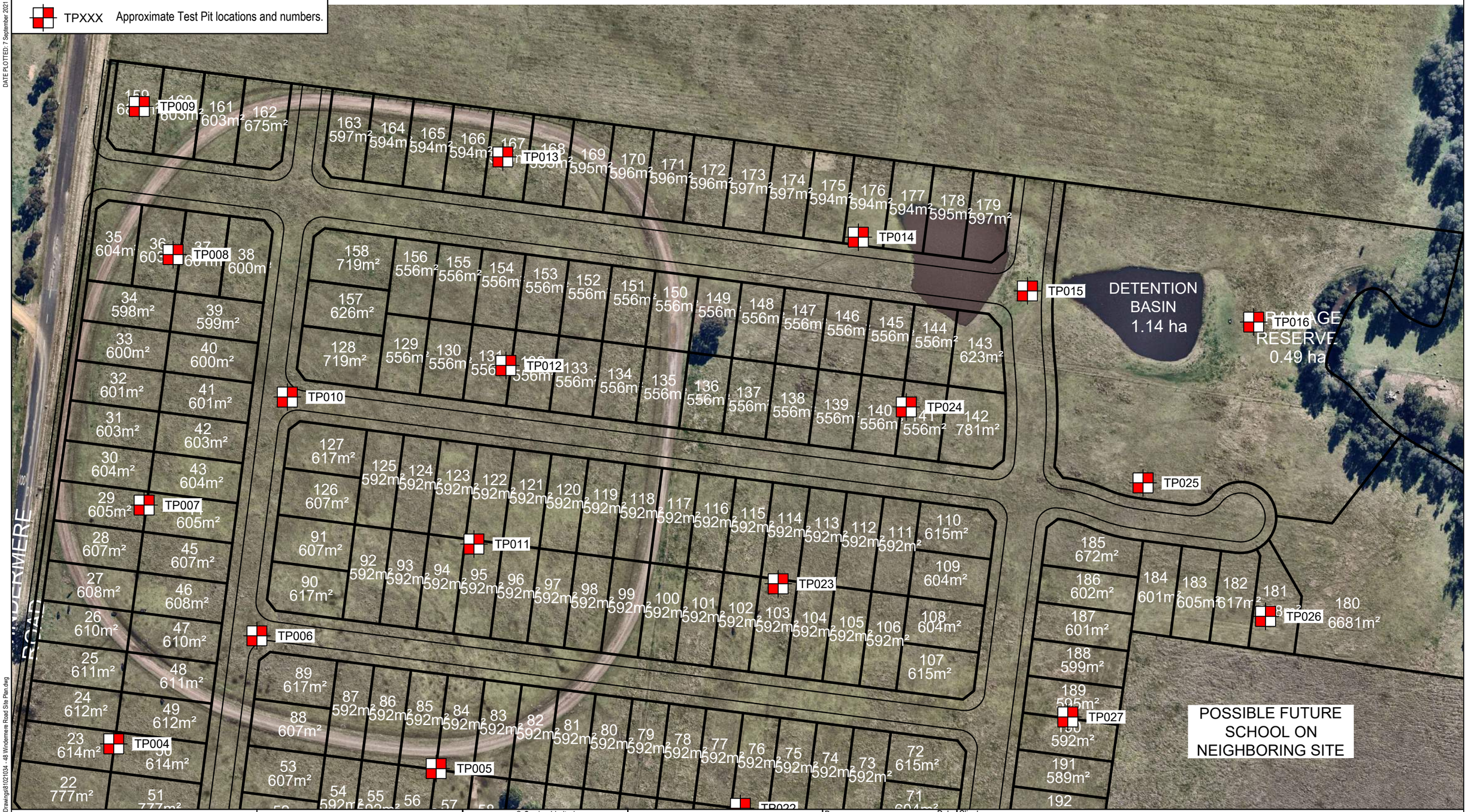
NOTES:

Image underlay adapted from nearmaps aerial imagery.

Lot layout provided by GCA referenced 20300-LD02 r3.

LEGEND:

TPXXX Approximate Test Pit locations and numbers.




0 50m

SCALE 1:1500 @A4

NORTH



Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Unit 1, 10 Denney Street
Broadmeadow, NSW 2292
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.cardno.com.au

| | | |
|---|---|---|
| Drawn | KS | Date 7/09/2021 |
| Checked | IGP | Date 7/09/2021 |
| Designed | | Date |
| Verified | | Date |
| Approved | | |

Client: Newpro20

Project: 48 Windermere Road, Lochinvar, NSW

Title: Geotechnical Investigation, Site Plan

Status: PRELIMINARY — NOT TO BE USED FOR CONSTRUCTION PURPOSES

| Project Number | Scale | Size |
|---|---|---|
| 81021034-002 | 1:1500 | A3 |

Figure Number: Figure 2

Revision: 003

DATE PLOTTED: 7 September 2021 4:34 PM BY : KOSTANDREAS SYKIOTIS

XREFs:
CAD File: N:\FY21\034_48 Windermere Road\Drawings\81021034 - 48 Windermere Road Site Plan.dwg

NOTES:

Image underlay adapted from nearmaps aerial imagery.

Lot layout provided by GCA referenced 20300LD-LD02 r3.

LEGEND:

TPXXX Approximate Test Pit locations and numbers.

TP011 TP023 TP006 TP004 TP005 TP022 TP003 TP027 TP028 TP021 TP002 TP017 TP018 TP020 TP001 TP019 TP030 TP029

91 607m² | 92 592m² | 93 592m² | 94 592m² | 95 592m² | 96 592m² | 97 592m² | 98 592m² | 99 592m² | 100 592m² | 101 592m² | 102 592m² | 103 592m² | 104 592m² | 105 592m² | 106 592m² | 107 615m² | 108 604m² | 109 604m² | 111 592m² | 112 592m² | 615m²

90 617m² | 89 617m² | 88 607m² | 53 607m² | 52 617m² | 54 592m² | 55 592m² | 56 592m² | 57 592m² | 58 592m² | 59 592m² | 60 592m² | 61 592m² | 62 592m² | 63 592m² | 64 592m² | 65 592m² | 66 592m² | 67 592m² | 68 592m² | 69 611m² | 70 604m² | 71 604m² | 72 615m² | 73 592m² | 74 592m² | 75 592m² | 76 592m² | 77 592m² | 78 592m² | 79 592m² | 80 592m² | 81 592m² | 82 592m² | 83 592m² | 84 592m² | 85 592m² | 86 592m² | 87 592m²

45 607m² | 46 608m² | 47 610m² | 48 611m² | 49 612m² | 50 614m² | 51 777m² | 22 777m² | 23 614m² | 24 612m² | 25 611m²

185 672m² | 186 602m² | 187 601m² | 188 599m² | 189 595m² | 190 592m² | 191 589m² | 192 586m² | 193 [illegible]m² | 194 602m² | 195 601m² | 184 601m² | 183 605m² | 182 617m² | 181 [illegible]m²

KICK AROUND AREA & PLAY EQUIPMENT 1.40 ha

231 503m² | 230 478m² | 229 478m² | 228 478m² | 227 520m² | 232 567m² | 237 564m² | 233 579m² | 234 472m² | 235 472m² | 236 553m²

199 496m² | 198 452m² | 197 452m² | 196 546m² | 200 502m² | 201 516m² | 202 [illegible]m² | 203 [illegible]m² | 204 [illegible]m²

10 507m² | 11 481m² | 20 453m² | 21 512m² | 9 507m² | 19 [illegible]m² | 8 491m² | 18 529m² | 7 477m² | 17 499m² | 6 459m² | 16 494m² | 5 451m² | 15 450m² | 4 450m² | 14 450m² | 3 450m² | 13 450m² | 2 450m² | 12 451m² | 1 451m²

226 454m² | 225 450m² | 224 450m² | 223 451m² | 222 452m² | 221 452m² | 220 453m² | 219 454m² | 217 455m² | 216 457m² | 215 458m² | 214 459m² | 213 460m² | 212 460m² | 211 459m²

210 528m² | 209 589m² | 208 587m² | 207 [illegible]m² | 206 [illegible]m² | 205 731m²

POSSIBLE FU SCHOOL C NEIGHBORING

PROPOSED SUBDIVISION LAYOUT - DA APPROVED

DRAINAGE RESERVE 0.22 ha

0 50m

SCALE 1:1500 @A4

NORTH



Cardno
Shaping the Future
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Unit 1, 10 Denney Street
Broadmeadow, NSW 2292
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.cardno.com.au

| | | |
|---|---|---|
| Drawn KS | Date 7/09/2021 | |
| Checked IGP | Date 7/09/2021 | |
| Designed | Date | |
| Verified | Date | |
| Approved | | |

Client: Newpro20

Project: 48 Windermere Road
Lochinvar, NSW

Title: Geotechnical Investigation
Site Plan

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

| Project Number | Scale | Size |
|---|---|---|
| 81021034-002 | 1:1500 | A3 |

Figure Number: Figure 3

Revision: 003

DATE PLOTTED: 7 September 2021 4:34 PM BY : KOSTANDREAS SYKIOTIS

XREFs:
CAD File: N:\FY21\034_48 Windermere Road\Drawings\81021034 - 48 Windermere Road Site Plan.dwg

48 Windermere Road
Geotechnical Investigation

# APPENDIX

# B

## ENGINEERING LOGS

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP001

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | R | 0.5 | | | TOPSOIL: Silty CLAY, medium plasticity, dark brown, with fine to coarse grained sand | M (<PL) | | TOPSOIL |
| | | | | | | | | | 0.25m<br>Silty CLAY: medium to high plasticity, dark brown | M (≈PL) | St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | 0.65m<br>Silty CLAY: medium to high plasticity, red-brown, with fine to coarse grained sand, with cemented sand gravel | M (<PL) | H | |
| | | | | | | | | | 0.90m<br>Silty CLAY: medium to high plasticity, pale brown mottled red, with fine to coarse grained sand, with cemented sand gravel | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | 1.5 | | | 1.30m<br>Clayey SAND: brown-yellow, fine to coarse grained sand, with fine coarsed gravel | M (<PL) | D | |
| | | | | | | | | | 1.50m<br>TERMINATED AT 1.50 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

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# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP002

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | | | | TOPSOIL: Silty CLAY, medium plasticity, dark brown, with fine to coarse grained sand | M (<PL) | | TOPSOIL |
| | | | | U50 0.35 - 0.58 m | | 0.5 | | | 0.30m<br>CLAY: high plasticity, pale brown, with silt | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | | M (<PL) | VSt | |
| | | | | | | | | | 1.20m<br>Clayey SAND: brown-yellow, fine to coarse grained sand, with fine coarsed gravel | M (<PL) | D | EXTREMELY WEATHERED |
| | | | | | R | 1.5 | | | 1.50m<br>TERMINATED AT 1.50 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

## Hole No: TP003

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**
**Machine Type:** 3.5 tonne Excavator **Excavation Method:**
**Excavation Dimensions:** **Contractor:** ARSK
**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | D 0.30 - 0.50 m | R | 0.5 | | | TOPSOIL; Sandy CLAY, medium plasticity, dark brown, with fine to coarse grained sand | M (<PL) | | TOPSOIL |
| | | | | | | | | | 0.15m<br>CLAY: high plasticity, pale brown, with silt | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | | | VSt | |
| | | | | | | 1.5 | | | 1.30m<br>Clayey SAND; brown-yellow, fine to coarse grained sand, with fine coarsed gravel | M (<PL) | D | EXTREMELY WEATHERED |
| | | | | | | 2.0 | | | 1.60m<br>TERMINATED AT 1.60 m<br>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

CARDNO (NSW/ACT) PTY LTD

Cardno

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP004

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | U50 1.60 - 1.85 m | R | 0.5<br>1.0<br>1.5<br>2.0 | | | TOPSOIL; Sandy CLAY, medium plasticity, dark brown, with fine to coarse grained sand<br>0.15m<br>CLAY: high plasticity, pale brown, with silt<br>1.10m<br>Silty CLAY; medium to high plasticity, pale grey mottled brown<br>1.80m<br>1.85m Clayey SAND: fine to coarse grained, brown-yellow, with fine to coarse sub-angular gravel<br>TERMINATED AT 1.85 m<br>Target depth | M (<PL)<br>M (<PL)<br>M (>PL)<br>M (<PL) | <br>F to St<br>St to VSt<br>D | TOPSOIL<br>RESIDUAL SOIL<br>EXTREMELY WEATHERED |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP005

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | D 0.10 - 0.20 m | | | | | TOPSOIL; Silty CLAY, medium plasticity, dark brown, with fine to coarse grained sand | M (<PL) | | TOPSOIL |
| | | | | D 0.40 - 0.50 m | | 0.5 | | | 0.20m<br>CLAY: high plasticity, pale brown, with silt | M (>PL) | F | RESIDUAL SOIL |
| | | | | U50 0.65 - 1.02 m | | 1.0 | | | 1.10m | | VSt | |
| | | | | D 1.10 - 1.20 m | | | | | Silty CLAY; medium to high plasticity, pale grey mottled red-yellow | M (≈PL) | H | EXTREMELY WEATHERED |
| | | | | B 1.60 - 1.80 m | | 1.5 | | | 1.80m | | | |
| | | | | | | 2.0 | | | TERMINATED AT 1.80 m<br>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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

## Hole No: TP006

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | 0.05m TOPSOIL; Silty CLAY, medium plasticity, dark brown, with fine to coarse grained sand | M (<PL) | | TOPSOIL |
| | | | | | | | | | Silty CLAY; medium to high plasticity, dark brown, trace fine to coarse grained sand | M (>PL) | F | RESIDUAL SOIL |
| | | | | | | | | | 0.30m CLAY: high plasticity, pale brown, with silt | M (>PL) | F to St | |
| | | | | D 0.80 - 0.90 m | | | | | As above: colour change to reddish-brown | | VSt | |
| | | | | D 1.00 - 1.10 m | | 1.0 | | | 1.00m Silty CLAY; medium to high plasticity, pale brown mottled red, fine to coarse grained sand, with cemented sand gravel | M (<PL) | H | |
| | | | | B 1.20 - 1.30 m | | | | | 1.20m Clayey SAND; brown-yellow, fine to coarse grained sand, with fine coarsed gravel | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | 1.5 | | | 1.30m TERMINATED AT 1.30 m Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

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# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP007

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL: Silty SAND: fine to coarse grained, dark brown<br>0.20m<br>CLAY: high plasticity, pale brown, with silt<br>As above: colour change to pale-brown<br>1.00m | D<br>M (>PL) | St | TOPSOIL<br>RESIDUAL SOIL |
| | | | | | | 1.0 | | | Silty CLAY: medium to high plasticity, pale grey mottled brown<br>1.50m | M (<PL) | VSt to H | |
| | | | | | | 1.5 | | | TERMINATED AT 1.50 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

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# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP008

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL: Silty SAND: fine to coarse grained, dark brown<br>0.20m | D | | TOPSOIL |
| | | | | | | 1.0 | | | CLAY: high plasticity, pale brown, with silt | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | | | | 1.10m | M (<PL) | VSt | |
| | | | | | | | | | Silty CLAY: medium, reddish brown | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | 1.5 | | | 1.50m<br>TERMINATED AT 1.50 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP009

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | D 0.00 - 0.10 m | | | | | TOPSOIL: Silty SAND: fine to coarse grained, dark brown | D | | TOPSOIL |
| | | | | | | | | | 0.10m | | | |
| | | | | D 0.50 - 0.60 m | | 0.5 | | | Silty CLAY: medium to high plasticity, reddish brown | M (>PL) | St | RESIDUAL SOIL |
| | | | | D 1.00 - 1.10 m | | 1.0 | | | | M (<PL) | VSt | |
| | | | | | | | | | As above: with fine to coarse grained sand, with fine sub-angular gravel | | | |
| | | | | | | | | | 1.20m | | | |
| | | | | B 1.20 - 1.40 m | | | | | Clayey SAND: fine to coarse grained, reddish brown | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | | | | 1.40m | | | |
| | | | | | | 1.5 | | | TERMINATED AT 1.40 m Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP010

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | B 0.50 - 0.60 m | R | 0.5<br>1.0<br>1.5<br>2.0 | | | TOPSOIL: Silty SAND: fine to coarse grained, dark brown<br>0.10m<br>CLAY: high plasticity, brown, with silt<br>As above: colour change to reddish brown<br>1.20m<br>Clayey SAND: fine to coarse grained, reddish brown<br>1.30m<br>TERMINATED AT 1.30 m<br>Target depth | D<br>M (≈PL)<br>M (<PL) | <br>St<br>D | TOPSOIL<br>RESIDUAL SOIL<br>EXTREMELY WEATHERED |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP011

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | | Sampling & Testing | | | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 12 | Depth (m) | 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL; Sandy CLAY; low plasticity, brown, fine to medium grained sand | M (<PL) | | TOPSOIL |
| | | | | | | | | | 0.10m<br>Silty CLAY; high plasticity, brown, trace fine sand | M (>PL) | F - St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | As above, colour change to red-brown, trace fine, sub-angular gravel, trace fine to coarse grained sand | M (≈PL) | VSt - H | |
| | | | | | | | | | 1.30m<br>Sandy CLAY; medium plasticity, red-brown, fine to coarse sand, trace fine, sub-angular gravel | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | U50 1.50 - 1.63 m | | 1.5 | | | 1.50m<br>TERMINATED AT 1.50 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP012

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL; Sandy CLAY; low plasticity, brown, fine to medium grained sand | D | | TOPSOIL |
| | | | | | | | | | 0.10m<br>CLAY; high plasticity, brown, with silt | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | As above, medium plasticity, colour change to pale grey mottled brown | M (<PL) | VSt - H | |
| | | | | | | 1.5 | | | 1.50m<br>Silty CLAY; medium plasticity, pale grey mottled brown, with fine gravels, rock structure present [Extremely Weathered Siltstone] | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | | | | 1.70m<br>TERMINATED AT 1.70 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP013

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL; Sandy CLAY; low plasticity, brown, fine to medium grained sand | D | | TOPSOIL |
| | | | | | | | | | 0.10m<br>CLAY; high plasticity, brown, with silt | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | 0.80m<br>Silty CLAY; medium to high plasticity, red-brown, trace sub-rounded, fine gravels | M (<PL) | St - VSt | |
| | | | | | | | | | 1.30m<br>Silty CLAY; medium plasticity, red-brown, trace fine to coarse gravel, rock structure present | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | 1.5 | | | 1.50m<br>TERMINATED AT 1.50 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

Cardno

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP014

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | D 0.00 - 0.10 m | | | | | TOPSOIL; Sandy CLAY; low plasticity, brown, fine to medium grained sand | D | | TOPSOIL |
| | | | | | | | | | 0.10m<br>Silty CLAY; low plasticity, dark brown | M (>PL) | St | Possibly COLLUVIUM |
| | | | | D 0.50 - 0.60 m | | 0.5 | | | 0.40m<br>Silty CLAY; medium to high plasticity, dark brown, trace fine to coarse sand, trace fine gravel | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | | | | 0.70m<br>CLAY; high plasticity, brown, with silt | M (>PL) | St | |
| | | | | D 1.00 - 1.10 m | | 1.0 | | | 1.10m<br>Silty CLAY; medium to high plasticity, pale grey mottled brown | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | D 1.50 - 1.60 m | | 1.5 | | | 1.60m | | | |
| | | | | | | 2.0 | | | TERMINATED AT 1.60 m<br>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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

## Hole No: TP015

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**
**Machine Type:** 3.5 tonne Excavator **Excavation Method:**
**Excavation Dimensions:** **Contractor:** ARSK
**Date Excavated:** 16/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | | Sampling & Testing | | | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 12 | Depth (m) | 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 | Groundwater Not Encountered | | | 0 | | | TOPSOIL; Sandy CLAY; low plasticity, brown, fine to medium grained sand | D | | TOPSOIL |
| | | | | | | | | | 0.10m<br>Silty CLAY; medium to high plasticity, brown, trace fine to coarse sand, trace fine sub-angular to sub-rounded gravel | M (>PL) | F | Possibly RESIDUAL SOIL |
| | | | | B 0.90 - 1.10 m | | 0.5 | | | | | | |
| | | | | | | 1.0 | | | | | St - VSt | |
| | | | | B 1.40 - 1.60 m | | 1.5 | | | 1.20m<br>Sandy CLAY; medium plasticty, brown, fine sand | M (≈PL) | H | EXTREMELY WEATHERED |
| | | | | | | 2.0 | | | 1.60m<br>TERMINATED AT 1.60 m<br>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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP016

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | B 0.90 - 1.00 m | R | 0.5 | | | TOPSOIL; Silty SAND; fine to coarse, dark brown<br>0.15m | D | | TOPSOIL |
| | | | | | | | | | Silty CLAY; low plasticity, dark brown, trace fine to coarse sand, trace fine sub-angular gravel<br>0.55m | M (>PL) | F | ALLUVIUM |
| | | | | | | 1.0 | | | Silty CLAY; medium plasticity, dark brown mottled orange, trace fine to coarse sand, trace fine, sub-angular gravel | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | 1.5 | | | 1.70m | | H | |
| | | | | | | 2.0 | | | TERMINATED AT 1.70 m<br>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

CARDNO (NSW/ACT) PTY LTD

Cardno

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP017

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | | Sampling & Testing | | | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 12 | Depth (m) | 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 | Groundwater Not Encountered | | | 0.5 | | | FILL; Silty CLAY; medium plasticity, brown, with fine, sub-angular to sub-rounded gravel, with fine to coarse sand | M (<PL) | | FILL |
| | | | | | | | | | 0.30m<br>Sandy CLAY; medium plasticity, red-brown, fine to coarse sand, trace organics | M (<PL) | VSt | TOPSOIL<br>0.30 m: Former Topsoil |
| | | | | | | 1.0 | | | 0.45m<br>Silty CLAY; medium to high plasticity, red-brow, trace fine to medium sand | M (<PL) | VSt<br>H | RESIDUAL SOIL |
| | | | | | | 1.5 | | | 1.35m<br>Sandy CLAY; low plasticity, reddish brown mottled grey, fine to coarse sand | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | | | | 1.50m<br>TERMINATED AT 1.50 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP018

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | R | 0.5 | | | TOPSOIL; Clayey SAND; fine to coarse, brown<br>0.15m | D | | TOPSOIL |
| | | | | | | | | | Silty CLAY; high plasticity, brown, trace fine to coarse sand<br>As above, colour change to red-brown<br>0.80m | M (<PL) | St | RESIDUAL SOIL |
| | | | | B 0.90 - 1.10 m | | 1.0 | | | Sandy CLAY; low plasticity, yellow-brown mottled red, fine to coarse grained sand, with fine to medium, sub-angular to sub-rounded gravel<br>1.10m | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | | | | Clayey SAND; fine to coarse, yellow-brown mottled red, with fine to medium sub-angular to sub-rounded gravel<br>1.20m | D | D | |
| | | | | | | 1.5 | | | TERMINATED AT 1.20 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP019

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | R | 0.5 | | | TOPSOIL; Clayey SAND; fine to medium grained, dark brown | D | | TOPSOIL |
| | | | | | | | | | 0.15m<br>Silty CLAY; medium to high plasticity, dark brown | M (>PL) | St | COLLUVIUM |
| | | | | | | | | | 0.45m<br>Silty CLAY; medium to high plasticity, red-brown, trace fine to coarse sand | M (≈PL) | VSt | RESIDUAL SOIL |
| | | | | | | 1.0 | | | 0.75m<br>Sandy CLAY; low plasticity, yellow-brown mottled red, fine to coarse grained sand, with fine to medium, sub-angular to sub-rounded gravel | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | | | | 1.20m<br>Clayey SAND; fine to coarse grained, red-brown mottled yellow, with fine to medium gravel | D | D | |
| | | | | | | 1.5 | | | 1.30m<br>TERMINATED AT 1.30 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP020

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | R | 0.5 | | | TOPSOIL; Clayey SAND; fine to medium grained, dark brown | D | | TOPSOIL |
| | | | | | | | | | 0.10m<br>Silty CLAY; high plasticity, dark brown, trace fine to coarse sand | M (>PL) | VSt | RESIDUAL SOIL |
| | | | | | | | | | 0.45m<br>As above, colour change to red-brown | | | |
| | | | | | | | | | Sandy CLAY; low plasticity, yellow-brown mottled red, fine to coarse grained sand, with fine to medium, sub-angular to sub-rounded gravel | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | 1.0 | | | 1.00m<br>Clayey SAND; fine to coarse grained, red-brown mottled yellow, with fine to coarse, angular gravel | D | D | |
| | | | | | | | | | 1.20m<br>TERMINATED AT 1.20 m<br>Target depth | | | |
| | | | | | | 1.5 | | | | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP021

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | R | 0.5 | | | TOPSOIL: Sandy CLAY; low plasticity, dark brown, fine to coarse grained sand | M (<PL) | St | TOPSOIL |
| | | | | | | | | | 0.13m<br>Silty CLAY; medium to high plasticity, dark brown-red, trace fine to medium grained sand | | | RESIDUAL SOIL |
| | | | | | | | | | 0.30 m: as above, colour change to brown-red | M (>PL) | F | |
| | | | | | | 1.0 | | | 0.70m<br>Sandy CLAY; low plasticity, reddish brown, fine to coarse grained sand | M (≈PL) | H | EXTREMELY WEATHERED |
| | | | | | | | | | 1.10m<br>Clayey SAND: fine to coarse grained, reddish brown, with fine to coarse sub-angular to angular gravel | D to M | D | |
| | | | | | | 1.5 | | | 1.30m<br>TERMINATED AT 1.30 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP022

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL: Sandy CLAY; low plasticity, dark brown, fine to coarse grained sand | M (≈PL) | | TOPSOIL |
| | | | | | | | | | 0.15m<br>CLAY; high plasticity, brown, with silt | M (>PL) | F | RESIDUAL SOIL |
| | | | | | | 1.0 | | | 0.75m<br>Silty CLAY; medium plasticity, reddish brown with black speckles, trace fine to coarse grained sand, trace fine, sub-angular gravel | M (>PL) | F<br>VSt | |
| | | | | | | 1.5 | | | 1.70m | | H | |
| | | | | | | | | | Silty CLAY; medium to high plasticity, pale grey mottled red brown | M (≈PL) | H | EXTREMELY WEATHERED |
| | | | | | | 2.0 | | | 2.00m<br>TERMINATED AT 2.00 m<br>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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

## Hole No: TP023

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**
**Machine Type:** 3.5 tonne Excavator **Excavation Method:**
**Excavation Dimensions:** **Contractor:** ARSK
**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | | Sampling & Testing | | | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 12 | Depth (m) | 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL: Sandy CLAY; low plasticity, dark brown, fine to coarse grained sand | D | | TOPSOIL |
| | | | | | | | | | 0.15m<br>CLAY; high plasticity, brown, with silt | M (>PL) | F | RESIDUAL SOIL |
| | | | | | | 1.0 | | | 0.45m<br>Silty CLAY; medium plasticity, reddish brown with black speckles, trace fine to coarse grained sand, trace fine, sub-angular gravel | M (>PL) | F<br>St - VSt | |
| | | | | | | 1.5 | | | 1.20m<br>Sandy CLAY: low to medium plasticity, brown mottled yellow, fine to coarse grained sand | M (≈PL) | VSt<br>H | EXTREMELY WEATHERED |
| | | | | | | 2.0 | | | 2.00m<br>TERMINATED AT 2.00 m<br>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

CARDNO (NSW/ACT) PTY LTD

Cardno

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP024

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL: Sandy CLAY; low plasticity, dark brown, fine to coarse grained sand<br>0.15m | D | St | TOPSOIL |
| | | | | | | | | | Silty CLAY; medium plasticity, dark brown, trace fine to coarse grained sand, trace fine sub-rounded gravel<br>0.45m | M (>PL) | St | RESIDUAL SOIL |
| | | | | | | 1.0 | | | CLAY; high plasticity, brown, with silt | M (>PL) | F | |
| | | | | | | | | | 0.90 m: as above, with fine to coarse grained sand | M (>PL) | St - VSt | |
| | | | | | | 1.5 | | | 1.40m<br>Clayey SAND: fine to coarse grained, reddish brown, with fine to coarse sub-angular to angular gravel<br>1.60m | D to M | D | EXTREMELY WEATHERED |
| | | | | | | 2.0 | | | TERMINATED AT 1.60 m<br>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

CARDNO (NSW/ACT) PTY LTD

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# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP025

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | Water | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | R | 0.5 | | | TOPSOIL: Sandy CLAY; low plasticity, dark brown fine to coarse grained sand | M (<PL) | F | TOPSOIL |
| | | | | | | | | | 0.15m<br>Silty CLAY; medium plasticity, dark brown, trace fine to coarse grained sand<br>0.30 m: as above, colour change to brown | M (>PL) | F | RESIDUAL SOIL |
| | | | | | | 1.0 | | | 0.60m<br>Sandy CLAY; low to medium plasticity, brown, fine to coarse grained sand | M (≈PL) | VSt | EXTREMELY WEATHERED |
| | | | | | | 1.5 | | | 1.00m<br>Clayey SAND: fine to coarse grained, reddish brown, with fine to coarse sub-angular to angular gravel | D to M | D | |
| | | | | | | 2.0 | | | 1.50m<br>TERMINATED AT 1.50 m<br>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

CARDNO (NSW/ACT) PTY LTD

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# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP026

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | D 0.00 - 0.10 m | | 0 | | | TOPSOIL: Clayey SAND; fine to coarse grained sand, dark brown | D | MD | TOPSOIL |
| | | | | | | | | | 0.15m<br>CLAY; high plasticity, brown, with silt, trace fine to coarse grained sand | | | Possibly ALLUVIUM |
| | | | | D 0.50 - 0.60 m | | 0.5 | | | 0.45 m: as above, colour change to pale brown, no sand | M (>PL) | F - St | |
| | | | | U50 0.95 - 1.30 m | | | | | 1.30m | | | |
| | | | | D 1.00 - 1.10 m | | 1.0 | | | Silty CLAY; medium to high plasticity, pale grey mottled brown and black, trace fine to coarse grained sand | | H | |
| | | | | D 1.50 - 1.60 m | | 1.5 | | | 1.60m | M (≈PL) | H | RESIDUAL SOIL |
| | | | | | | 2.0 | | | TERMINATED AT 1.60 m<br>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

CARDNO (NSW/ACT) PTY LTD

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# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP027

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL: Clayey SAND; fine to coarse grained sand, dark brown | D | MD | TOPSOIL |
| | | | | | | 1.0 | | | 0.20m<br>Silty CLAY; medium to high plasticity, brown, trace fine to coarse grained sand, trace fine, sub-angular gravel | M (>PL) | F - St | Possibly ALLUVIUM |
| | | | | | | 1.5 | | | 1.20m<br>Silty CLAY; medium to high plasticity, pale grey mottled pale brown | M (>PL) | VSt<br>H | RESIDUAL SOIL |
| | | | | | | 2.0 | | | 2.00m<br>TERMINATED AT 2.00 m<br>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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP028

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | 0.5 | | | TOPSOIL: Sandy CLAY; low plasticity, dark brown, fine to coarse grained sand<br>0.15m | D | St | TOPSOIL |
| | | | | | | | | | Silty CLAY; medium to high plasticity, reddish brown, trace fine to coarse grained sand<br>0.60m | M (>PL) | F | RESIDUAL SOIL |
| | | | | | | | | | Sandy CLAY; medium plasticity, reddish brown, fine to coarse grained sand<br>0.80m | M (≈PL) | VSt | EXTREMELY WEATHERED |
| | | | | | | 1.0 | | | Clayey SAND: fine to coarse grained, reddish brown, with fine to coarse sub-angular to angular gravel<br>1.20m | D to M | D | |
| | | | | | | 1.5 | | | TERMINATED AT 1.20 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

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# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

# Hole No: TP029

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**

**Machine Type:** 3.5 tonne Excavator **Excavation Method:**

**Excavation Dimensions:** **Contractor:** ARSK

**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | U50 0.60 - 0.79 m | | 0.5 | | | TOPSOIL: Silty SAND; fine to coarse grained, reddish brown | D | St | TOPSOIL |
| | | | | D 0.70 - 0.80 m | | | | | 0.15m<br>Silty CLAY; medium to high plasticity, reddish brown, trace fine to coarse grained sand, trace fine, sub-angular to angular gravel | M (<PL) | St<br>VSt - H | RESIDUAL SOIL |
| | | | | | | | | | 0.90m<br>0.95m SANDSTONE; fine to coarse grained, pale grey mottled black | | | WEATHERED ROCK |
| | | | | | | 1.0 | | | TERMINATED AT 0.95 m<br>Bucket refusal | | | |
| | | | | | | 1.5 | | | | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# TEST PIT LOG SHEET

**Client:** Newpro20
**Project:** Geotechnical Investigation
**Location:** 48 Windermere Road, Lochinvar NSW

## Hole No: TP030

**Job No:** 81021034 **Sheet:** 1 of 1

**Position:** Refer to site map **Angle from Horizontal:** 90° **Surface Elevation:**
**Machine Type:** 3.5 tonne Excavator **Excavation Method:**
**Excavation Dimensions:** **Contractor:** ARSK
**Date Excavated:** 17/9/20 **Logged By:** KS **Checked By:** JG

| Excavation | | | Water | Sampling & Testing | | Depth (m) | Material Description | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Resistance | Stability | | Sample or Field Test | DCP (blows per 150 mm) 1 3 6 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 | Groundwater Not Encountered | | | | | | TOPSOIL: Sandy CLAY; low plasticity, reddish brown, fine to coarse grained sand | M (<PL) | St | TOPSOIL |
| | | | | U50 0.20 - 0.40 m | | | | | 0.15m<br>Silty CLAY; medium to high plasticity, reddish brown, trace fine to coarse grained sand | M (<PL) | St | RESIDUAL SOIL |
| | | | | | R | 0.5 | | | 0.30 m: as above, with sand<br>0.45m<br>Sandy CLAY; medium plasticity, reddish brown mottled yellow, fine to coarse grained sand | M (<PL) | H | EXTREMELY WEATHERED |
| | | | | | | 1.0 | | | 1.00m<br>Clayey SAND: fine to coarse grained, reddish brown, with fine to coarse sub-angular to angular gravel | D to M | D | |
| | | | | | | 1.5 | | | 1.20m<br>TERMINATED AT 1.20 m<br>Target depth | | | |
| | | | | | | 2.0 | | | | | | |

**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

CARDNO (NSW/ACT) PTY LTD

# 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 (%)<br>(length of core recovered divided by the length of core run) |
| RQD | Rock Quality Designation (%)<br>(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


Silty CLAY


Sandy CLAY


Gravelly CLAY


Silty Gravelly CLAY


Silty Sandy CLAY


Sandy Gravelly CLAY


SILT


Clayey SILT


Sandy SILT


Gravelly SILT


Clayey Sandy SILT


Clayey Gravelly SILT


Sandy Gravelly SILT


SAND


Clayey SAND


Silty SAND


Gravelly SAND


Clayey Silty SAND


Clayey Gravelly SAND


Silty Gravelly SAND


GRAVEL


Clayey GRAVEL


Silty GRAVEL


Sandy GRAVEL


Clayey Silty GRAVEL


Clayey Sandy GRAVEL


Silty Sandy GRAVEL


COBBLES & BOULDERS


PEAT, highly organic soil


TOPSOIL


FILL


FILL: Asphalt or Bituminous Seal


FILL: Ballast


FILL: Concrete


FILL: Roadbase


Sedimentary rock: fine, mostly clay (CLAYSTONE)


Sedimentary rock: fine, mostly silt (SILTSTONE)


Sedimentary rock: fine, silt and clay (MUDSTONE, SHALE, LAMINITE)


Sedimentary rock: medium (SANDSTONE, GREYWACKE)


Sedimentary rock: fine to coarse, angular (BRECCIA)


Sedimentary rock: coarse, rounded (CONGLOMERATE)


Sedimentary rock: Organic (COAL)


Sedimentary rock: Carbonate (LIMESTONE, DOLOMITE)


Sedimentary rock: Volcanic (TUFF, VOLCANIC BRECCIA, AGGLOMERATE)


Igneous rock: Felsic, fine (RHYOLITE)


Igneous rock: Felsic, coarse (GRANITE)


Igneous rock: Mafic, fine to medium (BASALT, DOLERITE)


Igneous rock: Mafic, coarse (GABBRO)


Metamorphic rock: Foliated, fine to medium (SLATE, PHYLLITE, SHIST)


Metamorphic rock: Foliated, coarse (GNEISS)


Metamorphic rock: Non-foliated (QUARTZITE, HORNFELS, MARBLE)