Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Lot Classification
Stage 1, Western Precinct Redgum Ridge, Figtree

Prepared for
Edenvell Pty Ltd

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

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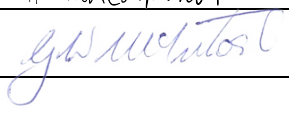
Reviewer		19 May 2022

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Report on Geotechnical Investigation
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1. Introduction

This report presents the results of a geotechnical investigation carried out for Stage 1 of the Western Precinct of Redgum Ridge Estate at Figtree. The work was commissioned by Edenvell Pty Ltd, the project developer and undertaken in liaison with K F Williams & Associates Pty Ltd, consulting engineers and project managers for the development.

The Stage 1 development comprises the creation of fourteen residential allotments (Lots 101 – 114) and construction of associated roadways. The purpose of the investigation described within was to broadly assess the subsurface conditions underlying the site and to classify each lot in accordance with Australian Standard AS 2870:2011 "Residential Slabs and Footings" .

The investigation comprised a review of existing geotechnical information, field mapping by a Principal geotechnical engineer, test pit excavation with in-situ testing and sampling of the overburden soils followed by laboratory testing, engineering analysis and reporting. Details of the work undertaken and the results obtained are given within this report, together with comments relating to design and construction practice.

A site plan indicating the subdivision layout was provided by the client for the investigation.

2. Proposed Development

Stage 1 of the Western Precinct of Redgum Ridge at Figtree comprises the creation of fourteen residential allotments (Lots 101 – 114) with approximate lot sizes in the range 1,210 – 4,990 m^2.

3. Background

A preliminary investigation of the Western Precinct was undertaken by Douglas Partners Pty Ltd (DP) prior to conceptual planning and design of the estate, with the results given in a report (Project 78502.18) dated 27 March 2014.

The 2014 DP investigation comprised field mapping by a senior engineering geologist and the excavation of test pits followed by laboratory testing, analysis and reporting. In summary, the Stage 1 development described within this report is located within a zone nominated as being "*suitable for residential development*".

The relevant test pit logs from the DP March 2014 investigation are included in Appendix B, with the approximate locations shown on Drawing 1 also in Appendix B.

4. Site Description and Regional Geology

Stage 1 of the Western Precinct of Redgum Ridge Estate, which includes the 570 m extension of Redgum Forest Way from the current western termination to Waterfall Way, comprises an irregular shaped area of approximately 4.6 ha with maximum plan dimensions of 200 m x 800 m. The site is centred on a north-west to south-east trending ridgeline. Surface levels fall away from the crest of the ridge at grades of 1 in 3 to 1 in 25 with an overall difference in level estimated to be about 22 m from the highest to the lowest part of the site.

At the time of the assessment, subdivision construction was nearing completion.

The site is mapped on the Wollongong 1:50 000 Geological Series Sheet (Department of Mines, 1977) as being underlain by the Pheasants Nest Formation of Permian age. The Pheasants Nest Formation is the basal unit of the Illawarra Coal Measures and typically comprises interbedded andesitic sandstone, mudrocks, carbonaceous mudrocks, tuff and coal (Unanderra Coal Member). Within the site area, the Pheasants Nest Formation also includes the Berkeley Latite Member, described as a fine grained, mid grey latite of sill or flow origin. The results of the field investigation were consistent with the geological mapping with sandstone or siltstone intersected in all the test pits.

5. Field Work

5.1 Methods

The current field work comprised the excavation of seven test pits (Pits 101 – 107) to depths of 1.0 – 2.5 m with a CAT308 excavator fitted with a 600 mm wide bucket.

The test pits were logged on site by a geotechnical engineer who collected disturbed and 'undisturbed' samples (in 50 mm diameter thin-walled tubes) to assist in strata identification and for possible laboratory testing. Dynamic cone penetrometer tests (DCP, AS 1289 6.3.2) were undertaken adjacent to the test pit locations to assess the consistency of the upper 0.5 – 1.2 m of the subsurface profile.

The locations of the test pits are shown on Drawing 1 (Appendix B). The surface levels given on the test pit logs to Australian Height Datum (AHD) and coordinates to Map Grid Australia (MGA) were provided by Glennos Constructions Pty Ltd, earthworks contractors for Redgum Ridge Estate.

5.2 Results

Details of the subsurface conditions encountered during the investigation are given on the test pit logs in Appendix B, which should be read in conjunction with the standard notes defining classification methods and descriptive terms.

Variable conditions were encountered underlying the site, with the succession of strata broadly summarised as follows:

TOPSOIL/TOPSOIL FILL:	to depths of 0.1 – 0.5 m in Pits 101 – 103 & 105 - 107;
FILL (controlled):	well compacted clay and gravelly clay to depths of 1.4 m in Pits 101 and 0.5 m in Pit 104. It is noted that fill in Pit 104 was associated with a backfilled sewer trench;
CLAY:	firm to very stiff (but typically stiff) clay, sandy clay and gravelly clay to depths of 0.5 – 2.2 m in Pits 101 – 104 & Pits 106 & 107;
ROCK:	variably low to medium strength siltstone and sandstone with some clay seams becoming medium strength at refusal of the excavator bucket at depths of 1.2 m and 1.8 m in Pit 103 and Pit 106 respectively. The remaining pits were terminated prior to bucket refusal in weathered rock at depths of 1.0 – 2.4 m.

No free groundwater was observed during test pit excavation. It is noted that the pits were immediately backfilled following completion of the field work which precluded longer term monitoring of groundwater levels.

6. Laboratory Testing

Selected samples from the pits were tested in the laboratory for measurement of field moisture content, Shrink-swell Index, Atterberg limits and linear shrinkage. The detailed test report sheets are given in Appendix C, with the results summarised in Table 1.

Table 1: Results of Laboratory Testing

Pit No	Depth (m)	W_F (%)	W_P (%)	W_L (%)	PI (%)	LS (%)	I_{SS} (%/ΔpF)	Material
101	0.5 – 0.9	18.3	23	40	17	9.5		Fill
103	0.5 – 0.8	22.1					1.7	Clay
104	0.5 – 0.9	31.3					2.0	Clay
107	0.5 – 0.9	22.6					3.2	Clay

Where W_F = Field moisture content, W_P = Plastic limit, W_L = Liquid limit, PI = Plasticity index, LS = Linear shrinkage, I_{ss} = Shrink Swell Index

The results indicate that the soils tested are of variable plasticity and would be susceptible to shrinkage and swelling movements with changes in soil moisture content.

7. Comments

7.1 General

The following comments are based on the surface and subsurface conditions encountered at the time of the investigation and the results of laboratory testing of selected samples from within the proposed development area.

7.2 Stability Assessment

The site lies within an area mapped for stability by H N Bowman in 1972 (Bowman, 1971b). From published information provided within Bowman's report, the site is located *"stable land – with some minor areas of slope instability"* and close to a boundary with *"topographically unsuitable land".* Due to the resolution at the scale of Bowman's mapping, it is difficult to delineate the zonal boundaries with precision.

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

Inspection of the site and adjacent areas by a Principal Geotechnical Engineer during the course of the works indicated no signs of deep-seated instability within the proposed residential allotments.

The site has also been assessed with reference to the Australian Geomechanics Society Landslide Taskforce *"Practice Note Guidelines for Landslide Risk Management"*, 2007 (AGS, 2007). The results of this assessment for each of these areas are outlined in Table 2 and 3 and are based on design and construction being undertaken in accordance with the specific recommendations given in this report.

Based on the observations made during the inspections, qualitative assessment has been undertaken for two zones, namely:

- Slight to Moderate Slopes Lots 101 – 106; and
- Moderate to Steep Slopes: Lots 107 – 114

Table 2 – Slope Stability Assessment (Slight Slopes – Lots 101 – 106)

Hazard	Likelihood	Consequence to Proposed Development	Risk to Proposed Development
Creep of surface soils	Unlikely	Minor	Low
Deep-seated slide	Rare	Major	Low

Table 3 – Slope Stability Assessment (Moderate to Steep Slopes – Lots 107 – 114)

Hazard	Likelihood	Consequence to Proposed Development	Risk to Proposed Development
Creep of surface soils	Possible	Medium	Moderate
Deep-seated slide	Unlikely	Major	Moderate

In summary, Lots 101 – 106 are classified as Low risk of damage to property occurring as a result of slope instability. Lots 107 – 114 are classified as Moderate risk These risk ratings are within the *acceptable* and *tolerable* range respectively as described in Wollongong Council's Development Control Plan – *"Development of Sites which may be Subject to Slope Instability"* (WCC, 2009).

Notwithstanding the various risk categories nominated, development of the site for residential purposes is considered geotechnically feasible, with erosion measures and dwelling construction/design appropriate for hillside sites required in the steeper (Moderate risk) areas of the site.

7.3 Site Fill and Subsurface Drainage

In order to attain the design levels, fill was placed on some of the lots to depths of up to 2.5 m.

The approximate areal extent of fill placed under engineering control is shown on Drawing 1. Inspection and testing services provided by GHD (who engaged Coffey Testing Pty Ltd to undertake the density testing) and Douglas Partners Pty Ltd. A copy of the GHD Earthworks Testing Report (Project No.12532871 dated 25 February 2022, which also includes the results of testing undertaken by DP, is included in Appendix D. The results indicate dry density ratios in excess of 98% relative to standard compaction, with placement moisture contents generally within 2% of standard optimum. The DP test result summary sheets and test location plans are also included in Appendix D.

Based on the survey information provided by K F Williams and Associates, the depth of controlled fill placed on the lots is summarised in Table 4. Reference should be made to the work-as-executed plan prepared by KFW (Appendix D) for the surveyed extent and depth of fill placed on the lots.

Table 4 – Controlled Filling Summary

Lot No	Depth of filling (m)	Lot No	Depth of filling (m)
101	0 – 2.5	108	-
102	0 – 2.0	109	-
103	-	110	-
104	-	111	0 – 2.5
105	-	112	0 – 2.5
106	-	113	0 – 2.5
107	0 – 0.5	114	0 – 3.0

A subsurface drain was installed during backfilling of a drainage depression within Lots 11 & 112 in order to intercept groundwater flow. The location of the subsurface drain is shown on Drawing 1.

7.4 Lot Classification

7.4.1 Lots 101 – 106

Based on the observed subsurface profiles encountered during the field work, the results of laboratory testing and previous experience in the Redgum Ridge Estate, characteristic surface movements of up to 55 mm are estimated for the lots. Accordingly, the following classifications are nominated in accordance with AS 2870:2011.

- Class H1* (highly reactive / filled lot): Lots 101, 102;
- Class H1 (highly reactive): Lots 103 – 106

It should be noted however, that the classification given is appropriate for the undeveloped lots. Notwithstanding the nominated classifications, reference must be made to Sections 7.8 with respect to footing requirements.

7.4.2 Lots 107 – 114

The topographical slopes over the remaining lots (Lots 107 – 114) are considered to be moderate to steep, with subsurface conditions including firm clays (in parts). These lots have therefore been classified as Class P (hillside lots). They have also been assessed as having no greater than a Moderate risk of damage to property when assessed in accordance with the guidelines prepared by the Australian Geomechanics Society Landslide Taskforce: *Practice Note Guidelines for Landslide Risk Management* (AGS, 2007).

All design and construction for residential structures must be undertaken in accordance with sound engineering practice with regard to hillside development and the comments given within. Accordingly, reference should be made to AGS (AGS, 2007) during the design phase for residences on the lots. Relevant extracts of the AGS (AGS, 2007) document are included in Appendix E.

7.5 Site Preparation

Subject to the location of the residences within the nominated lots, site preparation for the construction of residential structures should include the removal of all vegetation, organic topsoils, uncontrolled filling or other deleterious materials.

Within the Low risk section of the site (Lots 101 – 106), excavation and filling should generally be limited to a maximum vertical height of 1.5 m respectively below or above the existing ground surface. Excavations that exceed 1.5 m must be supported by engineer-designed retaining walls.

All fill should be placed in accordance with the following guidelines:

- strip all topsoils and other deleterious materials and remove to spoil or stockpile for later re-use in landscaping;
- inspect and test roll the exposed surface under the direction of a geotechnical engineer prior to the placement of fill materials;
- bench the stripped surface to ensure horizontal fill placement;
- place homogeneous fill in near-horizontal layers of maximum 250 mm loose thickness or as appropriate for the compaction equipment;
- compact the fill in the range 98% – 102% standard maximum dry density with placement moisture contents maintained within 2% of standard optimum values.

Fill materials should not contain vegetation or other organic matter. The site preparation works and all fill placement should be under controlled conditions as defined in AS 3798:2007.

Permanent batters within excavation or controlled filling should be no greater than 3(H):1(V) and should be topsoiled and vegetated as soon as possible after construction to minimise soil erosion. Proposed earthworks that exceed the above requirements should be subject to review by a geotechnical engineer during the design phase of the individual project.

Within the Class P lots (namely, Lots 106 –114), excavation and filling should generally be limited to a maximum vertical height of 1 m respectively below or above the existing ground surface. Excavations that exceed 1 m must be supported by engineer-designed retaining walls founded on bedrock, designed and certified by an experienced and accredited structural engineer, in accordance with Wollongong City Council requirements. However, it must be accepted that creep movement in retaining walls constructed along the slope contours is probably inevitable, due to the high active pressures of the retained material.

7.6 Footings

It is suggested that footing systems be designed and constructed in accordance with AS 2870:2011 *"Residential Slabs and Footings"* for the appropriate classification and the appropriate classification and the requirements given within this report.

7.6.1 Lots 101 – 106

From the reactivity viewpoint, structural design for Lots 101 – 106 should be commensurate with the minimum requirements for the classification given in Section 7.4 with reference made to AS 2870:2011. Notwithstanding this, due to the relatively shallow rock depth and the likelihood of partial rock exposure during site preparation, it is recommended that all footings found within a uniform bearing stratum of weathered rock. As a guide, footing and pier design could be based on an allowable end bearing pressure of 500 kPa in the weathered rock, with care exercised to ensure that footing trenches/piers are inspected for design compliance.

Piers or trench excavations should be primarily oriented in the upslope-downslope direction with footing excavations benched into the slope to provide vertical bearing into the rock. Based on the field work undertaken to date, founding depths would generally be in the range 1 m to 2 m. Some variability in rock depths and depths of weathering (and hence pier lengths and footing depths) should be expected across the lots. The main advantage of a footings-to-rock system would be that settlements (both total and differential) would be negligible and could possibly result in minimal site preparation works.

7.6.2 Lots 107 – 114

The principal recommendation for footing construction on hillside lots (ie Lots 107 – 114) is for the provision of a uniform bearing stratum below the level of potential soil creep. Allowance should therefore be made for piering or footing trench excavation to at least the level of the weathered rock in order to minimise the possibility of distress due to soil creep.

In this regard, allowance should be made during the conceptual planning of footings to the utilisation of piers or trench excavations oriented in the upslope-downslope direction and/or footing excavations benched into the slope to provide vertical bearing into the rock.

All footing systems should be designed and constructed in accordance with engineering principles relevant to hillside construction, with care exercised to ensure that footing trenches/piers are inspected for design compliance. As a guide, pier design could be based on an allowable end bearing pressure of 500 kPa in the weathered rock, with a minimum socket length of 300 mm (or prior refusal) suggested.

Due to the steep topography over parts of the site and the risk of spoil material accidentally moving downslope (particularly cobbles and boulders), measures will need to be put in place by building contractors to ensure that downslope properties are not impacted by debris flows.

The design of individual structures should include review and where necessary, additional subsurface investigation by a geotechnical engineer. All footing systems should be designed and constructed in accordance with engineering principles relevant to hillside construction. Allowance must be made for flexibility within the overall dwelling designs (such as provision for articulation, timber panelling and limiting panel lengths in brickwork).

7.7 Site Maintenance and Drainage

The developed lots should be maintained in accordance with the CSIRO publication *"Foundation Maintenance and Footing Performance: A Homeowners Guide"*, a copy of which is included in Appendix E. Whilst it must be accepted that minor cracking in most structures is inevitable, the guide describes suggested site maintenance practices aimed at minimising foundation movement or floor slab movement to keep cracking within acceptable limits.

Surface drainage should be installed and maintained at the site. Subject to the design of future residences and the earthworks required, the inclusion of subsurface drainage as part of the site development works may also be necessary. The need for such drainage however, can only be determined in consultation with the design engineer once excavation/earthworks details for the lots are

finalised. All collected stormwater and roof runoff should be discharged into the stormwater disposal system. Similarly, all effluent flows should be discharged into the sewerage system.

8. References

AGS. (2007). *Practice Note Guidelines for Landslide Risk Management.* Australian Geomechnics, Volume 42, No 1: Australian Geomechanics Society, Landslide Taskforce, Landslide Practice Note Working Group.

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

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

Bowman, H. (1971b). *Natural Slope Stability in the City of Greater Wollongong.* Vol 14(2), 159 – 222: Records of the Geological Survey of NSW.

Department of Mines. (1977). *Geology of Wollongong 1:50 000 Geological Series Sheet.* NSW State Archives and Records.

WCC. (2009). *Wollongong Development Control Plan 2009.* and subsequent amendments: Wollongong City Council.

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Stage 1, Western Precinct Redgum Ridge, Figtree in accordance with DP's proposal dated 25 November 2020 and acceptance received from Richard Clifford of Edenvell Pty Ltd dated 26 November 2020. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Edenvell Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

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

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

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Introduction

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

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

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Sampling Methods

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Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Description and Classification Methods

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

Soil Types

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

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

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

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

Definitions of grading terms used are:

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

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

In fine grained soils (>35% fines)

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

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

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

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

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

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

Soil Descriptions

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Origin

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

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

Moisture Condition – Coarse Grained Soils

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

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

Moisture Condition – Fine Grained Soils

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

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

Rock Strength

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

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

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

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

Degree of Weathering

The degree of weathering of rock is classified as follows:

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

Rock Descriptions

Degree of Fracturing

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

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

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Douglas Partners

Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

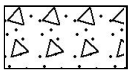
Symbols & Abbreviations

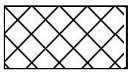
Graphic Symbols for Soil and Rock

General

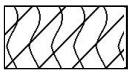
Asphalt

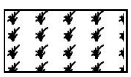
Road base

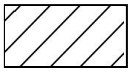

Concrete

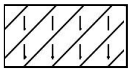

Filling

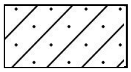
Soils


Topsoil

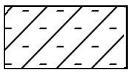

Peat

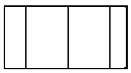

Clay

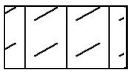

Silty clay

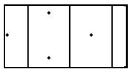

Sandy clay

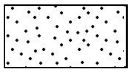
Gravelly clay

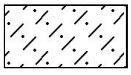

Shaly clay

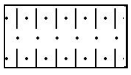

Silt


Clayey silt


Sandy silt

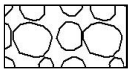

Sand

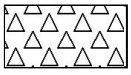

Clayey sand


Silty sand

Gravel

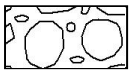
Sandy gravel


Cobbles, boulders

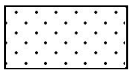

Talus

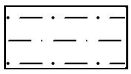
Sedimentary Rocks

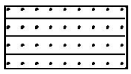
Boulder conglomerate

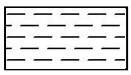

Conglomerate

Conglomeratic sandstone

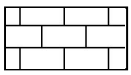

Sandstone


Siltstone

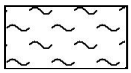

Laminite

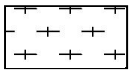

Mudstone, claystone, shale

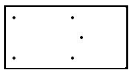
Coal


Limestone

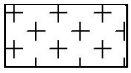
Metamorphic Rocks

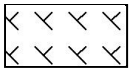

Slate, phyllite, schist

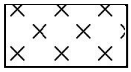

Gneiss

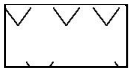

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia

Porphyry

Appendix B

Previous Test Pit Logs (Pits 2 – 5)
Current Test Pit Logs (Pits 101 – 107)
Drawing 1

TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge Estate, Figtree

SURFACE LEVEL: 78 AHD
EASTING: 301146
NORTHING: 6187695

PIT No: 2
PROJECT No: 78502.18
DATE: 4/3/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
78		FILLING - dark grey, silty clay with some roots and timber, damp							
	0.4	TOPSOIL - dark grey, silty clay with some roots, damp							
	0.8	SANDY CLAY - stiff to very stiff, light orange brown and dark brown, slightly gravelly (latite), sandy clay with some silt, damp							
77	1			D	1.0		pp = 250-350		1
					1.1				
	1.3	CLAY - firm to stiff, green grey and light brown clay with trace silt, moist							
				D	1.4		pp = 90-140		
					1.5				
	1.7	SILTY CLAY - very stiff, brown and white grey, silty clay with some gravel (fine to coarse latite) and extremely low to very low strength, extremely to highly weathered latite bands							
				D	1.8		pp = 300-340		
					1.9				
76	2								2
	2.4	LATITE - very low strength, highly weathered light orange brown and grey latite							
	2.5	Pit discontinued at 2.5m Limit of Investigation							

RIG: Case Backhoe (450mm bucket)

LOGGED: BNG

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge Estate, Figtree

SURFACE LEVEL: 87 AHD
EASTING: 301013
NORTHING: 6187815

PIT No: 3
PROJECT No: 78502.18
DATE: 4/3/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
87		TOPSOIL - dark grey, slightly silty clay with some gravel and roots, damp							
	0.2	CLAY - firm to stiff, light orange brown and grey brown clay with some fine to coarse gravel (sandstone)							
				U	0.6				
					0.9		pp = 180-200		
86	1								1
	1.2	GRAVELLY SILTY CLAY - stiff, light yellow brown and white grey, gravelly (fine to coarse sandstone, latite), silty clay, damp		D	1.2		pp = 150-200		
					1.3				
	1.8	SANDSTONE - medium to high strength, slightly weathered, grey and grey brown sandstone		D	1.8				
	1.9	Pit discontinued at 1.9m			1.9				
85	2	Slow progress							2

RIG: Case Backhoe (450mm bucket)

LOGGED: BNG

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge Estate, Figtree

SURFACE LEVEL: 80 AHD
EASTING: 300972
NORTHING: 6187767

PIT No: 4
PROJECT No: 78502.18
DATE: 12/3/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
80	0.1	TOPSOIL - brown, sandy silt with some clay trace roots, damp							
		SILTY CLAY - stiff, grey brown silty clay with a trace fine to medium gravel (latite), moist		D	0.3		pp = 150		
	0.5	LATITE - extremely low strength, orange brown and brown latite with clay bands		D	0.6		pp = 200		
	0.8	Pit discontinued at 0.8m Refusal on medium to high strength latite							
79	1								1
78	2								2

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

RIG: Case Backhoe (450mm bucket)

LOGGED: SB

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge Estate, Figtree

SURFACE LEVEL: 88 AHD
EASTING: 300923
NORTHING: 6187866

PIT No: 5
PROJECT No: 78502.18
DATE: 4/3/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Sampling & In Situ Testing: Depth	Sampling & In Situ Testing: Sample	Sampling & In Situ Testing: Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
88		TOPSOIL - dark grey, silty clay with some roots, damp							
	0.2	CLAY - firm, grey brown and orange brown clay with trace silt, damp to moist							
	0.5	SILTY CLAY - stiff, light brown and orange brown, slightly sandy, silty clay, damp		D	0.5 0.6		pp = 150-160		
87	1.0	SANDSTONE - extremely low strength, extremely weathered, light orange sandstone with some sandy clay bands		D	1.0 1.1				1
		- becoming low strength, highly to moderately weathered below 1.5m		D	1.9 2.0				
86	2.2	Pit discontinued at 2.2m Refusal on medium to high strength sandstone							2

RIG: Case Backhoe (450mm bucket)

LOGGED: BNG

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge, Figtree

SURFACE LEVEL: 81.1 AHD
EASTING: 301092
NORTHING: 6187766

PIT No: 101
PROJECT No: 89157.66
DATE: 11/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
81	0.15	TOPSOIL FILL/Clayey SILT (ML): low plasticity, dark brown, with fine to coarse grained sand, trace rootlets, w>PL, TOPSOIL FILL							
		FILL/CLAY (CI): medium plasticity, dark grey, trace silt, fine to coarse grained sand and fine to medium gravel, w~PL, stiff to very stiff, FILL		D	0.3				
	0.5	FILL/CLAY (CI/CH): medium to high plasticity, brown, with fine to coarse grained sand, trace silt and fine to coarse gravel, w<PL, very stiff, FILL		U_{50}	0.5				
		-from 0.8m, trace cobbles to 120mm in size			0.9				
80	1			D	1.1		pp = 290-310		1
	1.4	Silty CLAY (CL): low plasticity, brown, with rootlets, w<PL, stiff, residual							
	1.5	CLAY (CL/CI): low to medium plasticity, grey brown, with rootlets, trace roots, w>PL, stiff, residual		D	1.7		pp = 120-160		
	1.8	Sandy CLAY (CI): medium plasticity, brown mottled orange red brown, fine to coarse grained sand, w<PL, very stiff, residual							
79	2				2.0		pp = 220-250		2
	2.2	SANDSTONE: fine to coarse grained, brown mottled orange brown, dry to moist, medium strength, moderately weathered, fractured, latite shallower at western edge of pit		D	2.3				
	2.4	Pit discontinued at 2.4m -limit of investigation							

RIG: CAT 308 mini excavator fitted with a 600mm wide toothed bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

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

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge, Figtree

SURFACE LEVEL: 81.7 AHD
EASTING: 301040
NORTHING: 6187777

PIT No: 102
PROJECT No: 89157.66
DATE: 11/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
81	0.2	FILL/CLAY (CI): medium plasticity, grey brown, with fine to coarse grained sand, trace fine to coarse gravel and silt, w>PL, firm to stiff, TOPSOIL FILL							
	0.5	CLAY (CI/CH): medium to high plasticity, grey brown, with fine to coarse grained sand and silt, moist, w~PL, stiff, residual		D	0.4		pp = 150-170		
	1.0	SANDSTONE: fine to coarse grained, brown, dry to moist, low to medium strength, moderately to slightly weathered, fractured to slightly fractured		D	0.8				
80	1	Pit discontinued at 1.0m -bucket slow progress							1
79	2								2

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

RIG: CAT 308 mini excavator fitted with a 600mm wide toothed bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

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

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge, Figtree

SURFACE LEVEL: 87.4 AHD
EASTING: 301030
NORTHING: 6187824

PIT No: 103
PROJECT No: 89157.66
DATE: 11/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
87	0.1	TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with fine to coarse grained sand and fine gravel, w<PL, TOPSOIL FILL							
		Silty CLAY (CI/CH): medium to high plasticity, grey brown, trace rootlets, w=PL, stiff to very stiff, alluvial							
		-from 0.3m, w<PL, very stiff		D	0.4		pp = 270-310		
	0.5	CLAY (CI): medium plasticity, pale orange grey brown, trace silt, fine grained sand and rootlets, w<PL, very stiff, residual			0.5				
				U_{50} D	0.7		pp = 250-330		
	0.8	SANDSTONE: fine grained, pale grey orange brown, dry to moist, low to medium strength, moderately to slightly weathered, fractured			0.8				
	1			D	1.0				1
	1.2	Pit discontinued at 1.2m -bucket refusal							
86									
	2								2
85									

RIG: CAT 308 mini excavator fitted with a 600mm wide toothed bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

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

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge, Figtree

SURFACE LEVEL: 76.8 AHD
EASTING: 300970
NORTHING: 6187750

PIT No: 104
PROJECT No: 89157.66
DATE: 11/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
76	0.5	FILL/CLAY (CI/CH): medium to high plasticity, brown/grey brown, trace fine silt, fine to coarse grained sand, w~PL, stiff to very stiff, FILL (sewer trench backfill)							
		CLAY (CI/CH): medium to high plasticity, brown mottled orange brown, trace fine to coarse grained sand and silt, w>=PL, stiff, residual -from 0.6m, w<PL, very stiff		U_{50}	0.5 0.9				
75	1.3	SILTSTONE: fine grained, dark grey, dry to moist, medium to high strength, moderately weathered, fractured		D	1.5				
		1.7 - 2.0m - medium plasticity, pale grey brown, with highly weathered siltstone gravel, w<PL, very stiff (extremely weathered seam)		D	1.9				
	2.0	SILTSTONE: fine grained, pale grey brown, dry to moist, medium strength, moderately weathered, fractured, trace extremely weathered clay seams		D	2.2				
74	2.5	Pit discontinued at 2.5m -limit of investigation							

RIG: CAT 308 mini excavator fitted with a 600mm wide toothed bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Pit dug immediately adjacent & parallel to sewer trench. Surface levels and coordinates are approximate only and must not be relied upon.

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

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge, Figtree

SURFACE LEVEL: 79.4 AHD
EASTING: 300945
NORTHING: 6187792

PIT No: 105
PROJECT No: 89157.66
DATE: 11/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
79	0.4	TOPSOIL/Silty CLAY (CL): low plasticity, black, with rootlets, trace fine to coarse grained sand, w<PL, TOPSOIL							
		SANDSTONE: fine to coarse grained, brown, dry to moist, loose to medium strength, moderately to slightly weathered, fractured to slightly fractured, trace clay seams		D	0.7				
78	1								1
	2			D	2.0				2
77	2.4	Pit discontinued at 2.4m -limit of investigation							

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

RIG: CAT 308 mini excavator fitted with a 600mm wide toothed bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Inferred DCP penetrated clay seam. Surface levels and coordinates are approximate only and must not be relied upon.

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

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge, Figtree

SURFACE LEVEL: 84.8 AHD
EASTING: 300973
NORTHING: 6187814

PIT No: 106
PROJECT No: 89157.66
DATE: 11/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
84	0.1	FILL/MULCH							
		TOPSOIL/Silty CLAY (CI/CH): medium to high plasticity, black, with rootlets, w>PL, TOPSOIL							
	0.45	CLAY (CI/CH): medium to high plasticity, pale brown mottled grey, with silt, trace roots, w>PL, firm, residual		D	0.5				
	1	-from 0.9m, brown mottled red brown, trace fine grained sand, firm		D	1.0		pp = 80-100		
		-from 1.5m, w~PL, stiff to very stiff		D	1.5		pp = 180-250		
	1.7	SILTSTONE: fine grained, dark grey, dry to moist, high strength, slightly weathered, fractured to slightly fractured		D	1.75				
83	1.8	Pit discontinued at 1.8m -bucket refusal							
	2								
82									

RIG: CAT 308 mini excavator fitted with a 600mm wide toothed bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

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

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Edenvell Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Western Precinct Redgum Ridge, Figtree

SURFACE LEVEL: 82.8 AHD
EASTING: 300907
NORTHING: 6187841

PIT No: 107
PROJECT No: 89157.66
DATE: 11/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
82	0.4	TOPSOIL/Silty CLAY (CI): medium plasticity, dark grey brown, with rootlets, trace fine to coarse grained sand, w>PL, TOPSOIL							
		CLAY (CI/CH): medium to high plasticity, brown mottled grey brown, with silt, trace fine to coarse grained sand, w~PL, stiff, residual		U_{50}	0.4				
		-from 0.75m, w<=PL, very stiff							
	0.9	Gravelly Silty CLAY (CI): medium plasticity, pale grey, fine to medium sub-angular gravel, w<PL, very stiff, extremely weathered siltstone		D	0.9 1.1				
81	1.25	SILTSTONE: fine grained, pale grey, dry to moist, very low strength, highly weathered, highly fractured to fractured		D	1.4				
		-from 1.5m, low to medium strength, highly to moderately weathered							
		-from 1.75m, medium strength, moderately weathered, fractured to slightly fractured		D	1.8				
	1.9	Pit discontinued at 1.9m -bucket slow progress							
80									

RIG: CAT 308 mini excavator fitted with a 600mm wide toothed bucket

LOGGED: ADFH

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

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

SAMPLING & IN SITU TESTING LEGEND

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

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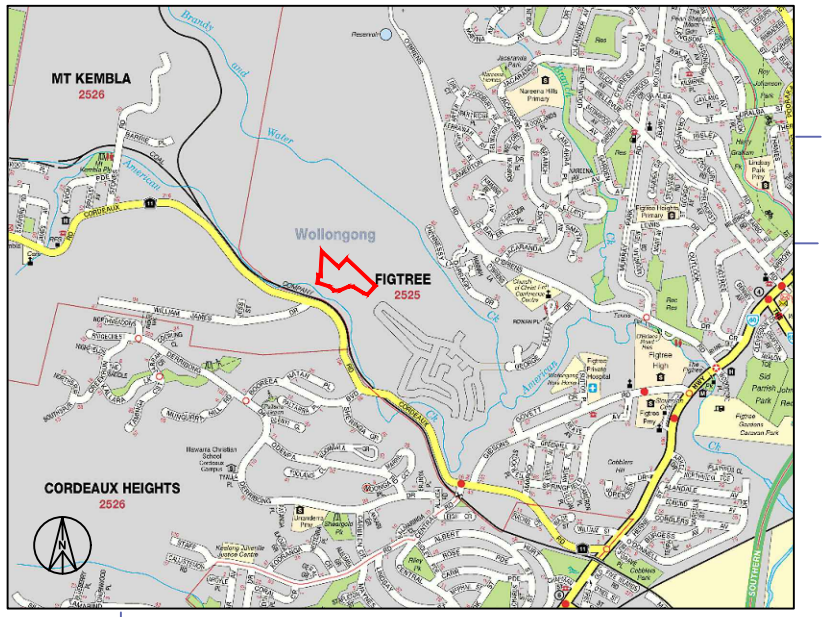

LOCALITY PLAN

REDGUM FOREST WAY

WAY

WATERFALL

101 102 103 104 105 106 107 108 109 110 111 112 113 114

1 2 3 4 5

Legend

- Current Test Pit Location
- Previous Test Pit Location (Project 78502.18 dated 4/3/14)
- Approximate extent of controlled fill
- Subsurface drainage line
- Asset Protection Zone
- Easement

0 10 20 30 40 50 75 100m

1:1000 @ A3

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CLIENT: Edenvell Pty Ltd		
OFFICE: Wollongong	DRAWN BY: DJM	
SCALE: 1:1000 @ A3	DATE: 17/05/2022	

TITLE: **Test Pit Location Plan**
Lot Classification
Stage 1, Western Precinct Redgum Ridge, Figtree

MGA

PROJECT No:	89157.66
DRAWING No:	1
REVISION:	0