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REPORT
ON
GEOTECHNICAL INVESTIGATION

CONCEPT PLAN APPLICATION
CALDERWOOD URBAN DEVELOPMENT PROJECT

Prepared for:
DELFIN LEND LEASE LTD

PROJECT 48742
MARCH 2010

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Executive Summary

A geotechnical investigation has been undertaken for the Concept Plan Application of the Calderwood Urban Development Project, a 720 ha site near Albion Park, NSW. The investigation comprised field mapping by a Principal Engineering Geologist, test pit excavations, borehole drilling and laboratory testing of soil samples.

The investigation was undertaken to assess geotechnical constraints (if any) that would need to be applied to development of the site and to address the Director General Requirements of:

- any likely geotechnical impacts and mitigation measures;
- groundwater details.

The subsurface conditions encountered ranged from typical alluvial deposits associated with Macquarie Rivulet (which traverses the site in the east-west direction), namely interbedded firm to stiff clays / sandy clays and loose to medium dense sands to residual clays overlying weathered rock belonging to either the Berry Formation or Budgong Sandstone. Groundwater was typically encountered at depths of 3 – 6 m below the existing surface in the lower elevations of the site. Site topography ranged from near-level adjacent to Macquarie Rivulet through gentle undulating terrain to steeper areas around the site perimeter.

Stability mapping and analysis indicates that instability risk classifications of very low to low are considered appropriate for most of the site. Engineering works and the adoption of conventional hillside design & construction techniques will be required in some areas (refer Drawing 9) to achieve a low risk classification following completion of construction.

Development of the site (as proposed) is considered to be geotechnically feasible and suitable for typical residential and commercial structures. Comments are given in the report on groundwater, slope stability, acid sulphate soils, hydrogeology, erosion, development potential and geotechnical site constraints.

This report addresses the Director General Requirements for geotechnical impacts and mitigation measures and groundwater.

TABLE OF CONTENTS

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Project 48742.00 Rev 3
3 March 2010

REPORT ON GEOTECHNICAL INVESTIGATION
CONCEPT PLAN APPLICATION
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1. INTRODUCTION

1.1 General

This report presents the results of a Geotechnical Assessment undertaken on a 720 ha parcel of land known as the Calderwood Urban Development Project, near Albion Park, henceforth "the site" (refer Drawing 1 and 2). The work was commissioned by Cardno Forbes Rigby Pty Ltd (Cardno) on behalf of the potential developer of the site, Delfin Lend Lease Ltd (DLL).

As part of the Part 3A application, Douglas Partners have also prepared the following studies:

- Report on Groundwater Investigation, Project Number 48742.02, dated 22 January 2010; and
- Report on Acid Sulphate Soils Investigation, Project Number 48742.03, dated 22 January 2010
- Report on Stage One Contamination Assessment, Project Number 48742.04, dated 22 January 2010;

It is noted that each of these assessments is a preliminary assessment for Concept Plan Application purposes. A preliminary master plan schematic as well as various GIS layers (including, contours, cadastre and aerial photography) were provided by the client for the purposes of the investigation.

The geotechnical investigation comprised test pit excavation and borehole drilling followed by laboratory testing of selected samples, groundwater monitoring, engineering analysis and reporting. Details of the work undertaken and the results obtained are given below together with comments relating to design and construction practice.

1.2 Background

This investigation has been prepared to accompany a Concept Plan Application under Part 3A of the Environmental Planning & Assessment Act, 1979 (EP&A Act) in relation to the Calderwood Urban Development Project. A Concept Plan Application under Part 3A of the Environmental Planning & Assessment Act 1979 and a State significant site listing proposal under Schedule 3 of the State Environmental Planning Policy Major Development 2005 have been submitted to the Department of Planning.

The Calderwood Urban Development Project proposes a mix of residential, employment, retail, education, conservation and open space uses. The development proposes 4,800 dwellings and approximately 50 hectares of retail, education, community and mixed use / employment land. The overall development will accommodate about 12,400 people and will deliver $3 billion in development expenditure and create 7,600 full time equivalent jobs by 2026.

The Calderwood Urban Development Project site is located within the Calderwood Valley in the Illawarra Region. It is approximately 700 hectares in area with approximately 600 hectares of land in the Shellharbour LGA and the balance located within the Wollongong LGA.

The Calderwood Valley has long been recognised as a location for future urban development, firstly in the Illawarra Urban and Metropolitan Development Programmes and more recently in the Illawarra Regional Strategy (IRS).

The IRS nominates Calderwood as an alternate release area if demand for additional housing supply arises because of growth beyond projections of the Strategy, or if regional lot supply is lower than expected.

In 2008, the former Growth Centres Commission reviewed the proposed West Dapto Release Area (WDRA) draft planning documents . The GCC concluded that forecast housing land supply in the IRS cannot be delivered as expected due to implementation difficulties with the WDRA,

and the significantly lower than anticipated supply of housing land to market in the Illawarra Region is now been recognised as a reality.

The GCC Review of the WDRA also recognised that there is merit in the early release of Calderwood in terms of creating a higher dwelling production rate and meeting State government policy to release as much land to the market as quickly as possible. Given the demonstrated shortfall in land supply in the Illawarra Region and the WDRA implementation difficulties highlighted in the GCC Report, the release of Calderwood for urban development now conforms to its strategic role under the IRS as a source of supply triggered by on-going delays in regional lot supply. The Calderwood Urban Development Project can deliver about 12% of the IRS' new dwelling target.

Changes in outlook arising from global, national and regional factors influencing investment and delivery certainty, housing supply and affordability and employment and economic development also add to the case for immediate commencement of the Calderwood Project.

In April 2008 the Minister for Planning issued terms of reference for the preparation of a Justification Report to address the implications of initiating the rezoning of Calderwood for urban development including associated staging, timing and infrastructure considerations.

In February 2009 the Minister for Planning considered a Preliminary Assessment Report for the Calderwood Urban Development Project that provided justification for the planning, assessment and delivery of the project to occur under Part 3A of the EP&A Act, having regard to the demonstrated contribution that the project will have to achieving State and regional planning objectives.

Subsequently, on the 16 April 2009, pursuant to Clause 6 of SEPP Major Development, the Minister for Planning formed the opinion that the Calderwood Urban Development Project constitutes a Major Project to be assessed and determined under Part 3A of the EP&A Act, and also authorised the submission of a Concept Plan for the site. In doing so, the Minister also formed the opinion that a State significant site (SSS) study be undertaken to determine whether to list the site as a State Significant site in Schedule 3 of SEPP Major Development.

The Part 3A process under the EP&A Act allows for the Calderwood Urban Development Project to be planned, assessed and delivered in an holistic manner, with a uniform set of planning

provisions and determination by a single consent authority. Given the scale of the proposal, the Concept Plan and SSS listing provide the opportunity to identify and resolve key issues such as land use and urban form, development staging, infrastructure delivery and environmental management in an integrated and timely manner.

This report has been prepared to fulfil the Environmental Assessment Requirements issued by the Director General for the inclusion of the Calderwood site as a State Significant Site under SEPP Major Development, and for a Concept Plan approval for the development. Specifically, this investigation has been prepared to satisfy the following bullet points in the DGRs under the heading 'Stage 1 Project Application':

- 'Any likely geotechnical impacts and mitigation measures.
- Groundwater Details.'

2. SITE DESCRIPTION

The site is located in the Calderwood Valley, northwest of the township of Albion Park. The site is bounded by the Illawarra Highway to the south and Marshall Mount Road in the north. North Macquarie Road bisects the site in an approximate northeast – southwest direction. The site itself comprises an irregular shaped area of 718.6 ha with maximum north-south and east-west dimensions of 3.70 km and 3.22 km respectively (refer Drawing 2, in Appendix A).

Macquarie Rivulet and Marshall Mount Creek run west to east across the site in the south and north respectively. Overhead high voltage electricity lines also cross the northern part of the site.

Topography across the site is varied and ranges from essentially flat flood plains bordering the creeks, gently undulating terrain across most of the site to extremely steep ground on the flanks of Johnstons Spur. Topographic relief is from RL 165 m, relative to Australian Height Datum (AHD) at the top of Johnstons Spur to less than RL 10 m in the Marshall Mount Creek drainage channel.

The site consists of 21 distinct land packages in the local government areas of Wollongong and Shellharbour. Each of these properties has been designated a letter from A – U for the purposes of this report (refer Drawing 2 for property names). The land is principally used as farm land, incorporating hobby farms, dairy farming, horse agistment and horse breeding. The site has been largely cleared though pockets of remnant vegetation remain, especially on the elevated portions of the site.

3. REGIONAL GEOLOGY AND SOIL LANDSCAPES

The Kiama and Robertson 1:50 000 Geological Series Sheets (References 1 and 2) indicate that the study area is underlain by a gently dipping (about 5° to the north - northwest), highly varied section of the stratigraphic sequence of the Permo - Triassic Sydney Basin. This sequence is locally to extensively overlain by alluvium, and locally by talus (slopewash and rockfall debris), of recent (Quaternary) age.

The distribution of the principal units of the bedrock stratigraphy is shown in Drawing 3. Typical lithologies of these units are summarised below in oldest to youngest order:

Berry Formation - comprising mid grey to dark grey siltstone and fine-grained sandstone. This formation is found at the foot of hill slopes in the subject area, adjoining the Budgong Sandstone up-slope and the alluvial deposits down-slope.

Budgong Sandstone - comprising red brown to grey volcanic sandstone. This formation underlies foot to upper valley slopes in most of the study area.

Bumbo Latite Member - a grey to blue grey aphanitic to porphyritic latite. This member within the Budgong Sandstone appears on the lower midslope of Johnstons Spur.

Cambewarra Latite Member – similar to the Bumbo Latite Member, this unit is present at higher elevations, specifically at the highest point of Johnstons Spur.

The Soils Landscapes of the Kiama 1:100 000 Sheet (Reference 3) indicates that the properties included within the study area are located within six soil landscapes representing swamp, erosional and depositional geomorphological processes. The distribution of the soil landscapes are given on Drawing 4 and are summarised below:

Albion Park Soil Landscape (ap)- an erosional soil group developed on short, steep (15% - 50%) upper slopes and long gentle (5% - 15%) footslopes generally underlain by rocks of the Berry Formation, but also including localised sections of the Budgong Sandstone and Bumbo Latite. The group comprises moderately deep (0.5 m - 1 m), Brown and Yellow Podzolic Soils, respectively on crests and upper slopes, and Soloths on footslopes and drainage lines. These soils include sandy clay loam or sandy loam topsoil to 0.4 m in depth underlain by light clay, sandy loam or heavy clay subsoils. Limitations of the soils include waterlogging, seasonally high watertable and hard setting topsoil.

Bombo Soil Landscape (bo) - an erosional soil group developed on low rolling hills (slope gradients 15% - 25%) with benched slopes underlain by the Bumbo Latite. The group comprises shallow (<0.5 m) Structured Loams on crests, moderately deep (0.5 m - 1 m) Krasnozems on upper slopes and benches, and Brown and Red Podzolic Soils on mid and lower slopes. These soils include sandy clay loam or sandy loam topsoil to 0.15 m in depth underlain by light medium clay, sandy clay or medium clay subsoils. Limitations of the soils include rock outcrop and hard setting character.

Cambewarra Soil Landscape (ca) - an erosional soil group developed on steep to very steep (>30%) hills with broad colluvial benches underlain by latite. The group comprises deep (>1.5 m) Red Solonetic Soils or Krasnozems on upper slopes or benches. These soils include sandy clay loam or silty clay loam topsoil to 0.5 m in depth underlain by light clay or medium clay subsoils. Limitations of the soils include mass movement hazard, extreme water erosion hazard, shallow soil, rock outcrop and stoniness.

Fairy Meadow Soil Landscape (fa) – a swamp landscape including floodplains, valley flats and minor terraces and scattered swamps with slopes generally <5%. The group includes moderately deep Alluvial Loams and Siliceous Sands on terraces and Prairie Soils and Yellow Podzolic Soils on the drainage plains. Limitations of the soils include flood hazard, low wet bearing strength, highly permeable topsoils and high watertable.

Wattamolla Road Soil Landscape (wt) - a depositional soil group developed on long, gently to moderately inclined (5% to 15%) sideslopes, undulating to rolling hills with broad benches underlain by the Budgong Sandstone (and to a lesser extent by latite). The group comprises moderately deep (0.5 - 1 m) Red Podzolic Soils on upper slopes and benches, and Yellow Podzolic Soils on the mid and lower slopes. These soils include sandy loam or silty loam topsoil to 0.1 m in depth underlain by light clay or medium clay subsoils. Limitations of the soils include rock outcrop, localised mass movement and hard setting character.

The Wollongong Acid Sulphate Soil Risk Map (Reference 4), published by NSW Department of land and Water Conservation (1997), maps the eastern extents of Properties C and I as having a low probability of finding ASS below a depth of 3 m (Refer to Drawing 5). Further it states that this mapping level '*Generally* [is] *not expected to contain ASS materials, although highly localised occurrences may occur especially near boundaries with environments with a high probability of ASS occurrence*.' The nearest boundary with high probability is 230 m further east down Marshall Mount Creek. Based on this level of mapping the probability of finding ASS soils was deemed to be low.

4. FIELD WORK METHODS

The field work comprised 89 test pits (TP1 – TP89) excavated to depths of 1.5 - 3 m and twelve boreholes (BH 101 – BH112) drilled to depths of 4 – 8.5 m.

The test pits were excavated by two teams both working with New Holland LB110B backhoes fitted with 450 mm wide buckets. The bores were drilled with a Gemco 210B trailer mounted drill rig using 140 mm solid flight augers. Boreholes 101 and 102 were drilled to refusal of the v-bit then continued to near refusal using a TC – bit. The remaining bores were terminated prior to refusal. The pits and bores were logged on-site by either experienced geotechnical engineers or engineering geologists who collected both disturbed and undisturbed samples to assist in strata identification and for geotechnical laboratory testing.

Dynamic Cone Penetration tests (AS1289 6.3.2) were undertaken from the surface level to depths of 1.2 m adjacent to each test pit to enable assessment to be made of the strength of the near surface soils. Standard penetration tests were undertaken in two of the boreholes (101 and 102) for in situ strength assessment and sample collection. A description of the test method is given in the general notes included in Appendix B with the penetration 'N' values shown on the borehole logs.

At the completion of drilling, standpipe piezometers were installed in BH102 – BH112 (excluding BH104, and BH111) to facilitate long term monitoring of groundwater levels and hydraulic conductivity determination (the results of which are reported in the Groundwater Investigation Report).

Samples were collected for initial testing from the test pits in areas known to have acid sulphate potential based on the ASS maps (refer Drawing 5). The results of which are reported in the Acid Sulphate Soil Investigation Report, Project 48742-4, dated 22 January 2010 and summarised within Section 8.4 of this report.

A site walkover was also undertaken by an experienced geotechnical engineer to assess, stability and general geotechnical constraint.

The locations of the field tests are shown on Drawing 6 in Appendix A. The levels shown on the pit logs and borehole log sheets were determined by interpolation from the 2 m contour levels supplied by Cardno.

5. FIELD WORK RESULTS

5.1 Test pits and boreholes

The test pit and borehole logs are included in Appendix B, together with notes defining classification methods and descriptive terms.

The field tests encountered relatively uniform subsurface conditions with the principal variation being between two distinct terrain units namely, alluvial and residual soil landscapes. The site is essentially a residual environment split by two valleys in-filled with alluvium. The two alluvial deposits meet as Johnstons Spur descends to the alluvial plain around Property I. The valleys contain Marshall Mount Creek in the north and Macquarie Rivulet in the south.

For each of the terrain units the succession of strata is broadly summarised as follows:

ALLUVIAL

TOPSOIL:	generally silty sand with clay, gravel and rootlets to depths of 0.1 – 0.4 m;
CLAY:	ranging from firm to very stiff clays or sandy clays, gravelly in parts, damp to saturated in most locations;

SAND: loose to dense sand, silty sand or clayey sand encountered at depths of 0.5 – 3.0 m, typically wet to saturated. (This strata was only present in approximately 15% of test pits)

RESIDUAL

TOPSOIL: generally silty clay or clayey silt, with gravel and rootlets to depths of 0.1 – 0.3 m;

RESIDUAL CLAY: ranging from firm to very stiff residual clays or sandy clays, gravelly in parts, humid to moist, (but saturated in parts);

SANDSTONE or LATITE: extremely low to low strength, extremely to moderately weathered sandstone or latite (two locations encountered siltstone) intercepted below depths of 0.7 – 3.0 m.

5.2 Groundwater

Groundwater monitoring wells were installed at 10 locations across the site. Wells were generally located in the alluvial deposits between RL10 and RL20 m AHD. Depths to the water table were measured from the surface and not converted to relative levels due to the low level of accuracy of survey available (from the 2 m contour plan). The results are provided in Table 1, below. Water Levels will be able to be calculated once accurate survey of the monitoring wells has been undertaken.

Table 1 – Groundwater Depths

Borehole ID	Depth below ground level (m) 11 December 09	Depth below ground level (m) 7 January 10
BH102	4.5	5.8
BH103	3.3	3.6
BH105	3.4	3.5
BH106	2.8	3.0
BH107	3.1	3.3
BH108	2.6	2.5
BH109	2.7	2.5
BH110	3.0	2.8
BH112	4.5	4.4

Testing was undertaken to determine the hydraulic conductivity of the shallow aquifers found on the site. The results of the hydraulic conductivity results are summarised in Table 2.

Table 2 – Hydraulic Conductivity Results

Borehole ID	Hydraulic Conductivity (m/sec)
BH102	4×10^{-8}
BH105	5×10^{-7}
BH106	9×10^{-8}
BH107	3×10^{-6}
BH110	High
BH112	4×10^{-7}

A detailed description of the test methods, results and discussion are given in our report dated 22 January, Project 48742.02, Report on Groundwater Investigation. The results indicate typical values for clayey sands and sand aquifers. The results also show the variability of the alluvial deposit across the site.

5.3 Geological Mapping

The main items noted during geological mapping on 11 and 12 November 2009 are summarised below and are additionally shown on Drawing 7 (Sheets 1 and 2) and Drawing 8 (Sheets 1 and 2). Drawing 7 shows the location of the Mapping reference Points, referred to below, as well as the approximate boundaries of geological units as determined from a combination of published mapping (References 1, 2 and 5) and the results of the test pitting and drilling of the current investigation.

- The alluvial sequence (mapping unit Qa) included at least two terrace levels within and extending some 2 km to the west of the Albion Park township. These comprised a lower terrace level associated with the current courses of the Macquarie Rivulet and Mount Marshall Creek, and a high level terrace system (approximately 5 m above the current terrace levels) representing an earlier deposition phase into which the current terrace and stream bed system are entrenched. The boundary between alluvium and colluvial/residual soils was commonly poorly defined due to the deposition of colluvial soils at the base of the steeper hillsides.
- The banks of the Macquarie Rivulet and Marshall Mount Creek are typically grass and shrub covered with only very minor areas of erosion being observed.
- The alluvial sequence exposed in gully walls of Hazelton Creek upstream of the Illawarra Highway included at least two distinct depositional regimes. These comprised a surface silty

clay layer to approximately 1 m to 2 m deep, overlying a gravel to boulder-rich (boulders to greater than 1.5 m) extending to greater than 3 m at some locations.

- Erosion channels locally expose alluvium (clays and gravelly clays) to the order of 1 m deep infilling the bases of gullies crossing mid and foot slope locations (e.g. near Mapping Reference Point 1).
- There are localised and discontinuous areas of erosion of gully beds and banks. The erosion is generally as a result of concentration of flow in farm dam spillways or under-road pipes and disturbance of the vegetation cover along animal pathways. Repairs to or filling of erosion gullies are noted in several locations (e.g. Mapping Reference Points 2 and 16) and, as such, some areas of uncontrolled filling may now be hidden by re-profiled pasture land.
- There are only isolated, distinct outcrops of micaceous siltstone and sandstone the Berry Formation (mapping unit Psb) and Budgong Sandstone (mapping unit Psg), these being mostly within the bases of entrenched gullies, where high strength material is present at depths of less than 1 m.
- Zones of sandstone joint blocks (some to boulder size) derived from the Budgong Sandstone mantle several of the highest (elevation) ridge crests or upper hill slopes lying to the north of North Macquarie Road and in isolated locations (e.g. Mapping Reference Points 14 and 15) may be associated with small landslides.
- A linear gully, with entrenchment depths of 0.5 m to 1 m and extending directly downslope from Mapping Reference Point 12, may represent a degraded erosion or landslide scarp.
- Rocks of the Berry Formation and Budgong Sandstone are additionally exposed in road cut batters of Illawarra Highway, Mount Marshall Road and North Macquarie Road, where the bedrock typically underlies 0.5 m to 1 m deep soil profiles.
- Small outcrops of latite (Bumbo Latite member; mapping unit Psgb) and associated dense joint block cover are present within a densely vegetated zone (between Mapping Reference Points 5 and 10) lying to the north of North Macquarie Road.
- A small zone of cemented latite blocks and fragments of colluvial origin is exposed in a track base (at Mapping Reference Point 7) downslope of the mapped location of the Bumbo Latite member.

6. LABORATORY TESTING

Selected samples from the test pits were tested in the laboratory for measurement of field moisture content, plasticity, particle size distribution, dispersivity and California bearing ratio. The detailed test report sheets are given in Appendix C, with the results summarised in Table 3.

Table 3 – Results of Laboratory Testing

Pit No.	Depth (m)	FMC (%)	LL (%)	PL (%)	PI (%)	LS (%)	ECN	Material
TP3	1.0-1.2	31.8						Brown orange silty clay
TP4	0.5-0.7	17.3						Brown orange grey sandy clay
TP6	1.0-1.1	11.5						Brown clayey silty sand
TP14	2.4-2.5	11.9						Brown clayey silty sand
TP18	1.0-1.2	17.1						Light brown gravelly silty clay
TP19	0.5-0.7	17.7						Brown clayey silt
TP22	0.5-0.6	37.8					4	Brown silty clay
TP23	0.9-1.0	37.1	90	35	55	21.5		Brown clay
TP24	1.0-1.2	18.1						Brown silty clay
TP25	1.0-1.1	21.6						Orange brown silty clay
TP27	0.5-0.6	12.9						Brown sandy clay
TP28	1.0-1.2	25.4						Brown sandy silty clay
TP29	0.5-0.7	22.6						Brown silty clay
TP30	1.0-1.2	26.3	67	23	44	15.0		Light brown silty clay
TP31	0.5-0.7						4	Brown sandy silty clay
TP32	0.5-0.6	27.0	62	25	37	16.5		Brown silty clay
TP33	1.0-1.1	39.4	97	35	62	22.0		Brown clay
TP39	0.9-1.0	24.0					4	Brown silty clay
TP40	0.5-0.6	28.0					4	Brown silty clay
TP41	1.0-1.1	27.8						Brown red grey silty clay
TP43	1.0-1.2	22.4					4	Brown silty clay
TP44	1.0-1.2	28.3	96	30	66	16.5		Brown clay
TP46	0.5-0.7	24.9					4	Brown clay
TP47	0.4-0.6	26.3					4	Brown clay
TP48	1.0-1.1	22.1						Brown red clay

Pit No.	Depth (m)	FMC (%)	LL (%)	PL (%)	PI (%)	LS (%)	ECN	Material
TP51	1.0-1.2	37.3	102	33	69	20		Brown clay
TP52	0.3-0.5	19.6					4	Brown gravelly silty clay
TP53	0.5-0.7	21.5						Brown gravelly silty clay
TP55	2.0-2.2	29.3						Brown silty clay
TP58	1.0-1.2	20.9						Light brown silty clay
TP58	1.0-1.2	30.5					4	Brown clay
TP62	1.5-1.7	22.5					4	Brown gravelly silty clay
TP64	0.5-0.7	11.7						Light brown gravelly sandy clay
TP65	0.5-0.7						4	Dark brown gravelly silty sandy clay
TP71	1.0-1.2	16.9					4	Brown silty clay
TP74	0.5-0.7	22.7						Brown gravelly silty clay
TP84	1.5-1.7	20.4						Brown gravelly silty clay
TP85	0.5-0.7	16.4						Brown clayey silt
TP87	0.5-0.7	26.1						Orange brown silty clay
TP88	0.5-0.7						4	Brown sandy clayey silt
TP89	0.5-0.7	34.6						Brown silty clay

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

Six samples of the clays were tested for measurement of Atterberg limits and linear shrinkage. The results indicated liquid limits in the range 62 – 102%, plastic limits in the range 23 – 35% and linear shrinkage from the liquid limit condition in the range 15 – 22%. Field moisture contents were 11 – 39%, with most results indicating moisture contents significantly dry of the plastic limit. These results indicate the soils are of intermediate to high plasticity and would be moderately reactive to changes in volume with seasonal fluctuations in soil moisture content.

Particle size distribution (grading) tests were carried out on fifteen samples and generally indicated three principal soils types:

- 29% of the samples tested were fine grained materials; clayey silts, slightly sandy in parts (refer TP 7, 31, 56, 88),

- 43% of the samples tested were coarser grained materials; typically sands with some silt (refer TP8, 15, 42, 65, 78, 81), and
- 29% of the samples tested were a mixture of these two groups (refer TP59, 69, 76, 82).

All of the particle size distribution results confirmed the field logging.

California bearing ratio tests were carried out on three samples of the silty clays recovered from various depths within the range 0.4 – 1.0 m and two samples of clayey silts to assess the suitability of the soils for both road subgrade and as general fill. The samples were compacted to 100% of standard maximum dry density at standard optimum moisture content and soaked for 4 days under surcharge loadings of 4.5 kg (refer Test Method AS1289 2.1.1). There was up to 3.3% swell recorded during soaking of the silty clays and 0.5% of swell for the clayey silts. The measured CBR values were within the range 2.5 – 8% for the silty clays and 9 – 12% for the clayey silts.

Emerson crumb dispersion testing was carried out on 13 samples of the upper soils to assess the dispersion characteristics. The results were all Emerson Class No 4 which is indicative of slightly to non-dispersive soils.

7. PROPOSED DEVELOPMENT

The Calderwood Urban Development Project is a master planned community development by Delfin Lend Lease. A concept plan for the site has been prepared (refer Drawing 1). The project proposes a mix of residential, commercial, conservation and open space uses. The site will also include the construction of water detention ponds, largely confined to the existing creek lines, sports fields as well as internal and connecting roads.

8. COMMENTS

8.1 Slope Stability

The following assessment is based on the results of the geological mapping, the subsurface investigation undertaken and DP's involvement in similar projects in the local area. Aspects included in the slope stability assessment are the bedrock geology, observed or anticipated soil depth, steepness of slope relative to historical or ancient slope failures in similar materials, the disturbance of soil and vegetation cover during development, the influence of groundwater or surface saturation, and the effects of earthquake forces.

The geological mapping has indicated only isolated, minor or possible (where surface conditions are degraded making visual confirmation uncertain) occurrences of slope instability within moderately steep (10° – 18° range), steep (18° – 27° range) or very steep (27° – 45° range) and locally extremely steep (>45°) slopes on the flanks of Johnstons Spur lying north of North Macquarie Road (refer Drawing 8, Sheet 2). These occurrences comprise joint block runout below outcrops (near Mapping Reference Point 15) and narrow linear or localised shallow slump scarps associated with erosion and over-steepening of gully heads.

Bowman (Reference 5) developed maps of the Greater Wollongong area, including the study area north of the Illawarra Highway, on which zones of instability were outlined and the remaining areas classified in terms of the suitability for development. Similar classification methods were employed by Neville (Reference 6) for the area lying to the south of Macquarie Rivulet. The mapping indicates that the study area includes several zones (refer Drawing 8, Sheets 1 and 2):

- *Stable land* with *no landslide problems*. Land within this zone encompasses most of the study area.
- *Stable land – minor area of slope instability* (most likely where thick accumulations of soil occur at the heads of gullies and at the toes of slopes). Land within this zone is restricted to an approximately 400 m by 200 m area, lying between the Illawarra Highway and the Macquarie Rivulet, within the south-western corner of the study area.
- *Less stable land that may mostly be safely utilised although some areas are unsuitable.* Land within this zone includes elevated ridge crest areas and mostly moderately sloping valley floors about two gully lines in Properties J, K and L that front North Macquarie Road

within the south-western section of the study area. At least one possible erosion of shallow soil slump scarp has been identified (at Mapping Reference Point 14) within the zone. Only one test pit (Pit 62) lies within the zone. It intersected a 1.3 m deep soil profile overlying sandstone bedrock.

- *Moderately unstable land* where *thorough investigation is required before development* and *generally topographically high relief land underlain by potentially unstable material*. Land within this zone occupies moderate to steep, mid and upper slope locations along the east-west oriented ridge within the southern section of the study area. It also includes locally over-steepened gully heads and rapid topographic steps down developed over weathering resistant sandstone and latite bands. Test pits within the zone (TP 52, 53, 59, 61 and 64) indicate potential for moderately deep (1.3 m to 1.5m) to deep (2.6 m to 3.1 m) soil profiles. Steep areas will, in particular, require additional detailed investigation to confirm the distribution of soil depths and any groundwater seepage. It is noted that the source points of gullies within the zone frequently correspond to the subcrop of the Bumbo Latite which may act as an aquifer.
- *Essentially unstable land*, that is *best left undeveloped* but *some areas may be developed after detailed evaluation*. Land within this zone comprises two ridge crest and steep to very steep, upper slope areas along the east-west oriented ridge within the southern section of the study area. Scattered joint blocks on the slopes may potential for downslope movement of material fallen or eroded from weathering resistance outcrops.

The capability for urban development may be related to the degree of surface disturbance involved in the following categories of site development:

Extensive building complexes - the development of commercial complexes such as offices or shopping centres, which require large scale clearing and levelling of broad areas of floor space and parking bays.

Residential development - infers a level of construction which provides for roads, drainage, and services to cater for current residential development lot sizes.

Strategic residential - refers to areas unsuitable for widespread development, but where closer investigation may permit isolation of pockets of land for individual house sites, or definition of engineering measures required to maintain stability of what would otherwise be unsuitable land for development.

Reserves - which may require shaping and modification of the ground surface and vegetation improvement, but no building and minimal roadway construction is envisaged.
In general, it is considered that, after development using good engineering practice for hillside slopes (refer Appendix D for general development guidelines), sites within the *Stable land* and *Stable land with minor areas of instability* zones will be expected to achieve very low or low risk of slope instability in accordance with the methods of the Australian Geomechanics Society (Reference 7). Such areas would be suitable for residential development. Extensive building complexes would preferably be sited within flat or more gently sloping sites to minimise the requirement for cutting and retaining of deeper soil profiles as intersected in many of the test pits of this investigation. Comparison of the development layout (refer Drawing 1) and the distribution of zones of instability indicates that sites of commercial and infrastructure development are included within areas of assessed very low risk of slope instability.

Comparison of the development layout (refer Drawing 1) and the distribution of zones of instability indicates that the majority of the proposed development areas are located on stable land. There are sections of the proposed residential areas that extend into zones of *Less stable land* or *Moderately unstable land*. Instability in the zone can be expected if development does not have regard to site conditions, with the most likely areas of instability being in gully heads and in areas of thick soil accumulation affected by seepage, especially if excavations for deeper road cuttings are required in areas of deep clay soils. Consequently, it is recommended that all proposed developments in these zones are subject to detailed investigation by appropriately qualified geotechnical practitioners.

It is considered that urban (residential) and/or strategic development is generally feasible within these zones subject to appropriate investigation and construction methodology to result in a low risk of slope instability after development. Site specific items indicated below should be included in investigation and design programs:

- Orientation of access roads, residential structures and services to minimise requirements for excavation and possible retaining structures. In general, unsupported cuts should be restricted to a maximum 1 m depth.
- Maximisation and/or replacement of tree cover.
- The creation of larger lots to permit more sensitive development of the individual site.
- Programming of development, particularly road works, which would be the main activity to expose potentially erodible or landslip susceptible colluvial and residual soils, to minimise

time of exposure and also the inclusion of techniques (e.g. spray coating) to minimise erosion which may trigger shallow slumping.

- Installation of site specific surface and subsurface drainage.
- Founding of residential and retaining structures in intact bedrock.
- Selection of residential designs to minimise the requirement for excavation.

Areas earmarked for development have been tentatively assigned AGS risk classifications based on the proposed development to be undertaken on the site on Drawing 9. The extent of the site that will require engineering works (described in the bullet points above) to achieve a low risk classification after development are shown in red. Areas with no shading are classified as low risk or very low risk. Areas on the current Concept Plan shown as non-development areas (ie green space reserves) have not been mapped. If it is proposed to revise the extent of development shown on the plans and discussed in the report, advice must be sought from DP in relation to the potential development outside the boundaries shown.

Areas of *Essentially unstable land* are included within proposed reserve areas and this is consistent with general requirements to maintain the risk of instability within no greater than tolerable levels.

8.2 Erosion

The study area is characterised by only isolated occurrences of stream and gully bank or bed erosion (refer Drawing 8; Sheets 1 and 2), mostly resulting from stock movements or concentrated flow from spillways of farm dams or pipe culverts in gently sloping lands and previous clearing and stock movements in moderately steep to steep lands. Control (and in some cases repair) of erosion as part of the agricultural and pastoral uses of the land has included the construction of farm dams, filling and revegetation of gullies.

The generally well vegetated alluvial flats, stream banks and hill slopes mostly restrict the potential for erosion within the study area. Future erosion and bank instability potential is assessed as mostly being restricted to localised sections of the banks of streams and tributary gullies during flood events. Volumes of eroded or slumped materials are anticipated to be of a few cubic metres or less per location under the existing vegetation conditions and flow regime.

The proposed development layout (refer Drawing 1) includes Macquarie Rivulet and the streams of the Hazelton Creek and Marshall Mount Creek systems and their associated tributary gullies within extensive drainage corridors. It is anticipated that the proposed development (including good engineering practice for disposal of stormwater drainage) will have minimal effect on erosion potential of the current stream courses. Site specific items indicated below should be included in investigation and design programs for the development to minimise the risk of erosion:

- Orientation of access roads, residential structures and services to minimise requirements for excavation and retaining structures.
- Maximisation and/or replacement of tree cover.
- Programming of development, particularly road works, which would be the main activity to expose potentially erodible colluvial and residual soils, to minimise time of exposure and also the inclusion of techniques (e.g. spray coating) to minimise erosion.

8.3 Acid Sulphate Soils

An acid sulphate soil investigation report (refer Section 1 of this report) was prepared for the site and should be read in conjunction with this report. The findings from the ASS report are summarised below.

The results of the limited testing undertaken to date indicate the presence of acid sulphate soils of heterogeneous lateral distribution within parts of the proposed development area, and generally below depths of 2 – 3 m. The extent of ASS at the site was beyond the published mapping. The act of disturbing or exposing these soils through construction activity shall necessitate the production of an acid sulphate soil management plan (ASSMP). The extent of ASS will require further investigation once final cut and fill levels have been determined for the areas of ASS risk prior to the creation of an ASSMP. Specifically the following will be required:

- Maximum excavation depths at Property A, B, C, G, I, N, O, P, and Q.
- Further ASS investigation in these properties where excavation is proposed.
- Preparation of an ASSMP based on the findings of this report supplemented by the findings of the additional investigations.

8.4 Hydrogeology

Based on the results of the groundwater investigation, which was reported under a separate cover (refer Section 1 of this report), the following comments are offered:

- Groundwater bores were generally drilled within the 10 m – 20 m AHD band of the site. Rock was intercepted during drilling at varying depths between 4 m and 8.5 m below ground surface level (refer to Borehole logs 101 – 112). Two bores (BH 106 & BH107) did not encounter rock and BH104 encountered rock at 0.7 m.

- Groundwater levels during the investigation were found to be in the range of 2.5 – 4.5 m below ground surface level (refer to the blue text on Drawing 1). Due to the proximity of the water table to the ground surface, further investigation is required to ascertain the seasonal high groundwater level in future stages of the development;

- The shallow aquifers generally were contained in the alluvial deposits of Marshall Mount Creek and Macquarie Rivulet and were limited by the underlying bed rock (the shallow groundwater was essentially perched on this impermeable unit). The aquifers comprised clays and sandy clays with some gravel.

- Hydraulic conductivities (K) varied across the site and were in general lower than expected considering the sand content of the aquifers, however they were in the expected range for clayey sands. The values ranged across 2 orders of magnitude from 10^{-6} m/s – 10^{-8} m/s (refer to the red text on Drawing 1). BH110 in the southeastern corner of the site, recorded high values of K (flow rates of 20 L per min were obtained with only minimal drawdown noted over a 15 min period.) The variability in K across the site could not be linked specifically to observed surface landforms but is more likely the result of heterogeneous alluvial deposits.

- In general groundwater will not be a significant constraint to development across the majority of the site above RL20. Below this RL groundwater may present itself as a moderate constraint due to its proximity to the ground surface. Planning for deep (>2 m) cuts in these areas will require careful consideration and planning to mitigate the effects of groundwater. In addition, the location of detention basins may also require further investigation to assess the local conditions at the proposed sites.

8.5 Drainage

Surface drainage should be installed and maintained at the site. In undertaking earthworks operations at the site, it should be recognised that the drainage characteristics of the site will be significantly altered and that temporary measures therefore, will be required during construction to divert stormwater flows from the work areas. Both the alluvial and residual soils would be highly susceptible to inundation and consequently, temporary drainage measures (with drains say 300 – 500 mm deep) should be designed where possible to avoid inundation during wet weather periods.

8.6 Site Constraints and Development Potential

Based on the results of the geotechnical investigations completed to date, development of the site as proposed on Drawing 1 is considered feasible.

Most of the site proposed for development will be classified as either very low or low risk with respect to instability with construction considered to be relatively straightforward. Some of the steeper areas of the site have been classified as less stable land or moderately unstable land (refer Drawing 8), parts of which encroach into the proposed development area (refer Drawing 9). Detailed design and the undertaking of engineering works described in Section 8.5 will be required to achieve a low risk classification of instability after completion of construction, commensurable with the majority of the development area.

The main geotechnical constraints to development with the nominated areas therefore are limited to the following:

- adoption of hillside design and construction techniques for the steeper portions shown on Drawing 9;
- awareness of groundwater profiles in designing basins and earthworks;
- site traffic ability in areas where sandy soils are exposed and susceptibility of the soils to rapidly loose strength on exposure.

In summary therefore, development of the site as proposed is considered feasible provided all work is undertaken in accordance with good engineering practice.

9. LIMITATIONS

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Calderwood in accordance with DP's proposal WOL090407 dated 17 September 2009 and acceptance received from Mr Anthony Barthelmess of Cardno Forbes Rigby Pty Ltd dated 2 October 2009 on behalf of Delfin Lend Lease Limited. The work was carried out under DP Conditions of Engagement. This report is provided for the exclusive use of Cardno Forbes Rigby Pty Ltd and Delfin Lend Lease Limited for the specific project and purpose 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.

The results provided in the report are considered to be indicative of the subsurface conditions on the site only to the depths investigated at the specific sampling and/or testing locations, and only at the time the work was carried out. DP's advice is based on observations, measurements, tests or derived interpretations. The accuracy of the advice provided by DP in this report is limited by unobserved features and variations in ground conditions across the site in areas between test locations and beyond the site boundaries or by variations with time. The advice may be limited by restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints. Actual ground conditions and materials behaviour observed or inferred at the test locations may differ from those which may be encountered elsewhere on the site. Should variations in subsurface conditions be encountered, then additional advice should be sought from DP and, if required, amendments made.

This report must be read in conjunction with the attached "Notes Relating to This Report" and any other attached explanatory notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions from review by others of this report or test data, which are not otherwise supported by an expressed statement, interpretation, outcome or conclusion stated in this report. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

DOUGLAS PARTNERS PTY LTD

Christopher C Kline
Associate

Reviewed by:

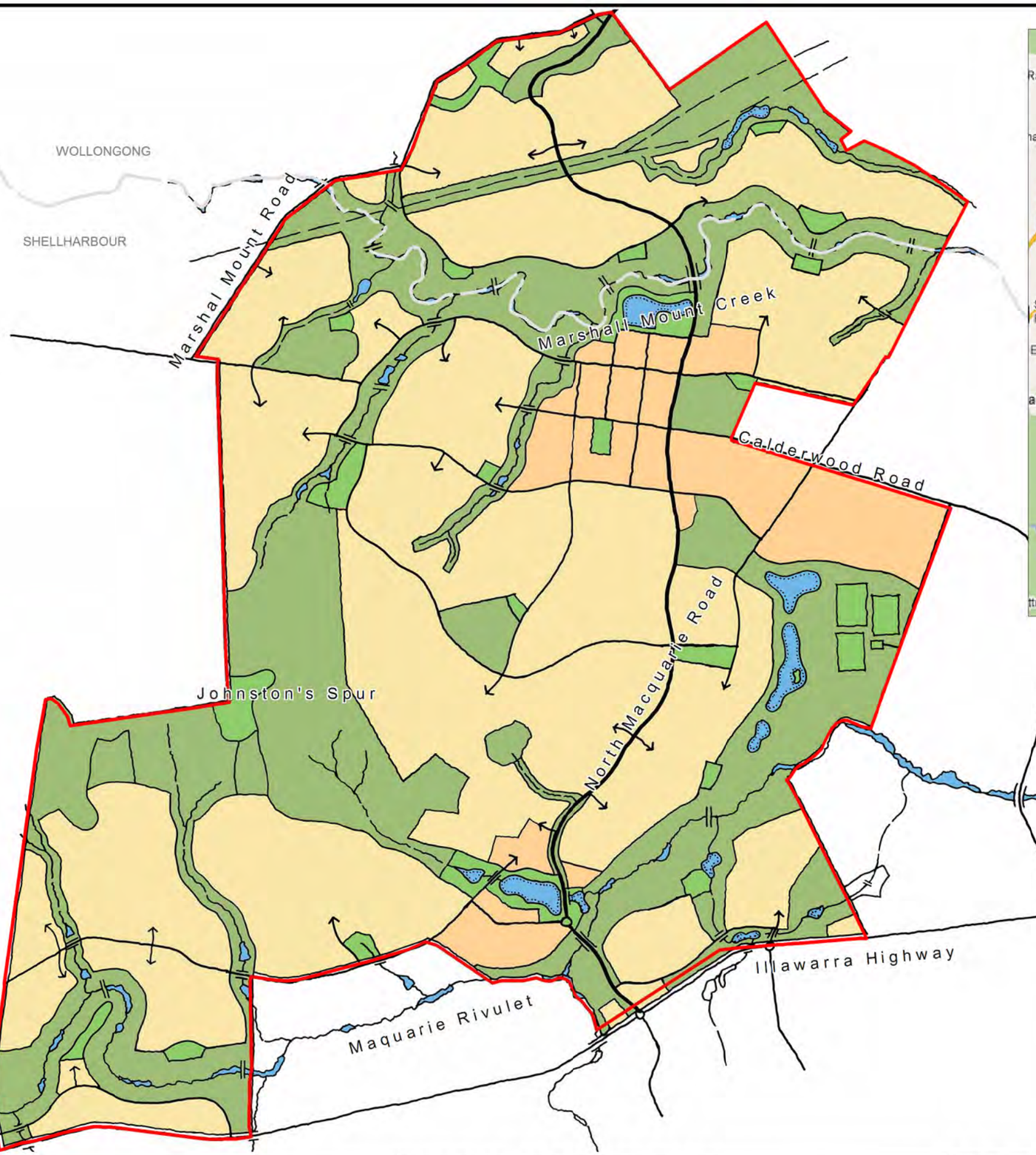
G W McIntosh
Principal

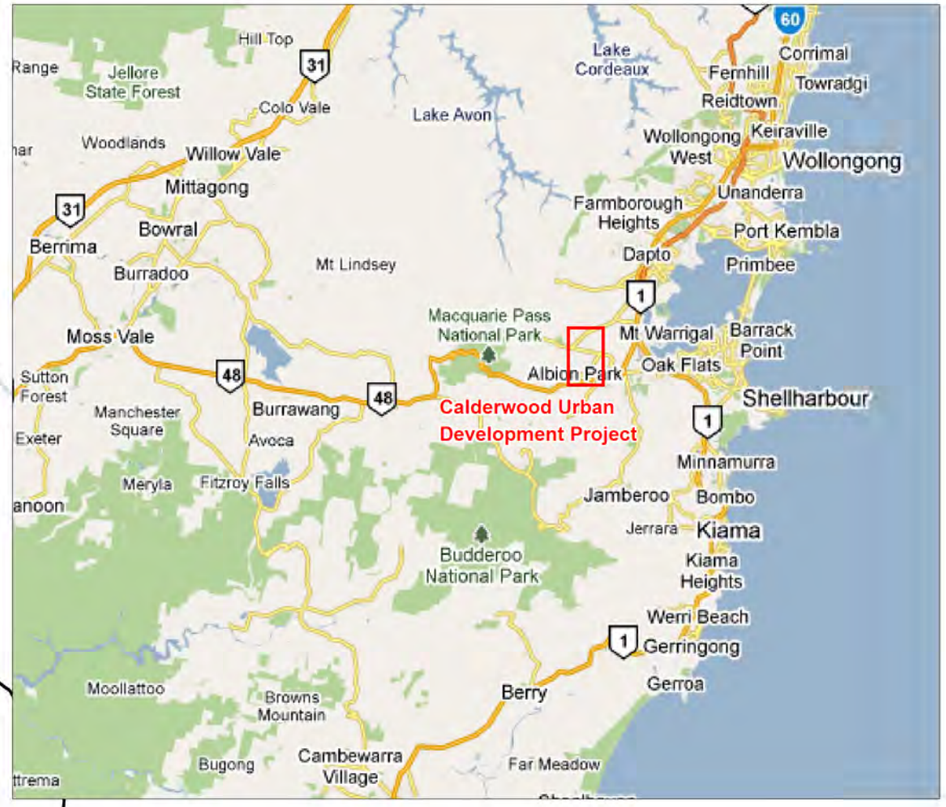
References:

1. Department of Mines, "Geology of the Kiama 1:50 000 Series Sheet No. 9028-1", 1977.
2. Department of Mines, "Geology of the Robertson 1:50 000 Series Sheet No. 9028-4", 1977.
3. Department of Conservation and Soil Management, “Soil Landscapes of Kiama 1:100 000 Series Sheet 09028” 1993
4. Wollongong 1:25 000 Acid Sulphate Risk Map. NSW Department of Land and Water Conservation (1997).
5. Bowman, H N. “Natural Slope Stability in the City of Greater Wollongong”. Records of the Geological Survey of NSW Vol. 14(2), pp.159-222 (1972).
6. Neville, M J. “Land Stability Assessment of the Kiama Area”. Geological Survey of NSW Report No. GS 1977, 067 (May 1977).
7. Australian Geomechanics Society. “Practice Note Guidelines for Landslide Risk Management”, Australian Geomechanics, Vol. 42 No. 1 (2007c).

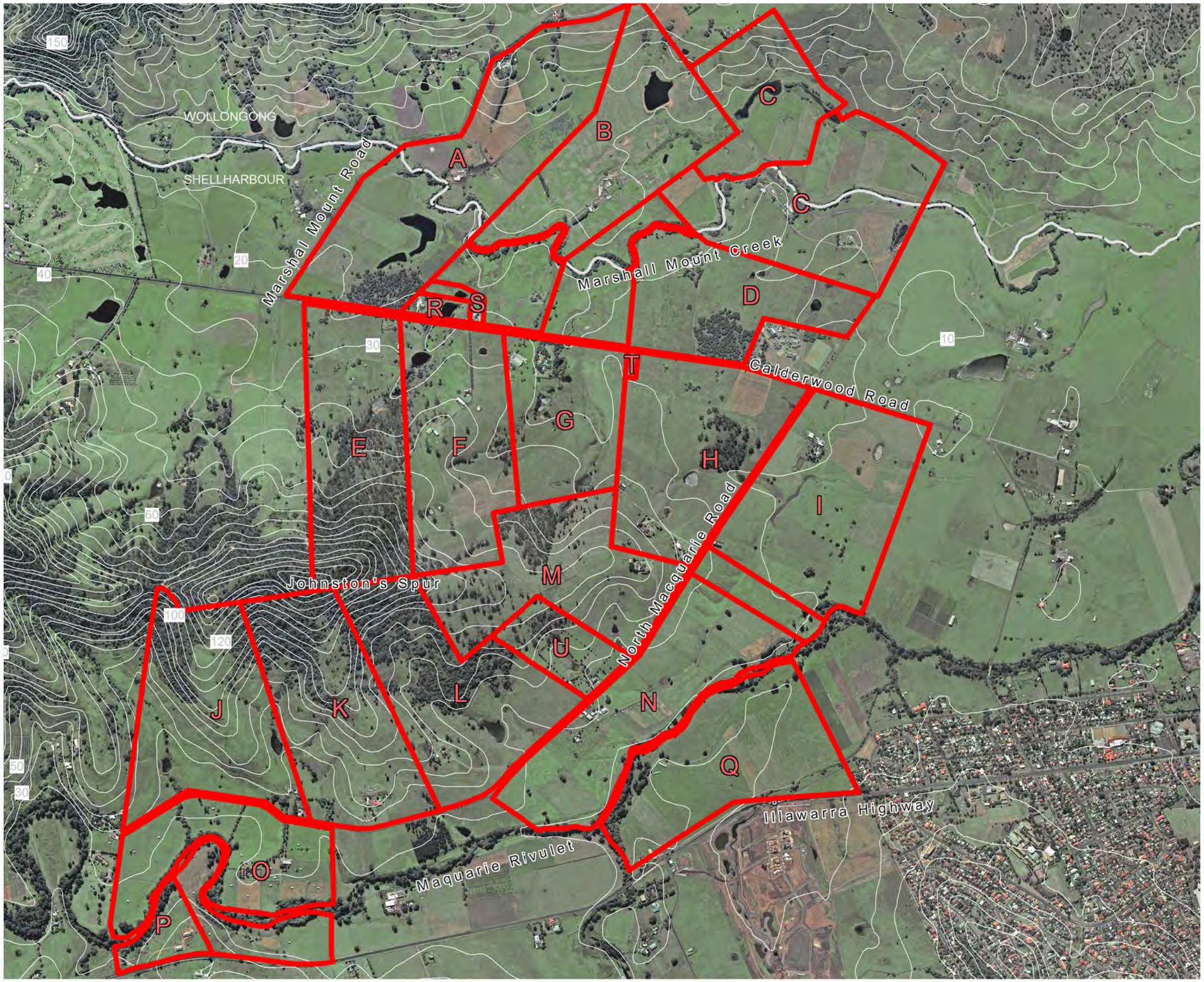
APPENDIX A

Drawing 1 – 9





Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: DELFIN LEND LEASE LTD		TITLE: CONCEPT PLAN AND LOCALITY PLAN CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY CALDERWOOD URBAN DEVELOPMENT PROJECT	PROJECT: 48742.00
	DRAWN BY: CCK	SCALE: 1:15000 @A3 OFFICE: W'GONG		DRAWING: 1
	APPROVED BY: CCK	DATE: 18 FEB10		REVISION: 1



Legend

- LGA Boundary
- 10 m Contour
- Region
- A — Property Name

Douglas Partners
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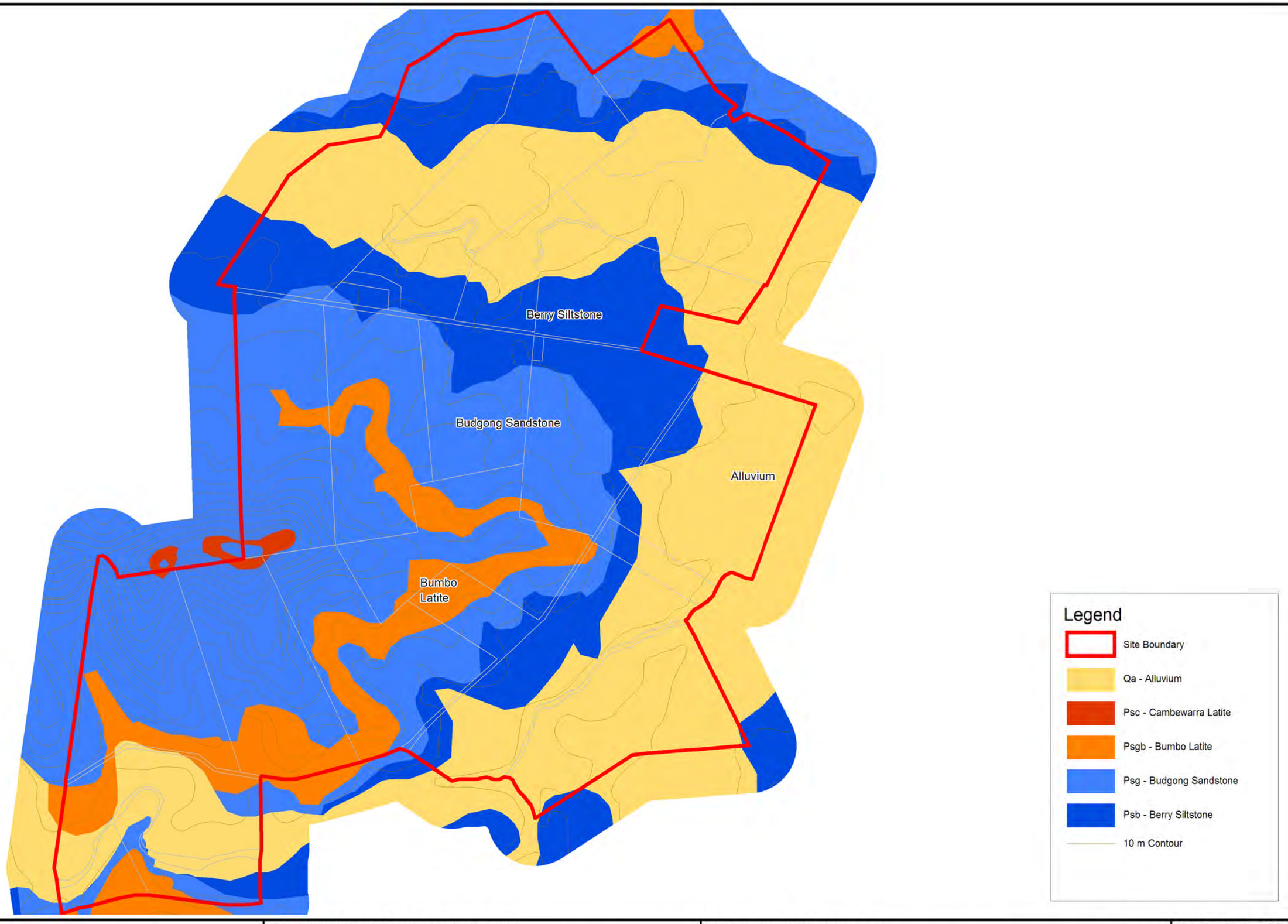
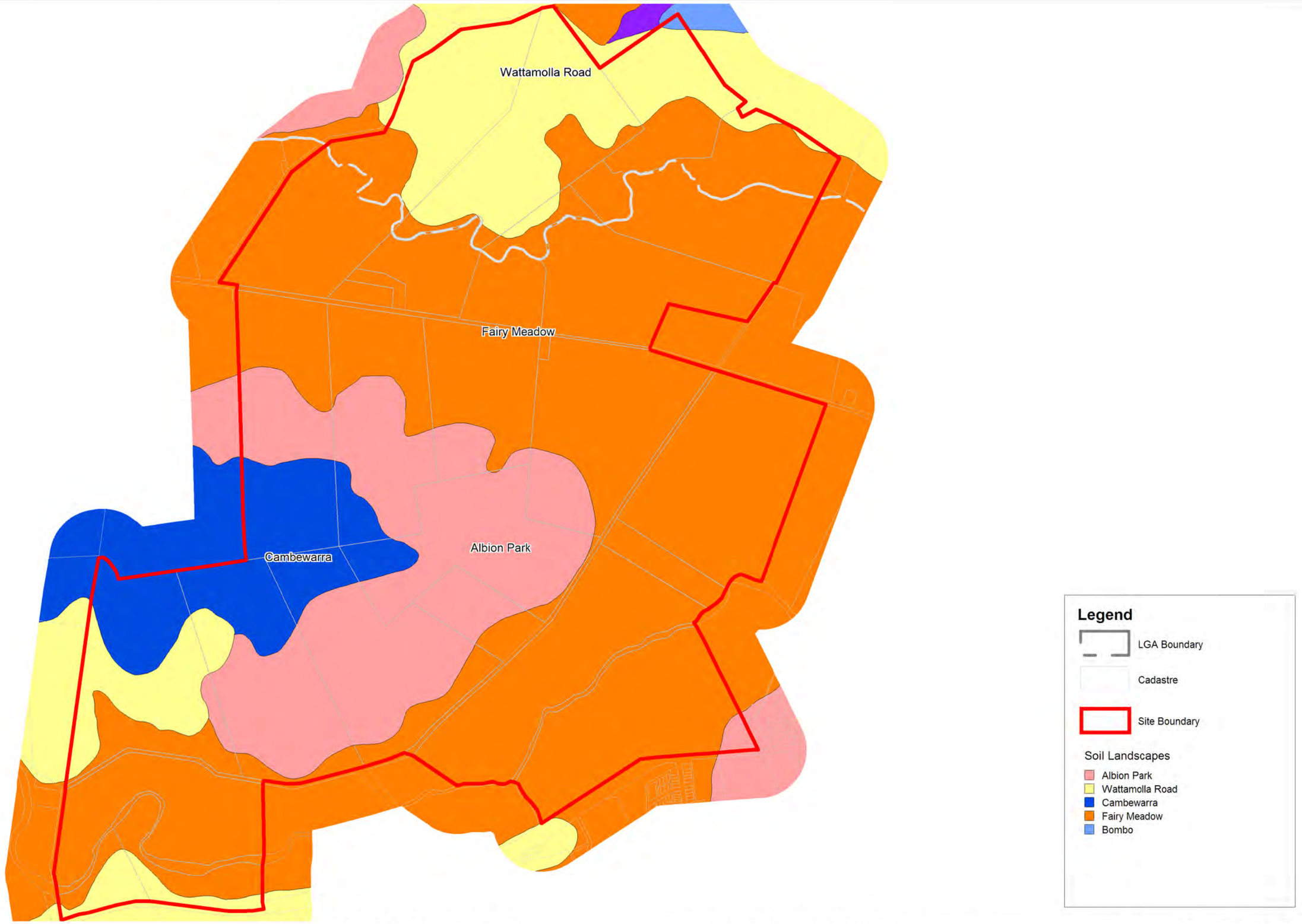
CLIENT: DELFIN LEND LEASE LTD			TITLE: SITE FEATURES AND PROPERTY NAMES CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY CALDERWOOD URBAN DEVELOPMENT PROJECT	PROJECT: 48742
DRAWN BY: CCK	SCALE: 1:15000 @A3	OFFICE: W'GONG		DRAWING: 2
APPROVED BY: CCK		DATE: 18 FEB10		REVISION: 1

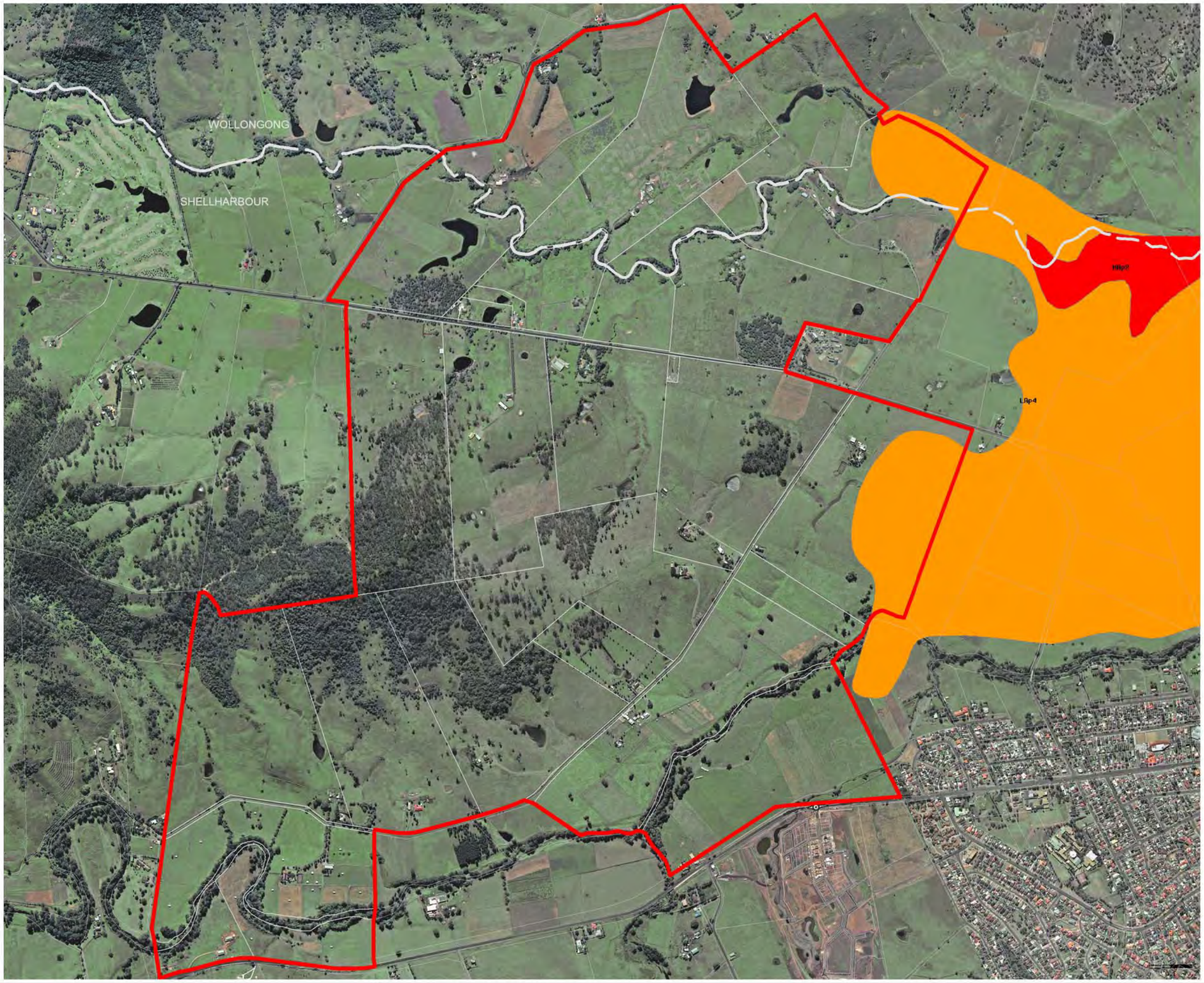


Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: DELFIN LEND LEASE LTD		TITLE: SITE GEOLOGY CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY CALDERWOOD URBAN DEVELOPMENT PROJECT
	DRAWN BY: CCK / SCALE: 1:15000 @A3	OFFICE: W'GONG	
	APPROVED BY: CCK	DATE: 18 FEB10	
			PROJECT: 48742
			DRAWING: 3
			REVISION: 1



Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: DELFIN LEND LEASE LTD			PROJECT: 48742
	DRAWN BY: CCK	SCALE: 1:15000 @A3	OFFICE: W'GONG	DRAWING: 4
	APPROVED BY: CCK		DATE: 18 FEB10	REVISION: 1

TITLE: SOIL LANDSCAPES
CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY
CALDERWOOD URBAN DEVELOPMENT PROJECT



Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: DELFIN LEND LEASE LTD			PROJECT: 48742
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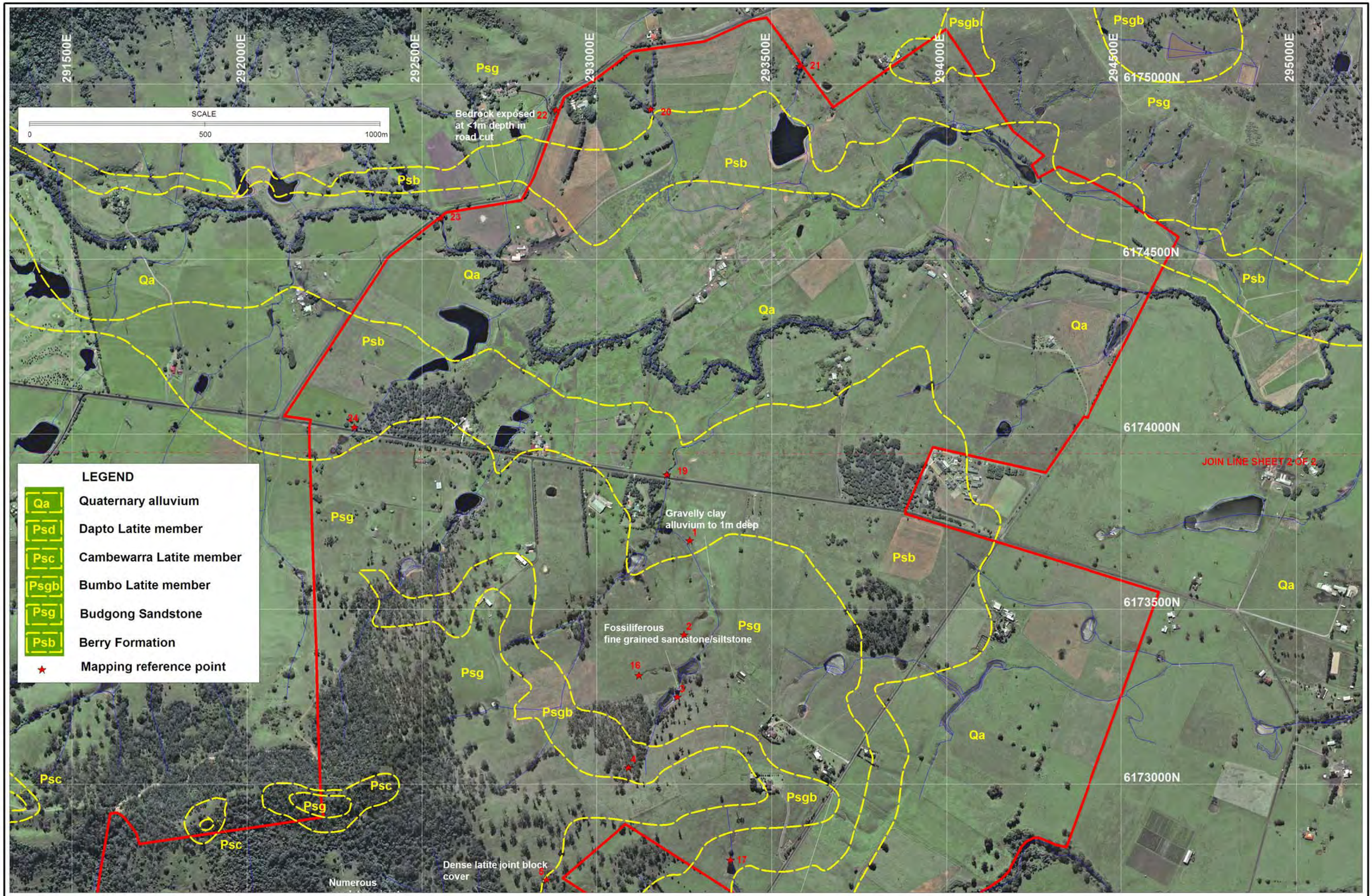
	APPROVED BY: CCK		DATE: 18 FEB10	REVISION: 1

TITLE: ACID SULPHATE SOIL RISK MAP
CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY
CALDERWOOD URBAN DEVELOPMENT PROJECT

Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: DELFIN LEND LEASE LTD		
	DRAWN BY: CCK	SCALE: 1:15000 @A3	OFFICE: W'GONG
	APPROVED BY: CCK		DATE: 18 FEB10

TITLE: TEST LOCATIONS
CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY
CALDERWOOD URBAN DEVELOPMENT PROJECT

PROJECT: 48742
DRAWING: 6
REVISION: 1



Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Delfin Lend Lease	TITLE: **SITE GEOLOGY** **CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY** **CALDERWOOD URBAN DEVELOPMENT PROJECT**	PROJECT No: 48742
	DRAWN BY: GRW / SCALE: As shown / OFFICE: Sydney		DRAWING No: 7 Sheet 1
	APPROVED BY: GRW / DATE: 18 FEB 10		REVISION: 1

SCALE

0 500 1000m

LEGEND

- Qa — Quaternary alluvium
- Psd — Dapto Latite member
- Psc — Cambewarra Latite member
- Psgb — Bumbo Latite member
- Psg — Budgong Sandstone
- Psb — Berry Formation
- ★ — Mapping reference point

Gravelly clay alluvium to 1m deep

Fossiliferous fine grained sandstone/siltstone

Dense latite joint block cover

Numerous sandstone joint blocks along ridge

Bedrock at <1m depth over much of road cuts

Cemented colluvium

Sandstone joint blocks

High strength sandstone in gully base

Micaceous siltstone/ fine grained sandstone

Bedrock at shallow depth

Gravel and cobble bedload

JOIN LINE SHEET 1 OF 2

6173500N
6173000N
6172500N
6172000N
6171500N

291500E
292000E
292500E
293000E
293500E
294000E
294500E

Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Delfin Lend Lease		
	DRAWN BY: GRW	SCALE: As shown	OFFICE: Sydney
	APPROVED BY: GRW		DATE: 18 FEB 10

TITLE: **SITE GEOLOGY**
CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY
CALDERWOODURBAN DEVELOPMENT PROJECT

PROJECT No: 48742
DRAWING No: 7 Sheet 2
REVISION: 1

SCALE

0 500 1000m

LEGEND

- Stable Land
- Stable Land - minor area of slope instability
- Less Stable Land
- Moderately Unstable Land
- Topographically Unstable for Development
- Essentially Unstable Land
- Mapping reference point
- Areas of discontinuous erosion

Discontinuous erosion in gully floor and walls

Partially filled erosion gullies

Boulders and cobble spill down slope

Latite cobbles and gravel bed load

Possible erosion or shallow soil slump scarp

Minor, discontinuous erosion in gully bases

Minor erosion below dam exposes bedrock

Mostly well vegetated creek banks

Well vegetated river banks

JOIN LINE SHEET 1 OF 2

6173500N

6173000N

6172500N

6172000N

6171500N

291500E

292000E

292500E

293000E

293500E

294000E

294500E

Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Delfin Lend Lease Ltd		
	DRAWN BY: GRW	SCALE: As shown	OFFICE: Sydney
	APPROVED BY: GRW		DATE: 18 FEB 10

TITLE: **SLOPE INSTABILITY HAZARD ZONING**
CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY
CALDERWOODURBAN DEVELOPMENT PROJECT

PROJECT No: 48742

DRAWING No: 8 Sheet 2

REVISION: 1

SCALE

0 500 1000m

LEGEND

- Stable Land
- Stable Land - minor area of slope instability
- Less Stable Land
- Moderately Unstable Land
- Topographically Unstable for Development
- Essentially Unstable Land
- Mapping reference point
- Areas of discontinuous erosion

292500E
293000E
293500E
294000E
294500E
295000E
6175000N
6174500N
6174000N
6173500N
6173000N

Creek banks well vegetated

Incised vegetated gullies

Localised exposure of soils

Revegetated erosion channels

<0.5m deep, discontinuous gully erosion

Discontinuous erosion in gully floor and walls

Partially filled erosion gullies

JOIN LINE SHEET 2 OF 2

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CLIENT: Delfin Lend Lease Ltd		
DRAWN BY: GRW	SCALE: As shown	OFFICE: Sydney
APPROVED BY: GRW		DATE: 18 FEB 10

TITLE: **SLOPE INSTABILITY HAZARD ZONING**
CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY
CALDERWOOD URBAN DEVELOPMENT PROJECT

PROJECT No:	48742
DRAWING No:	8 Sheet 1
REVISION:	1

Legend

- LGA Boundary
- Site Boundary
- Engineering works required to achieve low risk classification
- Very Low or Low Risk All development areas excluding the hatched area)
- Not Classified (Non development areas)

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CLIENT: DELFIN LEND LEASE LTD		
DRAWN BY: CCK	SCALE: 1:15000 @A3	OFFICE: W'GONG
APPROVED BY: CCK		DATE: 18 FEB10

TITLE: AGS CLASSIFICATIONS (POST DEVELOPMENT)
CONCEPT PLAN APPLICATION: GEOTECHNICAL STUDY
CALDERWOOD URBAN DEVELOPMENT PROJECT

PROJECT: 48742
DRAWING: 9
REVISION: 1

APPENDIX B

Notes Relating to this Report
Test Pit Logs (TP 1-89)
Borehole Logs (BH 101-112)

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring 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.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling 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 with 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.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of 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 sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole 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 in sands above the water

table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water 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 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength 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 short of full penetration, 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 tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. 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 relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein 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. 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 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, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it 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.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations 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.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company 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 condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

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

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, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation 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. The Company 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 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.

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DESCRIPTION AND CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh Stained	Fs	Rock substance unaffected by weathering, but showing limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index ($I_{S(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by Australian Standard 4133.4.1 - 1993.

Term	Symbol	Field Guide*	Point Load Index $I_{S(50)}$ MPa	Approx Unconfined Compressive Strength q_u ** MPa
Extremely low	EL	Easily remoulded by hand to a material with soil properties	<0.03	< 0.6
Very low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3 cm thick can be broken by finger pressure.	0.03-0.1	0.6-2
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 40 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1-0.3	2-6
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3-1.0	6-20
High	H	Can be slightly scratched with a knife. A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow, rock rings under hammer.	1 - 3	20-60
Very high	VH	Cannot be scratched with a knife. Hand specimen breaks with pick after more than one blow, rock rings under hammer.	3 - 10	60-200
Extremely high	EH	Specimen requires many blows with geological pick to break through intact material, rock rings under hammer.	>10	> 200

Note that these terms refer to strength of rock material and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

* The field guide assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

** The approximate unconfined compressive strength (q_u) shown in the table is based on an assumed ratio to the point load index of 20:1. This ratio may vary widely.

STRATIFICATION SPACING

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

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plane perpendicular to the core axis. Note that where possible, recordings of the actual defect spacing or range of spacings is preferred to the general terms given below.

Term	Description
Fragmented	The core consists mainly of fragments with dimensions less than 20 mm.
Highly Fractured	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured	Core lengths are mainly 40 mm - 200 mm with occasional shorter and longer sections.
Slightly Fractured	Core lengths are generally 200 mm - 1000 mm with occasional shorter and longer sections.
Unbroken	The core does not contain any fracture.

ROCK QUALITY DESIGNATION (RQD)

This is defined as the ratio of sound (i.e. low strength or better) core in lengths of greater than 100 mm to the total length of the core, expressed in percent. If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh, irregular breaks rather than joint surfaces) the fresh broken pieces are fitted together and counted as one piece.

SEDIMENTARY ROCK TYPES

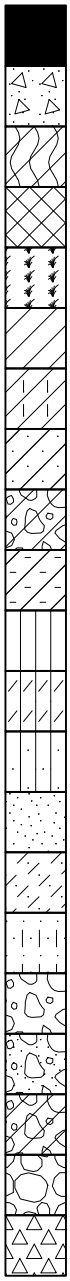
This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel-sized (greater than 2 mm) fragments
Sandstone:	More than 50% of the rock consists of sand-sized (0.06 to 2 mm) grains
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay-sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, eg. clayey sandstone, sandy shale.

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

GRAVEL

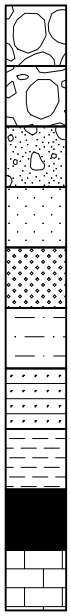
SANDY GRAVEL

CLAYEY GRAVEL

COBBLES/BOULDERS

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

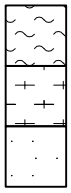
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

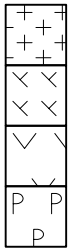


SLATE, PHYLITTE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 34
EASTING: 293222
NORTHING: 6174928
DIP/AZIMUTH: 90°/--

PIT No: 1
PROJECT No: 48742
DATE: 10 Nov 09
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)
34	0.0	TOPSOIL - dark brown slightly silty clay with some roots and rootlets, humid to damp							
	0.3	CLAY - stiff, light orange grey clay with trace rootlets, humid to damp (RESIDUAL SOIL)		D	0.5		pp = 470-570kPa		
		- becoming very stiff below 0.6m			0.6				
	0.8	TUFFACEOUS SANDSTONE - banded extremely low to very low strength and low to medium strength, extremely to slightly weathered, fine grained tuffaceous sandstone		D	0.9				
33	1				1.0				1
	1.1	Pit discontinued at 1.1m (refusal on low to medium strength tuffaceous sandstone)							
32	2								2
31	3								3

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

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 22
EASTING: 293550
NORTHING: 6174940
DIP/AZIMUTH: 90°/--

PIT No: 2
PROJECT No: 48742
DATE: 10 Nov 09
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)
22	0.15	TOPSOIL - dark brown friable clay with some roots and rootlets, humid to damp							
		GRAVELLY CLAY - firm to stiff, dark brown friable gravelly (medium to coarse sandstone) clay with trace rootlets, humid to damp (COLLUVIUM)		D	0.45				
	0.55	CLAY - firm to stiff, orange brown mottled light to mid grey clay with some silt and trace rootlets, damp (RESIDUAL SOIL)			0.55				
21	1			D	1.0		pp = 170-250kPa		1
					1.1				
				D	1.6		pp = 190-270kPa		
					1.7				
20	2	- becoming slightly fissured below 2.0m		D	2.1		pp = 170-250kPa		2
					2.2				
	2.5	SANDSTONE - extremely low to very low strength, extremely to highly weathered, orange brown to light to mid grey fine grained sandstone		D	2.5				
					2.6				
19	3	- with some extremely low strength bands below 3.0m		D	3.1				3
	3.2	Pit discontinued at 3.2m (limit of investigation)			3.2				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 34
EASTING: 292914
NORTHING: 6174806
DIP/AZIMUTH: 90°/--

PIT No: 3
PROJECT No: 48742
DATE: 10 Nov 09
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)
34		TOPSOIL - grey brown clay with some roots and rootlets, humid							
	0.3	CLAY - very stiff, red brown fissured clay with trace rootlets, humid to damp (RESIDUAL SOIL)		D	0.5		pp > 600kPa		
					0.6				
	0.7	TUFFACEOUS SANDSTONE - low to medium strength, moderately weathered, orange grey brown fine grained tuffaceous sandstone							
33	1			D	0.9				1
	1.1	Pit discontinued at 1.1m (very slow progress on low to medium strength tuffaceous sandstone)			1.0				
32	2								2
31	3								3

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

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293773
NORTHING: 6174780
DIP/AZIMUTH: 90°/--

PIT No: 4
PROJECT No: 48742
DATE: 10 Nov 09
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)
14		TOPSOIL - dark brown friable clay with some roots and rootlets, humid to damp							
	0.3	CLAY - firm, orange brown clay with trace rootlets, humid to damp		D	0.4		pp = 250-330kPa		
		(RESIDUAL SOIL)			0.5				
		- becoming stiff below 0.45m							
13	1	- becoming orange brown mottled light to mid grey with some silt below 0.9m		D	1.0		pp = 310-390kPa		1
					1.1				
				D	1.4		pp = 260-510kPa		
					1.5				
12	2	- becoming slightly sandy, slightly silty below 1.9m		D	1.9		pp = 180-280kPa		2
	2.4	SANDSTONE - low to medium strength, moderately to slightly weathered, orange brown to grey fine to medium grained sandstone		D	2.4				
	2.6	Pit discontinued at 2.6m			2.5				
		(very slow progress)							
11	3								3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 18
EASTING: 292641
NORTHING: 6174602
DIP/AZIMUTH: 90°/--

PIT No: 5
PROJECT No: 48742
DATE: 10 Nov 09
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)
18	0.35	TOPSOIL - orange brown clayey silt with some roots and rootlets, humid							
		SANDY SILT - medium dense, orange brown sandy silt with trace rootlets, humid (ALLUVIAL)		D	0.5 0.6				
	0.7	CLAY - very stiff, brown fissured clay with trace rootlets, humid (ALLUVIAL)							
17	1			D	1.0 1.1		pp > 600kPa		1
				D	1.4 1.5		pp > 600kPa		
	1.9	SAND - orange brown slightly clayey fine to medium sand with some silt, humid (ALLUVIAL)		D	1.9 2.0		pp > 600kPa		
16	2								2
	2.3	SANDY CLAY - hard, orange brown sandy clay, humid to damp (ALLUVIAL)		D	2.4 2.5		pp = 470-500kPa		
	2.95	SAND - light to mid grey slightly gravelly (fine to coarse sandstone) medium to coarse sand with some silt, clay and cobbles, wet (ALLUVIAL)						▼	
15	3			D	3.2				3
	3.5	Pit discontinued at 3.5m (limit of investigation)			3.5				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: Seepage below 2.9m

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 18
EASTING: 292884
NORTHING: 6174626
DIP/AZIMUTH: 90°/--

PIT No: 6
PROJECT No: 48742
DATE: 10 Nov 09
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)
18		TOPSOIL - grey brown clay with some roots and rootlets, humid							
	0.2	CLAY - very stiff to hard, grey brown fissured clay with trace rootlets, humid (ALLUVIAL)							
				D	0.5		pp > 600kPa		
					0.6				
17	1	- becoming slightly sand below 1.0m		D	1.0		pp > 600kPa		1
					1.1				
				D	1.4		pp > 600kPa		
					1.5				
	1.9	SAND - brown to orange grey fissured slightly clayey fine to medium sand, humid (ALLUVIAL)		D	1.9		pp > 600kPa		
16	2				2.0				2
		- becoming clayey sand below 2.4m		D	2.4		pp > 600kPa		
					2.5				
15	3	- becoming humid to damp below 2.9m		D	3.1		pp = 250-260kPa		3
	3.2	Pit discontinued at 3.2m (limit of investigation)			3.2				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293228
NORTHING: 6174644
DIP/AZIMUTH: 90°/--

PIT No: 7
PROJECT No: 48742
DATE: 10 Nov 09
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)
14	0.0	TOPSOIL - dark brown clay with some roots and rootlets, damp							
	0.5	CLAY - stiff, orange brown mottled grey fissured clay with some sand and silt with trace rootlets, humid (ALLUVIAL)		U	0.55		pp + 400-580kPa		
				D	0.9		pp = 380-450kPa		
13	1	- becoming humid to damp below 1.0m		D	1.0				1
		- becoming slightly sandy to sandy below 1.5m		D	1.5		pp = 250-400kPa		
					1.6				
12	2								2
	2.1	SILTY SAND - orange brown mottled grey silty fine to medium sand with some clay, humid (ALLUVIAL)		D	2.1				
					2.2				
		- moist to wet below 2.9m		D	2.5			▼	
					2.6				
11	3			D	3.0				3
	3.1	Pit discontinued at 3.1m (limit of investigation)			3.1				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: Seepage below 2.9m

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 11
EASTING: 293534
NORTHING: 6174656
DIP/AZIMUTH: 90°/--

PIT No: 8
PROJECT No: 48742
DATE: 10 Nov 09
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)
11		TOPSOIL - dark brown friable clay with some roots and rootlets, humid to damp							
	0.3	CLAY - firm, orange grey brown fissured slightly sandy clay with trace rootlets, humid to damp (ALLUVIAL)		D	0.4 0.5		pp = 570-600kPa		
		- becoming very stiff below 0.6m							
		- becoming hard below 0.75m							
10	1.0	SANDY CLAY - very stiff, orange brown fissured sandy clay with some medium to coarse gravel and trace rootlets, humid (ALLUVIAL)		D	1.0 1.1		pp > 600kPa		1
				D	1.5 1.6		pp > 600kPa		
	1.9	SANDY CLAY - very stiff, orange brown mottled grey fissured sandy clay, humid to damp (ALLUVIAL)		D	2.1 2.2		pp = 410-420kPa		2
		- becoming stiff and slightly sandy below 2.5m		D	2.5 2.6		pp = 150-190kPa		
		- becoming firm to stiff below 3.2m		D	3.2		pp = 50-130kPa	▼	
	3.3	Pit discontinued at 3.3m (limit of investigation)			3.3				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: Free groundwater observed at 3.3m

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 10
EASTING: 293906
NORTHING: 6174564
DIP/AZIMUTH: 90°/--

PIT No: 9
PROJECT No: 48742
DATE: 13 Nov 09
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)
10		TOPSOIL - brown silty clay with some rootlets and trace gravel (ironstone), humid		A	0.0				
					0.3				
	0.4	CLAY - firm to stiff, grey mottled brown slightly sandy clay, humid		D, A, B	0.5				
					0.7				
9	1			D, A	1.0		pp > 600kPa		1
					1.2				
				A	1.5				
					1.7				
8	2			D, A	2.0		pp > 600kPa		2
		- becoming very stiff, orange mottled grey clay with some organic content and gravel (ironstone) below 2.3m			2.2				
				A	2.5				
					2.7				
					2.9		pp = 410-460kPa		
7	3			D, A					3
	3.1	Pit discontinued at 3.1m (limit of investigation)			3.1				

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 10
EASTING: 294128
NORTHING: 6174654
DIP/AZIMUTH: 90°/--

PIT No: 10
PROJECT No: 48742
DATE: 13 Nov 09
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)
10	0.0	TOPSOIL - brown silty clay with some rootlets, humid		A	0.0				
	0.3	CLAY - stiff to very stiff, brown mottled grey slightly sandy clay, humid			0.3				
				A	0.5				
					0.7				
9	1			U_{50}					1
				D, A	1.1		pp > 600kPa		
					1.2				
					1.5				
				D, A					
					1.7				
8	2				2.0		pp = 260-460kPa		2
	2.1	SANDY CLAY - stiff to very stiff, orange mottled grey sandy clay, damp		A					
					2.2				
					2.5				
				D, A					
					2.7				
					2.8		pp = 170-230kPa		
				A					
7	3				3.0				3
	3.1	Pit discontinued at 3.1m (limit of investigation)							

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 8
EASTING: 294295
NORTHING: 6174544
DIP/AZIMUTH: 90°/--

PIT No: 11
PROJECT No: 48742
DATE: 13 Nov 09
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)
8	0.0	TOPSOIL - brown clay with some rootlets, humid		A	0.0				
	0.3	CLAY - stiff, brown mottled grey slightly sandy clay, humid			0.3				
				D, A	0.5		pp > 600kPa		
		- becoming damp below 0.7m			0.7				
7	1			D, A	1.0		pp = 120-160kPa		1
					1.2				
				D, A	1.5		pp = 190-210kPa		
					1.7				
		- becoming orange mottled grey and moist - wet below 1.8m							
6	2			D, A	2.0		pp = 110-140kPa		2
					2.2				
				A	2.5		pp = 90-170kPa		
					2.7				
				D, A	2.8			▽	
5	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: Groundwater seepage observed at 2.8m

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 22
EASTING: 292348
NORTHING: 6174345
DIP/AZIMUTH: 90°/--

PIT No: 12
PROJECT No: 48742
DATE: 10 Nov 09
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)
22	0.35	TOPSOIL - brown grey silty clay with some roots and rootlets and trace sand, humid to damp							
		CLAY - stiff, orange grey brown clay with trace sand and rootlets, humid to damp (ALLUVIAL)		B	0.5		pp = 250-320kPa		
	0.8				0.7				
		SANDY CLAY - stiff, orange brown mottled grey fissured sandy clay, humid to damp (ALLUVIAL)		U	0.75				
21	1			D	1.0		pp = 380-590kPa		1
					1.1				
				D	1.5		pp > 600kPa		
					1.6				
20	2			D	2.0		pp > 600kPa		2
					2.1				
	2.4	SILTY CLAY - very stiff, orange red brown mottled grey silty clay with some sand, humid to damp (ALLUVIAL)		D	2.5		pp = 390-510kPa		
					2.6				
		- becoming friable and slightly sandy below 2.8m							
				D	2.9				
19	3				3.0				3
	3.0	Pit discontinued at 3.0m (limit of investigation)							

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 19
EASTING: 292533
NORTHING: 6174396
DIP/AZIMUTH: 90°/--

PIT No: 13
PROJECT No: 48742
DATE: 10 Nov 09
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)
19	0.0	TOPSOIL - grey brown clay with some roots and rootlets, humid							
	0.2	CLAY - very stiff, orange brown clay with trace sand and rootlets, humid to damp (ALLUVIAL)		D	0.5		pp = 270-360kPa		
					0.6				
	0.7	CLAYEY SAND - dense, orange brown mottled light grey clayey medium to coarse sand with some silt, humid to damp (ALLUVIUM)							
18	1	- becoming medium dense below 0.9m		D	1.0		pp = 340->600kPa		1
					1.1				
	1.2	CLAY - stiff to very stiff, orange brown mottled light to mid grey clay withsome sand and silt, humid to damp (ALLUVIUM)		D	1.4		pp = 480->600kPa		
					1.5				
		- becoming slightly sandy below 1.9m							
17	2			D	2.0		pp = 150-210kPa		2
					2.1				
				D	2.5		pp = 350-400kPa		
					2.6				
	2.8	SANDY CLAY/CLAYEY SAND - stiff, orange red brown mottled light grey sandy clay/clayey sand, damp with moist patches (ALLUVIUM)		D	2.9		pp = 80-240kPa	▼	
16	3				3.0				3
	3.0	Pit discontinued at 3.0m (limit of investigation)							

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: Water inflow at 2.9m

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 16
EASTING: 292939
NORTHING: 6174357
DIP/AZIMUTH: 90°/--

PIT No: 14
PROJECT No: 48742
DATE: 10 Nov 09
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)
16		TOPSOIL - grey brown friable clay with some roots and rootlets and trace sand and fine gravel, humid to damp							
	0.3	SANDY CLAY - stiff, orange brown mottled grey slightly sandy to sandy clay, humid to damp (ALLUVIAL)		D	0.5		pp = 330-430kPa		
					0.6				
		- becoming hard below 0.6m							
15	1			D	1.0		pp = 520->600kPa		1
		- becoming sandy clay below 1.0m			1.1				
				D	1.4		pp = 360->600kPa		
					1.5				
				D	1.9		pp > 600kPa		
14	2	- with fissured below 1.9m			2.0				2
				D	2.4				
	2.5	SAND - brown fine to medium sand with some silt, humid (ALLUVIAL)			2.5				
13	3			D	3.0				3
					3.1				
	3.2	Pit discontinued at 3.2m (limit of investigation)							

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 13
EASTING: 293211
NORTHING: 6174378
DIP/AZIMUTH: 90°/--

PIT No: 15
PROJECT No: 48742
DATE: 10 Nov 09
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)
13		TOPSOIL - dark brown friable clay with some roots and rootlets, humid to damp							
	0.3	SANDY SILT - medium dense to dense, light brown grey sandy silt, humid (ALLUVIAL)		B	0.4				
	0.6	SANDY CLAY - very stiff, orange brown mottled grey fissured slightly sandy to sandy clay, humid (ALLUVIAL)			0.6				
12	1			D	1.0		pp = 510->600kPa		1
					1.1				
				D	1.4		pp > 600kPa		
					1.5				
	1.9	CLAY - dark grey mottled orange brown clay, humid to damp (ALLUVIAL)		D	1.9		pp = 430-480kPa		
11	2				2.0				2
				D	2.4		pp = 410-420kPa		
					2.5				
		- becoming slightly sandy below 2.9m							
10	3			D	3.0				3
	3.1	Pit discontinued at 3.1m (limit of investigation)			3.1				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293529
NORTHING: 6174367
DIP/AZIMUTH: 90°/--

PIT No: 16
PROJECT No: 48742
DATE: 11 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
14		TOPSOIL - brown silty clay with some rootlets, humid							
	0.3	CLAY - very stiff to hard, orange mottled grey slightly sandy clay with trace gravel (ironstone), humid		D	0.5		pp = 400-480kPa		
					0.7				
13	1			D	1.0		pp > 600kPa		1
					1.2				
				D	1.5		pp > 600kPa		
					1.7				
12	2			D	2.0		pp > 600kPa		2
					2.2				
				D	2.5		pp = 480-590kPa		
					2.7				
11	3 3.0	Pit discontinued at 3.0m (limit of investigation)							3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293881
NORTHING: 6174312
DIP/AZIMUTH: 90°/--

PIT No: 17
PROJECT No: 48742
DATE: 13 Nov 09
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)
14	0.0	TOPSOIL - brown slightly sandy silty clay with some rootlets and trace gravel (ironstone), humid		A	0.0				
	0.3	SANDY CLAY - stiff to very stiff, light brown sandy clay with some gravel (ironstone), humid		A	0.3				
				U_{50}	0.5				
	0.8	CLAY - very stiff, red mottled grey clay with some gravel (ironstone) and sand, humid			0.7				
13	1			D, A	0.9				
					1.0				1
					1.2				
				D, A	1.5		pp = 250-400kPa		
					1.7				
	1.9	CLAY - hard, orange mottled grey slightly sandy clay with some gravel (ironstone, sandstone), humid							
12	2			D, A	2.0				2
					2.2				
				A	2.5		pp > 600kPa		
					2.7				
				D, A	2.9				
11	3								3
	3.1	Pit discontinued at 3.1m (limit of investigation)			3.1				

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 12
EASTING: 294056
NORTHING: 6174171
DIP/AZIMUTH: 90°/--

PIT No: 18
PROJECT No: 48742
DATE: 13 Nov 09
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)
12	0.0	TOPSOIL - brown silty sandy clay with some rootlets, humid		A	0.0				
	0.3	CLAY - stiff, brown mottled orange and grey clay with some sand, humid			0.3				
				D, A	0.5		pp > 600kPa		
					0.7				
11	1	- becoming grey sandy clay below 0.9m		D	1.0				1
					1.2				
				D	1.5		pp > 600kPa		
					1.7				
10	2			D	2.0				2
					2.2				
				D	2.8				
9	3	3.0 Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 6
EASTING: 294463
NORTHING: 6174297
DIP/AZIMUTH: 90°/--

PIT No: 19
PROJECT No: 48742
DATE: 13 Nov 09
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)
6		TOPSOIL - brown silty clay with some sand and rootlets, humid		A	0.0				
	0.2	CLAY - stiff, brown mottled orange and grey clay with some sand, humid			0.2				
				A, D, B	0.5		pp = 170-200kPa		
					0.7				
	0.9	CLAY - stiff, grey mottled red and orange clay, damp							
5	1			D, A	1.0		pp = 130-150kPa		1
					1.2				
				D, A	1.5		pp = 130-160kPa		
					1.7				
		- with some sand below 1.8m							
4	2			A	2.0		pp = 170-200kPa		2
					2.2				
				D, A	2.5		pp = 130-190kPa		
					2.7				
				D	2.8		pp = 180-200kPa		
3	3	3.0 Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 6
EASTING: 294580
NORTHING: 6174438
DIP/AZIMUTH: 90°/--

PIT No: 20
PROJECT No: 48742
DATE: 13 Nov 09
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)
6	0.1	TOPSOIL - brown silty sandy cay with some rootlets, humid			0.1				
		SAND - medium dense, light brown slightly clayey sand, humid		A	0.3				
	0.4	CLAY - stiff, brown mottled black and orange slightly sandy clay, humid			0.5		pp = 520-560kPa		
				A U_{50}	0.7				
					0.9				
5	1			D, A	1.0		pp = 350-540kPa		1
					1.2				
		- becoming damp to moist below 1.9m							
4	2			D, A	2.0		pp = 120-220kPa		2
					2.2				
				A	2.5		pp = 60-110kPa		
					2.7				
3	3								3
				D, A	3.3				
	3.5	Pit discontinued at 3.5m (limit of investigation)			3.5				

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 24
EASTING: 292325
NORTHING: 6174051
DIP/AZIMUTH: 90°/--

PIT No: 21
PROJECT No: 48742
DATE: 10 Nov 09
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)
24	0.2	TOPSOIL - grey brown silty clay with some roots and rootlets, humid							
		CLAY - stiff, grey brown fissured clay with trace sand and rootlets, damp (RESIDUAL SOIL)		D	0.5		pp = 250-310kPa		
		- becoming firm below 0.6m			0.6				
23	1	- becoming grey brown mottled orange brown below 1.0m		D	1.0		pp = 310-400kPa		1
					1.1				
	1.4	TUFFACEOUS SANDSTONE - extremely low strength, extremely weathered, orange brown to grey and white fine grained tuffaceous sandstone		D	1.4				
		- becoming low strength below 1.7m			1.5				
	1.8	Pit discontinued at 1.8m (slow progress in low strength tuffaceous sandstone)							
22	2								2
21	3								3

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

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 22
EASTING: 292723
NORTHING: 6174120
DIP/AZIMUTH: 90°/--

PIT No: 22
PROJECT No: 48742
DATE: 10 Nov 09
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)
22		TOPSOIL - grey brown friable silty clay with some roots and rootlets, damp							
	0.25	CLAY - soft to firm, grey brown clay with trace rootlets, damp (RESIDUAL SOIL)		D	0.5		pp = 150-200kPa		
					0.6				
	0.8	TUFFACEOUS SANDSTONE - extremely low strength, extremely weathered, orange brown fine grained tuffaceous sandstone		D	0.9		pp > 600kPa		
21	1				1.0				1
		- becoming orange brown mottled grey below 1.5m		D	1.5		pp > 600kPa		
					1.6				
20	2			D	2.0				2
					2.1				
		- becoming low to medium strength recovered as gravel and cobble sized blocks below 2.4m		D	2.4				
					2.5				
	2.6	Pit discontinued at 2.6m (limit of investigation)							
19	3								3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 20
EASTING: 292912
NORTHING: 6174054
DIP/AZIMUTH: 90°/--

PIT No: 23
PROJECT No: 48742
DATE: 10 Nov 09
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)
20		TOPSOIL - brown silty clay with some roots and rootlets, humid to damp							
	0.45	CLAY - stiff, dark orange grey brown fissured clay with trace fine gravel (ironstone), humid to damp (RESIDUAL SOIL)		D	0.5		pp = 390-460kPa		
				D	0.9		pp > 600kPa		
19	1				1.0				1
				D	1.5		pp = 340-470kPa		
					1.6				
18	2			D	2.0		pp = 260-310kPa		2
					2.1				
				D	2.4		pp = 250-310kPa		
					2.5				
	2.9	SANDSTONE - extremely low to very low strength, extremely to highly weathered, orange brown to light grey fine grained sandstone		D	2.9				
17	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 18
EASTING: 292911
NORTHING: 6174054
DIP/AZIMUTH: 90°/--

PIT No: 24
PROJECT No: 48742
DATE: 11 Nov 09
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)
18		TOPSOIL - brown silty clay with some rootlets, humid							
	0.3	CLAY - very stiff to hard, brown clay with some gravel (ironstone), humid			0.5		pp = 410-480kPa		
				U_{50}					
	0.9	CLAY - hard, brown mottled orange clay with some gravel (ironstone), humid			0.9				
17	1				1.0		pp > 600kPa		1
				D					
					1.2				
					1.5		pp > 600kPa		
				D					
					1.7				
16	2								2
					2.5				
				D					
					2.7				
	2.8	Pit discontinued at 2.8m (limit of investigation)							
15	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 16
EASTING: 293509
NORTHING: 6174096
DIP/AZIMUTH: 90°/--

PIT No: 25
PROJECT No: 48742
DATE: 10 Nov 09
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)
16		TOPSOIL - dark brown silty clay with some roots and rootlets, damp							
	0.3	CLAY - stiff, red brown fissured clay with trace rootlets, damp (ALLUVIAL)							
				U	0.6		pp = 220-420kPa		
		- becoming red brown mottled grey below 0.9m			0.95				
15	1			D	1.0		pp = 180->600kPa		1
					1.1				
		- becoming slightly sandy, slightly silty clay below 1.5m		D	1.5		pp = 400-580kPa		
					1.6				
14	2			D	2.0		pp = 330-500kPa		2
					2.1				
				D	2.5		pp = 220-310kPa		
					2.6				
13	3	3.0 SANDY CLAY - light grey mottled orange brown sandy clay/clayey sand, damp to moist (ALLUVIAL)		D	3.2				3
	3.3	Pit discontinued at 3.3m (limit of investigation)			3.3				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 16
EASTING: 293822
NORTHING: 6174011
DIP/AZIMUTH: 90°/--

PIT No: 26
PROJECT No: 48742
DATE: 10 Nov 09
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)
16		TOPSOIL - dark brown silt with some roots and rootlets and trace sand, humid							
	0.45	CLAY - stiff, red brown fissured clay with trace rootlets, humid to damp (RESIDUAL SOIL)		D	0.5		pp = 390-530kPa		
				D	0.6				
15	1	- becoming red brown mottled grey below 1.0m		D	1.0		pp > 600kPa		1
				D	1.1				
	1.5	SANDY CLAY - light grey mottled yellow orange brown sandy clay with trace root remains, humid to damp (RESIDUAL SOIL)		D	1.6		pp > 600kPa		
				D	1.7				
14	2			D	2.0		pp > 600kPa		2
				D	2.1				
				D	2.4		pp = 430-560kPa		
				D	2.5				
13	3			D	3.0		pp > 600kPa		3
	3.1	Pit discontinued at 3.1m (limit of investigation)			3.1				

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

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 294042
NORTHING: 6173950
DIP/AZIMUTH: 90°/--

PIT No: 27
PROJECT No: 48742
DATE: 10 Nov 09
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)
14		TOPSOIL - dark brown friable slightly clayey silt with some roots and rootlets, humid							
	0.3	SANDY CLAY - stiff, orange red brown friable sandy clay with trace rootlets, humid to damp (RESIDUAL SOIL)		D	0.5 0.6				
	0.9	CLAY - stiff, red brown mottled light to mid grey clay with some sand, humid to damp (RESIDUAL SOIL)		D	1.0 1.1		pp = 360-420kPa		1
		- becoming slightly sandy with medium to coarse gravel sized pockets of sand below 1.5m		D	1.6 1.7		pp = 350-420kPa		
12	2.0	SANDY CLAY - red brown mottled light to mid grey sandy clay, humid to damp (RESIDUAL SOIL)		D	2.1 2.2		pp = 220-480kPa		2
				D	2.5 2.6		pp = 430-540kPa		
11	3.0	SANDSTONE - extremely low to very low strength, extremely to highly weathered, orange brown to grey fine to medium grained sandstone							3
	3.1	Pit discontinued at 3.1m (limit of investigation)							

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 36
EASTING: 293266
NORTHING: 6174025
DIP/AZIMUTH: 90°/--

PIT No: 28
PROJECT No: 48742
DATE: 12 Nov 09
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)
36		FILLING - brown silty clay and coalwash gravel with some rootlets, humid							
	0.3	CLAY -firm to stiff, brown clay with trace sand, humid			0.4		pp = 250-350kPa		
				U_{50}					
					0.8				
	0.9	CLAY - hard, grey mottled orange and red clay with some sand and gravel (ironstone), humid							
35	1			D	1.0				1
					1.2				
					1.5		pp > 600kPa		
				D					
					1.7				
		- becoming very stiff below 1.8m							
34	2								2
					2.5		pp = 280-410kPa		
				D					
					2.7				
33	3								3
	3.1	Pit discontinued at 3.1m (limit of investigation)							

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 34
EASTING: 292357
NORTHING: 6173774
DIP/AZIMUTH: 90°/--

PIT No: 29
PROJECT No: 48742
DATE: 12 Nov 09
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)
34		TOPSOIL - brown silty clay with some rootlets, humid							
	0.4	CLAY - stiff, brown mottled red and black clay with some gravel (ironstone, latite), humid		D	0.5		pp = 440-510kPa		
	0.7	CLAY - very stiff, brown mottled orange clay, humid			0.7				
33	1			D	1.0		pp > 600kPa		1
					1.2				
				D	1.5		pp = 310-410kPa		
					1.7				
	1.8	CLAY - very stiff to hard, brown mottled red and black clay with some gravel (latite), humid							
32	2			D	2.0		pp > 600kPa		2
					2.2				
31	3								3
	3.1	Pit discontinued at 3.1m (limit of investigation)							

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 30
EASTING: 292542
NORTHING: 6173751
DIP/AZIMUTH: 90°/--

PIT No: 30
PROJECT No: 48742
DATE: 12 Nov 09
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)
30		TOPSOIL - brown silty clay with some rootlets and trace gravel (ironstone), humid							
	0.3	CLAY - stiff to very stiff, red mottled grey clay, humid							
				U_{50}	0.5		pp = 360-460kPa		
	0.9	CLAY - very stiff, grey mottled orange clay with trace sand, humid			0.9				
29	1			D	1.0		pp = 330-380kPa		1
					1.2				
	1.8	SANDSTONE - very low strength, extremely weathered, orange and grey sandstone							
28	2			D	2.0				2
					2.2				
				D	2.5				
		- becoming low strength below 2.7m			2.7				
27	3 3.0	Pit discontinued at 3.0m (limit of investigation)							3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 22
EASTING: 292943
NORTHING: 6173857
DIP/AZIMUTH: 90°/--

PIT No: 31
PROJECT No: 48742
DATE: 11 Nov 09
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)
22	0.0	TOPSOIL - brown slightly silty clay with some rootlets, damp							
	0.4	CLAY - firm to stiff, brown mottled orange clay with trace gravel (sandstone), humid		D	0.5		pp = 200-300kPa		
				D	0.7				
21	1			D	1.0				1
					1.2				
	1.5	CLAY - very stiff to hard, orange and white clay, humid							
20	2			D	2.0		pp > 600kPa		2
					2.2				
				D	2.7				
	2.9	Pit discontinued at 2.9m (slow progress)			2.9				
19	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 22
EASTING: 293527
NORTHING: 6173759
DIP/AZIMUTH: 90°/--

PIT No: 32
PROJECT No: 48742
DATE: 10 Nov 09
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)
22	0.3	TOPSOIL - dark brown slightly silty clay with some roots and rootlets, humid to damp							
		CLAY - firm, orange brown clay with trace rootlets, humid to damp (RESIDUAL SOIL)		D	0.5 0.6		pp = 330-430kPa		
		- becoming red brown mottled light grey below 0.8m							
21	1	- becoming stiff below 1.0m		D	1.0 1.1		pp = 170-250kPa		1
	1.2	TUFFACEOUS SANDSTONE - very low to low strength, highly weathered, orange brown to white and grey fine grained tuffaceous sandstone with some extremely low strength bands		D	1.4 1.5		pp = 240-370kPa		
		- becoming low to medium strength below 1.7m		D	1.7				
	1.8	Pit discontinued at 1.8m (slow progress in low to medium strength tuffaceous sandstone)			1.8				
20	2								2
19	3								3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 18
EASTING: 293819
NORTHING: 6173711
DIP/AZIMUTH: 90°/--

PIT No: 33
PROJECT No: 48742
DATE: 10 Nov 09
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)
18		TOPSOIL - dark brown slightly silty clay with some roots and rootlets, humid to damp							
	0.3	CLAY - stiff, grey mottled orange brown fissured clay with trace rootlets (RESIDUAL SOIL)		D	0.5		pp = 250-450kPa		
					0.6				
17	1			D	1.0		pp = 330-370kPa		1
					1.1				
		- becoming mid to dark grey mottled red brown below 1.5m		D	1.5		pp = 250-320kPa		
					1.6				
16	2			D	2.0		pp = 370-430kPa		2
					2.1				
		- becoming light to mid grey mottled orange brown fissured slightly silty clay with some sand below 2.4m		D	2.4		pp = 440-460kPa		
					2.5				
				D	2.9		pp = 470-570kPa		
15	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 64
EASTING: 293232
NORTHING: 6173475
DIP/AZIMUTH: 90°/--

PIT No: 34
PROJECT No: 48742
DATE: 12 Nov 09
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)
64		TOPSOIL - brown silty clay with some rootlets, humid							
	0.4	CLAY - very stiff to hard, brown mottled orange slightly sandy clay with trace gravel (ironstone), humid			0.5				
				U_{50}					
					0.9				
63	1				1.0				1
				D					
					1.2				
	1.5	SANDSTONE - very low strength, extremely weathered, orange and grey fine grained sandstone			1.5				
				D					
					1.7				
62	2								2
					2.5				
				D					
	2.7	Pit discontinued at 2.7m (limit of investigation)			2.7				
61	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 48
EASTING: 292991
NORTHING: 6173472
DIP/AZIMUTH: 90°/--

PIT No: 35
PROJECT No: 48742
DATE: 12 Nov 09
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)
48	0.4	TOPSOIL - brown silty clay with some rootlets, humid							
		CLAY - hard, brown mottled orange clay with trace gravel (ironstone) and sand, humid		D, B	0.5		pp > 600kPa		
					0.7				
47	1			D	1.0				1
	1.2	SILTSTONE - very low to low strength, extremely weathered, brown and orange siltstone			1.2				
				D	1.4				
	1.6	Pit discontinued at 1.6m (refusal on medium strength siltstone)			1.6				
46	2								2
45	3								3

5 10 15 20

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 58
EASTING: 292345
NORTHING: 6173504
DIP/AZIMUTH: 90°/--

PIT No: 36
PROJECT No: 48742
DATE: 12 Nov 09
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)
58	0.2	TOPSOIL - brown silty gravelly (latite, siltstone) clay with some rootlets and cobbles (silstone, latite), humid							
		GRAVELLY CLAY - stiff to very stiff, red brown gravelly (latite, siltstone) slightly sandy clay with some cobbles (latite, siltstone), humid		D, B	0.5				
					0.7				
		- gravel content increasing below 0.8m							
57	1			D	1.0				1
	1.4				1.2				
		Pit discontinued at 1.4m (slow progress)							
56	2								2
55	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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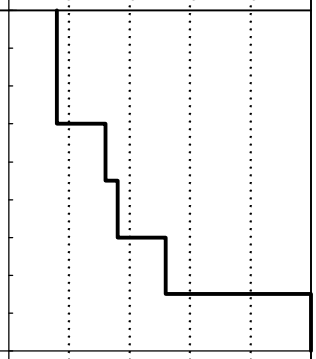
TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 34
EASTING: 292343
NORTHING: 6172271
DIP/AZIMUTH: 90°/--

PIT No: 37
PROJECT No: 48742
DATE: 11 Nov 09
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)
34	0.3	TOPSOIL - brown silty clay with some rootlets, humid							
	0.7	CLAY - very stiff to hard, orange mottled grey clay with some gravel (ironstone, sandstone), humid		U_{50}	0.5				
	0.9	SANDSTONE - very low to low strength, moderately weathered, brown and grey sandstone		D	0.8				
33	1	Pit discontinued at 0.9m (refusal on medium strength sandstone)			0.9				
32	2								
31	3								



RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 32
EASTING: 292643
NORTHING: 6173484
DIP/AZIMUTH: 90°/--

PIT No: 38
PROJECT No: 48742
DATE: 11 Nov 09
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)
32	0.2	TOPSOIL - brown slightly silty clay with some rootlets, damp							
		CLAY - firm to stiff, brown mottled orange clay with some gravel (sandstone), damp		D, B	0.5		pp = 170-350kPa		
					0.7				
31	1	- becoming very stiff below 1.0m		D	1.0		pp = 250-370kPa		1
					1.2				
	1.4	CLAY - hard, brown mottled orange clay with some gravel (sandstone), humid		D	1.5		pp > 600kPa		
30	2				1.7				2
	2.1	SANDSTONE - very low to low strength, extremely weathered, grey and brown sandstone		D	2.4				
	2.6	Pit discontinued at 2.6m (refusal on medium strength shale)			2.6				
29	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 28
EASTING: 293524
NORTHING: 6173470
DIP/AZIMUTH: 90°/--

PIT No: 39
PROJECT No: 48742
DATE: 10 Nov 09
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)
28	0.15	TOPSOIL - grey brown friable clay with some roots and rootlets, humid to damp							
		CLAY - firm, orange brown mottled grey clay with trace rootlets, humid to damp (RESIDUAL SOIL)			0.3		pp = 210-320kPa		
				U	0.4				
		- becoming very stiff and fissured with some sand below 0.6m			0.7				
				D	0.9		pp = 250-370kPa		
27	1.0	TUFFACEOUS SANDSTONE - extremely low to very low strength, extremely to highly weathered, orange brown to grey fine grained tuffaceous sandstone			1.0				1
		- low to medium strength band between 1.2 - 1.3m		D	1.5				
					1.6				
		- becoming low strength below 1.8m		D	1.9				
26	2.0	Pit discontinued at 2.0m (slow progress in low strength tuffaceous sandstone)			2.0				2
25	3								3

5 10 15 20

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 16
EASTING: 293922
NORTHING: 6173404
DIP/AZIMUTH: 90°/--

PIT No: 40
PROJECT No: 48742
DATE: 10 Nov 09
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)
16		TOPSOIL - dark brown friable clay with some roots and rootlets, humid to damp							
	0.4	CLAY - firm, orange grey brown fissured clay with trace sand and rootlets, humid to damp (RESIDUAL SOIL)		D	0.5		pp = 540-580kPa		
					0.6				
15	1	- becoming grey mottled orange brown below 1.0m		D	1.0		pp = 260-270kPa		1
					1.1				
				D	1.4		pp = 400-410kPa		
		- becoming light grey mottled orange brown fissured slightly silty clay below 1.5m			1.5				
14	2			D	2.0		pp = 500-570kPa		2
					2.1				
				D	2.5		pp = 460->600kPa		
					2.6				
		- becoming dark grey mottled yellow orange brown clay with some medium gravel and damp below 2.7m							
13	3			D	3.1		pp = 270-360kPa		3
	3.2	Pit discontinued at 3.2m (limit of investigation)			3.2				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 294103
NORTHING: 6173451
DIP/AZIMUTH: 90°/--

PIT No: 41
PROJECT No: 48742
DATE: 10 Nov 09
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)
14	0.0	TOPSOIL - dark brown silty clay with some roots and rootlets, humid							
	0.4	CLAY - stiff, red brown mottled grey clay with trace rootlets, humid to damp (RESIDUAL SOIL)		Dx2	0.5 0.6		pp = 360-450kPa		
		- becoming very stiff below 0.7m							
13	1	- becoming fissured below 1.0m		Dx2	1.0 1.1		pp > 600kPa		1
	1.3	CLAYEY SAND - red brown mottled grey fissured slightly clayey to clayey medium sand, humid (RESIDUAL SOIL)		Dx2	1.4 1.5		pp > 600kPa		
	1.8	SILTY CLAY - light grey mottled orange red brown fissured silty clay, humid to damp (RESIDUAL SOIL)		Dx2	1.9 2.0		pp > 600kPa		
12	2								2
				Dx2	2.4 2.5		pp = 340-350kPa		
11	3 3.0	Pit discontinued at 3.0m (limit of investigation)							3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Dx2 = two disturbed samples

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 11
EASTING: 294446
NORTHING: 6173474
DIP/AZIMUTH: 90°/--

PIT No: 42
PROJECT No: 48742
DATE: 10 Nov 09
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)
11		TOPSOIL - dark brown clayey silt with some roots and rootlets, humid to damp							
	0.25	SILTY SAND - medium dense, brown silty fine to medium sand with some clay and medium to coarse gravel sized pockets of clayey sand, humid (ALLUVIAL)		Dx2	0.5 0.6				
	0.8	SANDY CLAY - very stiff, red brown mottled grey sandy clay, humid to damp (ALLUVIAL)		Dx2	1.0 1.1				
10	1			Dx2	1.5 1.6				1
	1.7	SILTY CLAY - very stiff, light grey mottled orange brown silty clay with some sandy clay bands, humid to damp (ALLUVIAL)		Dx2	1.9 2.0		pp = 240-300kPa		
9	2								2
	2.5	SAND - red brown slightly clayey medium to coarse sand, humid to damp (ALLUVIAL)		Dx2	2.5 2.6				
	2.9	SANDY CLAY - light to mid grey slightly gravelly (medium to coarse sandstone) sandy clay, humid to damp (ALLUVIAL)		Dx2	3.1				
8	3								3
	3.2	Pit discontinued at 3.2m (limit of investigation)			3.2				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Dx2 = two disturbed samples

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 72
EASTING: 292227
NORTHING: 6173340
DIP/AZIMUTH: 90°/--

PIT No: 43
PROJECT No: 48742
DATE: 12 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
72	0.2	TOPSOIL - brown silty clay with some rootlets and trace gravel (ironstone), humid							
		CLAY - stiff to very stiff, brown mottled orange clay with some sand and trace gravel (sandstone), humid			0.4		pp = 510-590kPa		
				U_{50}					
					0.8				
71	1				1.0		pp = 450-600kPa		1
				D					
					1.2				
					1.5		pp > 600kPa		
				D					
					1.7				
70	2				2.0				2
				D					
					2.2				
69	3								3
	3.1	SANDSTONE - very low to low strength, extremely weathered, orange, brown and grey sandstone			3.1				
				D					
	3.3	Pit discontinued at 3.3m (limit of investigation)			3.3				

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 70
EASTING: 292929
NORTHING: 6172889
DIP/AZIMUTH: 90°/--

PIT No: 44
PROJECT No: 48742
DATE: 11 Nov 09
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)
70		TOPSOIL - brown silty clay with some rootlets and gravel (ironstone), humid							
	0.3	GRAVELLY CLAY - very stiff, brown slightly sandy gravelly (latite, sandstone) clay, humid		D	0.5		pp = 450-510kPa		
					0.7				
	0.8	CLAY - very stiff to hard, orange mottled grey slightly gravelly (latite, sandstone) clay with trace sand, humid		D	1.0		pp > 600kPa		
69	1								1
					1.2				
	1.4	LATITE - very low to low strength, extremely weathered, brown, orange and grey latite		D	1.6				
	1.8	Pit discontinued at 1.8m (refusal on medium strength latite)			1.8				
68	2								2
67	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 44
EASTING: 292624
NORTHING: 6173173
DIP/AZIMUTH: 90°/--

PIT No: 45
PROJECT No: 48742
DATE: 11 Nov 09
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)
44		TOPSOIL - brown silty clay with some rootlets, humid							
	0.3	CLAY - stiff to very stiff, orange mottled grey clay with some gravel (siltstone), humid			0.5		pp > 600kPa		
				U_{50}					
					0.9				
43	1				1.0		pp > 600kPa		1
				D					
	1.2	SILTSTONE - very low to low strength, extremely weathered, brown and grey siltstone			1.2				
	1.4	Pit discontinued at 1.4m (refusal on medium strength siltstone)							
42	2								2
41	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 45
EASTING: 293029
NORTHING: 6173263
DIP/AZIMUTH: 90°/--

PIT No: 46
PROJECT No: 48742
DATE: 11 Nov 09
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)
45	0.2	TOPSOIL - brown silty clay with some rootlets, humid							
		CLAY - stiff to very stiff, brown mottled orange clay with trace gravel (siltstone), humid		D	0.5		pp > 600kPa		
					0.7				
44	0.8	CLAY - very stiff to hard, brown, orange and grey shaly clay with some gravel (sandstone), humid		D	1.0				1
	1				1.2				
				D	1.5				
43	2				1.7				2
				D	2.5				
	2.7	Pit discontinued at 2.7m (slow progress)			2.7				
42	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 32
EASTING: 293633
NORTHING: 6173170
DIP/AZIMUTH: 90°/--

PIT No: 47
PROJECT No: 48742
DATE: 10 Nov 09
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)
32	0.3	TOPSOIL - dark brown friable clay with some roots and rootlets, humid to damp							
		CLAY - stiff, grey brown fissured clay with trace rootlets, damp (RESIDUAL SOIL)		D	0.4 0.5		pp = 310-490kPa		
	0.7	SILTY CLAY - very stiff, orange brown mottled grey silty clay with some sand and trace roots, humid to damp (RESIDUAL SOIL)		D	0.7 0.8		pp = 380-510kPa		
31	1	TUFFACEOUS SANDSTONE - extremely low to low strength, extremely to highly weathered, orange brown to grey fine grained tuffaceous sandstone		D	1.1				1
	1.2	Pit discontinued at 1.2m (slow progress in low strength tuffaceous sandstone)			1.2				
30	2								2
29	3								3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 20
EASTING: 293828
NORTHING: 6173166
DIP/AZIMUTH: 90°/--

PIT No: 48
PROJECT No: 48742
DATE: 10 Nov 09
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)
20		TOPSOIL - dark brown silty clay with some roots and rootlets, humid to damp							
	0.35	CLAY - stiff, dark grey mottled red brown fissured clay, humid to damp (RESIDUAL SOIL)		D	0.4		pp > 600kPa		
					0.5				
				U					
					0.9				
19	1			Dx2	1.0		pp > 600kPa		1
					1.1				
	1.2	SANDY CLAY - very stiff, light grey mottled orange brown slightly sandy to sandy clay, humid to damp (RESIDUAL SOIL)							
				Dx2	1.6		pp = 570->600kPa		
					1.7				
	1.9	CLAY - very stiff, dark brown grey fissured clay, humid to damp (RESIDUAL SOIL)							
18	2			Dx2	2.0		pp = 300-420kPa		2
					2.1				
				Dx2	2.5		pp = 250-420kPa		
					2.6				
				Dx2	2.8		pp = 330-350kPa		
	2.9	Pit discontinued at 2.9m (refusal on low to medium strength sandstone)			2.9				
17	3								3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Dx2 = two disturbed samples

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 10
EASTING: 294094
NORTHING: 6173170
DIP/AZIMUTH: 90°/--

PIT No: 49
PROJECT No: 48742
DATE: 10 Nov 09
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)
10		TOPSOIL - brown grey clay with some roots and rootlets, humid							
	0.3	CLAY - stiff, grey mottled orange brown fissured clay with trace rootlets, humid to damp (ALLUVIAL)		D	0.5		pp = 240-430kPa		
				B	0.7				
9	1			Dx2	1.0		pp = 580->600kPa		1
					1.1				
		- becoming orange brown below 1.4m		Dx2	1.4		pp = 370-460kPa		
					1.5				
		- becoming orange brown mottled light grey slightly sandy clay below 1.9m		Dx2	1.9		pp = 130-230kPa		
8	2				2.0				2
	2.4	SAND - orange brown mottled light to mid grey fine to medium sand with some silt and clay, moist (ALLUVIAL)		Dx2	2.6				
					2.7			▼	
		- becoming wet below 2.9m							
7	3			Dx2	3.0				3
	3.1	Pit discontinued at 3.1m (limit of investigation)			3.1				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: Seepage below 2.9m

REMARKS: Dx2 = two disturbed samples

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 10
EASTING: 294406
NORTHING: 6173166
DIP/AZIMUTH: 90°/--

PIT No: 50
PROJECT No: 48742
DATE: 10 Nov 09
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)
10	0.2	TOPSOIL - brown clayey silt with some roots and rootlets, humid to damp							
		SILTY SAND - medium dense, brown silty fine sand, humid (ALLUVIAL)		Dx2	0.5 0.6				
9	1.0	CLAY - stiff to very stiff, dark grey clay with some silt, humid to damp (ALLUVIAL)		Dx2	1.0 1.1		pp = 210-220kPa		
				Dx2	1.6 1.7		pp = 180-250kPa		
8	2	- becoming light to mid grey mottled red brown below 2.0m		Dx2	2.1 2.2		pp = 250-300kPa		
		- becoming orange red brown mottled light grey below 2.3m		Dx2	2.4 2.5		pp = 140-160kPa		
7	3.0	- with some moist pockets below 2.9m		Dx2	2.9 3.0		pp = 150-180kPa		
		Pit discontinued at 3.0m (limit of investigation)							

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Dx2 = two disturbed samples

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 64
EASTING: 292962
NORTHING: 6173038
DIP/AZIMUTH: 90°/--

PIT No: 51
PROJECT No: 48742
DATE: 11 Nov 09
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)
64	0.3	TOPSOIL - brown slightly silty clay with some sand and rootlets, humid							
		CLAY - very stiff, grey mottled brown clay with some gravel (latite), humid		U_{50}	0.4		pp = 450-550kPa		
					0.8				
63	1			D	1.0				1
		- gravel content increasing below 1.2m			1.2				
	1.4	LATITE -very low to low strength, extremely weathered, grey and brown latite							
	1.8	Pit discontinued at 1.8m (refusal on medium strength shale)							
62	2								2
61	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 78
EASTING: 293232
NORTHING: 6172884
DIP/AZIMUTH: 90°/--

PIT No: 52
PROJECT No: 48742
DATE: 11 Nov 09
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		TOPSOIL - brown slightly silty clay with trace gravel (latite), humid							
	0.3	CLAY - very stiff to hard, brown clay with some gravel (latite), humid		D	0.3		pp > 600kPa		
	0.5	Pit discontinued at 0.5m (refusal on high strength latite)			0.5				
77	1								1
76	2								2
75	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 62
EASTING: 293229
NORTHING: 6173174
DIP/AZIMUTH: 90°/--

PIT No: 53
PROJECT No: 48742
DATE: 11 Nov 09
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)
62		TOPSOIL - brown silty gravelly (latite) clay with some rootlets, humid							
	0.3	GRAVELLY CLAY - very stiff to hard, brown slightly silty gravelly (latite) clay with trace sand, humid							
				D	0.5		pp > 600kPa		
					0.7				
61	1			D	1.0				1
		- gravel content increasing below 1.2m			1.2				
				D	1.5				
	1.7	Pit discontinued at 1.7m (slow progress)			1.7				
60	2								2
59	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 40
EASTING: 293823
NORTHING: 6172869
DIP/AZIMUTH: 90°/--

PIT No: 54
PROJECT No: 48742
DATE: 11 Nov 09
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)
40	0	TOPSOIL - brown slightly silty clay with some sand and rootlets, humid							
	0.3	CLAY - stiff, grey mottled orange clay, humid		U_{50}	0.5		pp = 410-430kPa		
	0.8	SANDSTONE - very low to low strength, moderately weathered, brown and grey sandstone		D	0.8				
39	1 1.0	Pit discontinued at 1.0m (refusal on medium strength sandstone)			1.0				1
38	2								2
37	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 12
EASTING: 294142
NORTHING: 6172953
DIP/AZIMUTH: 90°/--

PIT No: 55
PROJECT No: 48742
DATE: 10 Nov 09
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)
12		TOPSOIL - brown slightly sandy clay with some rootlets and trace sand, humid							
	0.4	SANDY CLAY - firm, brown mottled orange sandy clay, humid		D	0.5		pp = 40-70kPa		
					0.7				
11	1			U_{50}					1
					1.1		pp = 40-90kPa		
				D					
					1.3				
10	2								2
					2.0		pp = 80-140kPa		
				D					
					2.2				
	2.3	CLAY - stiff, dark brown slightly sandy clay, damp to moist							
9	3								3
					3.0		pp = 170-210kPa		
				D					
	3.2	Pit discontinued at 3.2m (limit of investigation)			3.2				

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 12
EASTING: 294143
NORTHING: 6172953
DIP/AZIMUTH: 90°/--

PIT No: 56
PROJECT No: 48742
DATE: 10 Nov 09
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)
12	0.0	TOPSOIL - brown clayey silt with some roots and rootlets, humid to damp							
	0.35	CLAY - stiff, dark grey mottled orange brown clay with some silt and trace rootlets, humid to damp (ALLUVIAL)		Dx2	0.5 0.6		pp = 320-450kPa		
		- firm below 0.75m							
11	1			Dx2	1.0 1.1		pp = 150-210kPa		1
				Dx2	1.4 1.5		pp = 170-250kPa		
	1.7	CLAY - stiff to very stiff, red brown clay, humid to damp (ALLUVIAL)							
10	2			Dx2	2.0 2.1		pp = 200=370kPa		2
				Dx2	2.4 2.5		pp = 160-210kPa		
		- becoming stiff, red brown mottled light grey below 2.8m		Dx2	2.9		pp = 100-150kPa		
9	3	3.0			3.0				3
		Pit discontinued at 3.0m (limit of investigation)							

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Dx2 = two disturbed samples

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 42
EASTING: 292879
NORTHING: 6172146
DIP/AZIMUTH: 90°/--

PIT No: 57
PROJECT No: 48742
DATE: 10 Nov 09
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)
42	0.0	TOPSOIL - brown silty clay with some gravel (sandstone, ironstone), humid							
	0.4	CLAY - hard, grey and brown clay with some gravel (sandstone), humid		D	0.5		pp > 600kPa		
				D	0.7				
41	1			D	1.0		pp > 600kPa		1
					1.2				
	1.3	SANDSTONE - very low to low strength, extremely weathered, grey and orange sandstone		D	1.5				
					1.7				
		- becoming extremely low strength below 1.8m		D	2.0				
40	2				2.2				2
	2.5	Pit discontinued at 2.5m (refusal on medium strength sandstone)							
39	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 20
EASTING: 293514
NORTHING: 6172852
DIP/AZIMUTH: 90°/--

PIT No: 58
PROJECT No: 48742
DATE: 10 Nov 09
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)
20	0.0	TOPSOIL - brown silty clay with some sand and rootlets, humid							
	0.3	CLAY - stiff, brown mottled orange clay with some gravel (siltstone), humid		D, B	0.5		pp > 600kPa		
	0.7	SILTSTONE - very low to low strength, extremely weathered, grey and orange siltstone		D	1.0				
19	1				1.2				1
				D	2.0				
18	2				2.2				2
	2.4	Pit discontinued at 2.4m (slow progress)							
17	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 12
EASTING: 293428
NORTHING: 6172495
DIP/AZIMUTH: 90°/--

PIT No: 59
PROJECT No: 48742
DATE: 10 Nov 09
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)
12	0.0	TOPSOIL - brown slightly silty clay with some rootlets and trace sand, humid							
	0.5	SAND - loose to medium dense, brown fine to medium sand with trace gravel (ironstone) and silt, humid		D	0.5				
					0.7				
11	1			D	1.0				1
					1.2				
	1.4	SAND - loose to medium dense, orange brown fine to medium sand with trace clay and gravel (ironstone), humid		D	1.5				
					1.7				
10	2								2
				D	2.5				
					2.7				
9	3 3.0	Pit discontinued at 3.0m (limit of investigation)							3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 294972
NORTHING: 6172506
DIP/AZIMUTH: 90°/--

PIT No: 60
PROJECT No: 48742
DATE: 13 Nov 09
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)
14	0.0	TOPSOIL - brown silty clay with some rootlets		D	0.0				
	0.3	CLAY - very stiff to hard, brown clay with some silt			0.3				
				D	0.6				
				U_{50}	0.7				
13	1			D, D	1.0				1
					1.2				
	1.5	CLAYEY SAND - medium dense, light brown clayey fine to medium grained sand		D, D	1.5				
	1.7	CLAY - very stiff to hard, brown slightly sandy clay			1.7				
12	2			D	2.0				2
					2.2				
				D, D	2.5		pp = 370-550kPa		
				D	2.8		pp > 600kPa		
11	3				3.0				3
	3.0	Pit discontinued at 3.0m (limit of investigation)							

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 294131
NORTHING: 6172514
DIP/AZIMUTH: 90°/--

PIT No: 61
PROJECT No: 48742
DATE: 10 Nov 09
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)
14	0.0	TOPSOIL - grey clay with some silt, roots and rootlets, damp							
	0.3	CLAY - grey slightly silty clay with trace rootlets, humid to damp (ALLUVIAL)		D, D	0.5				
	0.6	SILTY SAND - orange brown silty fine to medium sand with trace rootlets, humid (ALLUVIAL)			0.6				
13	1			D, D	1.0				1
					1.1				
		- becoming humid to damp below 1.3m							
				D, D	1.5		pp = 170-300kPa		
					1.6				
12	2			D, D	2.0				2
					2.1				
		- with some clay below 2.4m		D, D	2.4				
					2.5				
				D, D	2.9				
11	3	3.0 Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 36
EASTING: 292213
NORTHING: 6171527
DIP/AZIMUTH: 90°/--

PIT No: 62
PROJECT No: 48742
DATE: 09 Nov 09
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)
36		TOPSOIL - brown slightly silty clay with some rootlets and trace gravel (latite), humid							
	0.3	CLAY - stiff, brown mottled orange slightly sandy clay with some gravel (latite), humid							
				D	0.5		pp = 200-270kPa		
					0.7				
35	1	- gravel content increasing below 0.9m with some cobbles (latite)		D	1.0				1
		- becoming damp to moist below 1.2m			1.2				
				D	1.5				
					1.7				
34	2			D	2.0			▽	2
					2.2				
	2.6	Pit discontinued at 2.6m (limit of investigation)							
33	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: Groundwater seepage at 2.0m

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 62
EASTING: 291586
NORTHING: 6172398
DIP/AZIMUTH: 90°/--

PIT No: 63
PROJECT No: 48742
DATE: 09 Nov 09
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)
62	0.3	TOPSOIL - dark brown slightly silty clay with some rootlets, humid							
		SANDY CLAY - stiff, red-brown sandy clay with trace gravel (sandstone), humid		D, B	0.5		pp = 310-450kPa		
					0.7				
61	1			D	1.0				1
					1.2				
	1.4	SANDSTONE - very low to low strength, slightly weathered, orange brown fine to medium grained sandstone		D	1.5				
	1.7	Pit discontinued at 1.7m (refusal on medium strength sandstone)			1.7				
60	2								2
59	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 58
EASTING: 292091
NORTHING: 6172141
DIP/AZIMUTH: 90°/--

PIT No: 64
PROJECT No: 48742
DATE: 10 Nov 09
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)
58	0.2	TOPSOIL - brown silty clay with some rootlets, humid							
		GRAVELLY CLAY - very stiff to hard, orange brown mottled grey slightly sandy gravelly (sandstone, latite) clay with some cobbles (sandstone, latite), humid		D, B	0.5		pp > 600kPa		
					0.7				
57	1			D	1.0				1
					1.2				
	1.3	LATITE - very low strength, extremely weathered, orange, brown and grey latite							
	1.4	Pit discontinued at 1.4m (slow progress)							
56	2								2
55	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 18
EASTING: 292600
NORTHING: 6172347
DIP/AZIMUTH: 90°/--

PIT No: 65
PROJECT No: 48742
DATE: 10 Nov 09
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)
18		CLAY - firm, dark brown slightly sandy clay, moist							
				D	0.5		pp = 70-90kPa		
					0.7				
				U_{50}					
17	1				1.1			▽	1
	1.4	CLAY - firm to stiff, grey mottled orange slightly sandy clay with some gravel (sandstone, latite), moist		D	1.5		pp = 50-90kPa		
					1.7				
		- becoming stiff below 1.8m							
16	2								2
				D	2.5		pp = 110-150kPa		
					2.7				
15	3	3.0 Pit discontinued at 3.0m (limit of investigation)							3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: Groundwater seepage at 1.2m

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 18
EASTING: 293067
NORTHING: 6172340
DIP/AZIMUTH: 90°/--

PIT No: 66
PROJECT No: 48742
DATE: 10 Nov 09
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)
18	0.0	TOPSOIL - brown silty clay with some gravel (ironstone) and rootlets, humid							
	0.3	CLAY - very stiff to hard, grey brown slightly silty clay, humid		D	0.5		pp = 510-600kPa		
	0.7				0.6				
		CLAY - very stiff to hard, brown mottled orange clay with some sand and gravel (ironstone), humid		U_{50}					
17	1			D	1.0				1
					1.2				
				D	1.5				
					1.7				
16	2								2
				D	2.5				
					2.7				
15	3	3.0 Pit discontinued at 3.0m (limit of investigation)							3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 12
EASTING: 293786
NORTHING: 6172357
DIP/AZIMUTH: 90°/--

PIT No: 67
PROJECT No: 48742
DATE: 13 Nov 09
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)
12	0.0	TOPSOIL - brown silty clay with some rootlets		D	0.0				
	0.3	CLAYEY SAND - medium dense, brown clayey fine sand and silt		D, D, B	0.3 0.5 0.7				
11	1			D, D	1.0				1
	1.2	SANDY CLAY - very stiff to hard, brown mottled grey sandy clay		D, D	1.2 1.5 1.7		pp = 360-490kPa		
	1.8	SAND - loose, grey and brown medium to coarse sand with some silt and clay		D, D	2.0 2.2				
10	2			D	2.5				2
	2.7	SANDY CLAY - soft to firm, brown and grey sandy clay with some alluvial gravel, moist to wet		D, D	2.7 2.8		pp = 30-70kPa		
9	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293922
NORTHING: 6172347
DIP/AZIMUTH: 90°/--

PIT No: 68
PROJECT No: 48742
DATE: 10 Nov 09
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)
14		TOPSOIL - grey brown slightly silty clay with some roots and rootlets, humid							
	0.3	CLAY - very stiff, grey brown highly fissured silty clay with trace rootlets, humid (ALLUVIAL)		D, D	0.5 0.6				
	0.7	SILTY SAND - medium dense to dense, orange grey brown silty fine to medium sand, humid (ALLUVIAL)							
13	1			D, D	1.0 1.1				1
		- becoming slightly clayey below 1.8m		D, D	1.8 1.9				
12	2								2
		- becoming humid to damp below 2.4m		D, D	2.4 2.5				
	2.8	SANDY CLAY - stiff, red brown mottled light grey slightly sandy to sandy clay, damp (ALLUVIAL)		D, D	2.9		PP = 110-150kPa		
11	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 13
EASTING: 294051
NORTHING: 6172340
DIP/AZIMUTH: 90°/--

PIT No: 69
PROJECT No: 48742
DATE: 10 Nov 09
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)
13	0.0	TOPSOIL - brown grey slightly silty clay with some roots and rootlets, humid							
	0.3	CLAY - stiff to verys tiff, grey mottled brown highly fissured clay with some silt and trace rootlets, humid		D	0.5 0.6		pp = 580->600kPa		
12	1.0	SANDY SILT - medium dense, orange brown sandy silt, humid (ALLUVIAL)		D	1.0 1.1				1
				D	1.5 1.6				
11	2			D	2.0 2.1				2
	2.5	CLAY - firm to stiff, light to mid grey clay with some silt, damp (ALLUVIAL)		D	2.6 2.7		pp = 90-130kPa		
	2.8	SANDY CLAY - firm, grey mottled orange red brown slightly sandy to sandy clay, damp (ALLUVIAL)							
10	3			D	3.0		pp = 80-90kPa		3
	3.1	Pit discontinued at 3.1m (limit of investigation)							

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 28
EASTING: 293242
NORTHING: 6172285
DIP/AZIMUTH: 90°/--

PIT No: 70
PROJECT No: 48742
DATE: 09 Nov 09
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)
28		TOPSOIL - brown silty clay with some rootlets, humid							
	0.4	CLAY - stiff, dark brown mottled red slightly sandy clay with some gravel (sandstone), humid		D, B	0.5				
					0.7				
27	1			D	1.0		pp = 570->600kPa		1
					1.2				
				D	1.5		pp = 550-600kPa		
					1.7				
		- with some sand below 1.8m							
26	2								2
		- becoming very stiff to hard below 2.4m		D	2.5		pp = 590-600kPa		
					2.7				
25	3								3
	3.1	Pit discontinued at 3.1m (limit of investigation)							

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 26
EASTING: 293027
NORTHING: 6172584
DIP/AZIMUTH: 90°/--

PIT No: 71
PROJECT No: 48742
DATE: 09 Nov 09
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)
26	0.0	TOPSOIL - brown silty clay with some rootlets, humid							
		- trace ceramic fragments observed within topsoil							
	0.3	CLAY - stiff, brown mottled orange clay with trace sand, humid							
				D	0.5		pp = 350-390kPa		
					0.7				
25	1			D	1.0		pp = 550-600kPa		1
	1.2	CLAY - very stiff to hard, brown and grey slightly sandy clay with some gravel (latite), humid			1.2				
				D	1.5		pp = 380-500kPa		
	1.7	CLAY - very stiff to hard, brown mottled orange clay with some gravel (latite) and trace sand, humid			1.7				
24	2								2
		- gravel content increasing and becoming damp below 2.4m		D	2.5		pp = 400-600kPa		
					2.7				
23	3 3.0	Pit discontinued at 3.0m (limit of investigation)							3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 38
EASTING: 291795
NORTHING: 6172082
DIP/AZIMUTH: 90°/--

PIT No: 72
PROJECT No: 48742
DATE: 09 Nov 09
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)
38		TOPSOIL - brown silty clay with some rootlets, humid							
	0.3	CLAY - very stiff to hard, orange and grey clay with some sand and gravel (sandstone, latite), humid							
				D, B	0.5		pp = 450-540kPa		
					0.7				
37	1			D	1.0				1
					1.2				
				D	1.5				
					1.7				
36	2								2
				D	2.5				
					2.7				
35	3								3
	3.1	Pit discontinued at 3.1m (limit of investigation)							

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Metal rod, some plastic at surface

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 52
EASTING: 293219
NORTHING: 6173756
DIP/AZIMUTH: 90°/--

PIT No: 73
PROJECT No: 48742
DATE: 09 Nov 09
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)
52	0.4	TOPSOIL - brown silty clay with some rootlets, humid							
		CLAY - stiff to very stiff, grey mottled orange slightly sandy clay, humid		D	0.5		pp = 150-210kPa		
					0.7				
51	1			D	1.0		pp = 190-210kPa		1
	1.2	CLAY - very stiff to hard, yellow orange clay with some gravel (latite), humid			1.2				
				D	1.5		pp = 270-400kPa		
	1.8	Pit discontinued at 1.8m (refusal on high strength latite)			1.7				
50	2								2
49	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 40
EASTING: 291496
NORTHING: 6171446
DIP/AZIMUTH: 90°/--

PIT No: 74
PROJECT No: 48742
DATE: 10 Nov 09
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)
40	0.1	TOPSOIL - brown silty clay with some sand and rootlets, humid							
		GRAVELLY CLAY - stiff to very stiff, orange and grey gravelly (latite) clay with some sand, humid							
				D	0.5		pp = 170-290kPa		
					0.7				
		- gravel content increasing below 0.8m							
39	1			D	0.9				1
	1.1				1.0				
		Pit discontinued at 1.1m (refusal on medium strength latite)							
38	2								2
37	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 36
EASTING: 292541
NORTHING: 6172394
DIP/AZIMUTH: 90°/--

PIT No: 75
PROJECT No: 48742
DATE: 10 Nov 09
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)
36	0	TOPSOIL - brown silty clay with some rootlets, humid							
	0.3	CLAY - stiff to very stiff, brown mottled orange slightly gravelly (sandstone) clay, humid							
				U_{50}	0.5				
					0.7				
35	1			D	1.0		pp > 600kPa		1
	1.1	Pit discontinued at 1.1m (refusal on medium strength sandstone)			1.1				
34	2								2
33	3								3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293580
NORTHING: 6172204
DIP/AZIMUTH: 90°/--

PIT No: 76
PROJECT No: 48742
DATE: 10 Nov 09
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) 5 10 15 20
14		TOPSOIL - brown silty sand with some fine to medium gravel sized pockets of clay, roots and rootlets, humid to damp							
	0.3	SILTY SAND - medium dense, brown silty fine to medium sand with trace rootlets, humid to damp (ALLUVIUM)			0.5				
				B	0.6				
				D	0.7				
	0.8	SILTY CLAY - stiff, grey highly fissured silty clay, humid to damp (ALLUVIAL)							
13	1			Dx2	1.0				1
					1.1				
	1.4	SILTY SAND - brown silty fine to medium sand, humid (ALLUVIAL)			1.5				
				Dx2	1.6				
					1.9				
12	2			Dx2	2.0				2
		- becoming slightly clayey to clayey below 2.3m							
					2.5				
				Dx2	2.6				
					2.9				
11	3			Dx2	3.0				3
	3.0	Pit discontinued at 3.0m (limit of investigation)							

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293728
NORTHING: 6172157
DIP/AZIMUTH: 90°/--

PIT No: 77
PROJECT No: 48742
DATE: 10 Nov 09
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)
14		TOPSOIL - grey brown slightly silty clay with some roots and rootlets, humid							
	0.2	CLAY - stiff, grey mottled brown highly fissured slightly silty clay with trace rootlets, humid (ALLUVIAL)		D, D	0.5 0.6				
13	1			D, D	1.0 1.1		pp > 600kPa		1
				D, D	1.5 1.6		pp = 460->600kPa		
	1.9	CLAY - very stiff, light to mid grey mottled orange brown fissured clay with some silt, damp (ALLUVIAL)		D, D	2.0 2.1		pp = 320-480kPa		
12	2			D, D	2.4 2.5		pp = 260-280kPa		2
		- with some sand below 2.9m		D, D	2.9		pp = 260-410kPa		
11	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket
LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293945
NORTHING: 6172191
DIP/AZIMUTH: 90°/--

PIT No: 78
PROJECT No: 48742
DATE: 10 Nov 09
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)
14	0.0	TOPSOIL - grey brown fissured slightly silty clay with some roots and rootlets, humid							
	0.2	SILTY SAND - medium dense, orange brown silty sand, humid (ALLUVIAL)		D, D	0.5				
					0.6				
13	1 1.0			D, D	1.0				1
					1.1				
	1.5	GRAVELLY CLAY - very stiff, light to mid grey medium to coarse gravelly (sandstone, ironstone) clay, damp (COLLUVIUM)		D, D	1.6		pp = 270-360kPa		
					1.7				
12	2 2.0	CLAY - stiff to very stiff, light to mid grey clay with some gravel and trace sand, damp (RESIDUAL)		D, D	2.0		pp = 300-480kPa		2
					2.1				
				D, D	2.4		pp = 260-270kPa		
					2.5				
				D, D	2.9		pp = 170-220kPa		
11	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 12
EASTING: 294105
NORTHING: 6172187
DIP/AZIMUTH: 90°/--

PIT No: 79
PROJECT No: 48742
DATE: 10 Nov 09
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)
12		TOPSOIL - brown clayey silt with some roots and rootlets, humid							
	0.25	CLAY - very stiff, grey mottled brown friable silty clay with trace rootlets, humid (ALLUVIAL)		D	0.5		pp > 600kPa		
					0.6				
	0.8	CLAY - stiff to very stiff, grey mottled brown fissured clay, humid to damp (ALLUVIAL)		D	1.0		pp > 600kPa		
11	1				1.1				1
				D	1.4		pp = 450-570kPa		
		- becoming light grey mottled orange brown below 1.5m			1.5				
	1.8	SANDY CLAY - very stiff, orange red brown mottled light grey sandy clay with pockets of sand, humid to damp (ALLUVIAL)		D	1.9		pp = 390-550kPa		
10	2				2.0				2
				D	2.4		pp = 300-330kPa		
					2.5				
		- becoming stiff below 2.9m							
9	3								3
				D	3.1		pp = 130-170kPa		
	3.2	Pit discontinued at 3.2m (limit of investigation)			3.2				

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 294291
NORTHING: 6172189
DIP/AZIMUTH: 90°/--

PIT No: 80
PROJECT No: 48742
DATE: 10 Nov 09
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)
14	0.25	TOPSOIL - dark brown silty clay with some gravel (medium to coarse sandstone), roots and rootlets, humid to damp							
		CLAY - stiff, brown grey slightly silty gravelly (medium to coarse sandstone) clay with trace rootlets, damp (RESIDUAL SOIL)		D	0.5 0.6		pp = 70-150kPa		
13	0.9 1	TUFFACEOUS SANDSTONE - extremely low to very low strength, extremely to highly weathered, brown to orange brown fine grained tuffaceous sandstone with some low to medium strength gravel to cobble sized blocks		D	0.9 1.0				1
	1.3	Pit discontinued at 1.3m (very slow progress in low to medium strength sandstone)							
12	2								2
11	3								3

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

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293452
NORTHING: 6171987
DIP/AZIMUTH: 90°/--

PIT No: 81
PROJECT No: 48742
DATE: 10 Nov 09
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)
14	0.0	TOPSOIL - grey brown slightly sandy clay with some silt, roots and rootlets, humid to damp							
	0.3	CLAYEY SILTY SAND - medium dense, brown slightly clayey to clayey silty fine to medium sand with trace rootlets (ALLUVIAL)		D, D	0.5 0.6				
	0.8	SILTY SAND - loose to medium dense, orange brown slightly silty to silty sand, humid (ALLUVIAL)		D, D	1.0 1.1				
13	1			D, D	1.5 1.6				1
		- becoming slightly clayey below 1.5m							
12	2 2.0	SANDY CLAY - very stiff, orange red brown sandy clay with some silt, humid to damp (ALLUVIAL)		D, D	2.1 2.2		pp = 500->600kPa		2
				D, D	2.4 2.5		pp = 470->600kPa		
				D, D	2.9		pp = 260-320kPa		
11	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293552
NORTHING: 6172055
DIP/AZIMUTH: 90°/--

PIT No: 82
PROJECT No: 48742
DATE: 10 Nov 09
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)
14	0.0	TOPSOIL - brown slightly clayey to clayey fine to medium sand with some silt, roots and rootlets, humid to damp							
	0.3	SILTY SAND - medium dense, brown silty fine to medium sand with trace rootlets, humid (ALLUVIAL)		D, D	0.5 0.6				
	0.8	SILTY CLAY - very stiff, grey mottled brown fissured silty clay, humid to damp (ALLUVIAL)		D, D	1.0 1.1		pp > 600kPa		
13	1			D, D	1.5 1.6		pp = 420->600kPa		1
12	2			D, D	2.1 2.2		pp = 300kPa		2
				D, D	2.4 2.5		pp > 600kPa		
	2.8	SANDY CLAY - hard, grey mottled orange brown sandy clay, humid to damp (ALLUVIUM)		D, D	2.9		pp = 420-580kPa		
11	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 15
EASTING: 293742
NORTHING: 6172038
DIP/AZIMUTH: 90°/--

PIT No: 83
PROJECT No: 48742
DATE: 10 Nov 09
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)
15		TOPSOIL - mid to dark grey clay with some roots and rootlets, humid to damp							
	0.25	CLAY - very stiff, mid to dark grey heavily fissured slightly silty clay with trace rootlets, humid (ALLUVIAL)		D, D	0.5		pp = 230-530kPa		
					0.6				
14	1			D, D	1.0		pp = 570->600kPa		1
					1.1				
	1.4	CLAY - hard, grey mottled orange brown fissured clay, humid to damp (ALLUVIAL)		D, D	1.6		pp = 520-540kPa		
					1.7				
				D, D	1.9		pp = 470-530kPa		
13	2				2.0				2
				D, D	2.4		pp = 430-460kPa		
		- with some silt below 2.5m			2.5				
	2.8	SILTY CLAY - grey mottled red brown silty clay, humid to damp (ALLUVIAL)		D, D	2.9		pp = 220-270kPa		
12	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B - 450mm bucket

LOGGED: RJH

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 24
EASTING: 291670
NORTHING: 6171553
DIP/AZIMUTH: 90°/--

PIT No: 84
PROJECT No: 48742
DATE: 09 Nov 09
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)
24	0.0	TOPSOIL - brown silty clay with some rootlets, humid							
	0.3	SAND - medium dense, brown slightly clayey fine to medium grained sand, humid		D	0.5				
					0.7				
	0.9	CLAY - firm to stiff, grey mottled orange brown slightly sandy clay with trace gravel (sandstone), humid		D	1.0		pp = 70-120kPa		1
23	1				1.2				
				D	1.5		pp = 180-240kPa		
					1.7				
		- becoming very stiff below 1.8m							
22	2			D	2.0		pp = 310-370kPa		2
					2.2				
	2.6	SANDY CLAY - variable firm to very stiff, orange and grey sandy clay with some gravel (sandstone), humid		D	2.8		pp = 260-410kPa		
21	3	3.0 Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: -
EASTING: 292049
NORTHING: 6171685
DIP/AZIMUTH: 90°/--

PIT No: 85
PROJECT No: 48742
DATE: 13 Nov 09
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)
		TOPSOIL - brown silty clay with some rootlets, humid		A	0.0				
	0.3	SILTY CLAY - stiff, brown silty clay with some sand, humid			0.2				
				D, A	0.5		pp > 600kPa		
					0.7				
	0.9	CLAY - very stiff to hard, brown mottled orange clay with some gravel (sandstone, latite) and sand, humid							
1				D, A	1.0		pp > 600kPa		1
					1.2				
				D, A	1.5				
					1.7				
2		- becoming gravelly (sandstone, latite) clay and moist below 1.9m		A	2.0				2
					2.2				
				D, A	2.5				
	2.7	Pit discontinued at 2.7m (slow progress)			2.7				
3									3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: -
EASTING: 292079
NORTHING: 6171963
DIP/AZIMUTH: 90°/--

PIT No: 86
PROJECT No: 48742
DATE: 13 Nov 09
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)
		TOPSOIL - brown silty clay with some rootlets, humid		A	0.0				
	0.2	GRAVELLY CLAY - hard, brown red and black gravelly (latite, siltstone) clay, humid			0.2				
				A	0.5		pp > 600kPa		
				U_{50}	0.7				
					0.9				
	1			D	1.0				1
					1.2				
				D	1.5		pp > 600kPa		
					1.7				
	2								2
				D	2.4				
	2.6	Pit discontinued at 2.6m (limit of investigation)			2.6				
	3								3

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

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: A = Potential acid sulphate soil sample

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 27
EASTING: 291613
NORTHING: 6171977
DIP/AZIMUTH: 90°/--

PIT No: 87
PROJECT No: 48742
DATE: 09 Nov 09
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)
27		TOPSOIL - brown silty clay with some gravel (ironstone) and rootlets, humid							
	0.3	CLAY - very stiff to hard, orange brown clay with some sand and gravel (latite), humid			0.5		pp = 380-540kPa		
				D					
					0.7				
		- gravel content increasing below 0.8m							
26	1				1.0				1
				D					
					1.2				
	1.3	LATITE - very low to low strength, slightly weathered, black, red and grey latite			1.3				
				D					
	1.5	Pit discontinued at 1.5m (refusal on medium strength latite)			1.5				
25	2								2
24	3								3

5 10 15 20

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: 18
EASTING: 291459
NORTHING: 6171699
DIP/AZIMUTH: 90°/--

PIT No: 88
PROJECT No: 48742
DATE: 09 Nov 09
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)
18	0.0	TOPSOIL - brown silty clay with some sand and rootlets, humid							
	0.3	CLAY - very stiff, dark brown slightly sandy clay with some silt and gravel (ironstone), humid		D	0.5		pp = 450-550kPa		
				D	0.7				
	0.9	SAND - loose, brown fine to medium slightly clayey fine to medium grained sand with some gravel (ironstone), humid		D	1.0				
17	1			D	1.2				1
				D	1.5				
				D	1.7				
16	2			D	2.0				2
	2.2	SAND - loose, orange brown slightly clayey medium to coarse grained sand with some gravel (ironstone, sandstone), humid		D	2.2				
				D	2.8				
15	3	3.0 Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Delfin Lend Lease
PROJECT: Proposed Urban Development
LOCATION: Calderwood

SURFACE LEVEL: -
EASTING: 292888
NORTHING: 6172755
DIP/AZIMUTH: 90°/--

PIT No: 89
PROJECT No: 48742
DATE: 09 Nov 09
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)
		TOPSOIL - brown silty clay with some rootlets, humid							
	0.4	CLAY - stiff, grey mottled brown slightly sandy clay, humid		D	0.5		pp = 180-240kPa		
					0.7				
	1			D	1.0		pp = 300-380kPa		1
		- becoming very stiff below 1.2m			1.2				
				D	1.5		pp = 310-390kPa		
					1.7				
	2			D	2.0				2
		- extremely low strength sandstone band at 1.8-2.3m			2.2				
		- becoming gravelly (sandstone) clay below 2.6m							
				D	2.8		pp = 350-410kPa		
	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0				3

RIG: New Holland LB110B backhoe - 450mm bucket

LOGGED: AAW

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	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 16
EASTING: 293421
NORTHING: 6172019
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 48742
DATE: 02 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
16	0.15	TOPSOIL - dark brown clay with some roots and rootlets, humid							
		CLAY - firm, dark brown clay with some sand and silt with trace rootlets, humid to damp							
15	1			S	1.0		2,2,3 N = 5		1
					1.45				
14	2	- becoming soft to firm below 2.0m		S	2.0		2,2,2 N = 4		2
					2.45				
13	3	- becoming firm, grey mottled orange brown slightly sandy clay below 3.0m (ALLUVIUM)		S	3.0		2,3,4 N = 7		3
	3.5	SANDY CLAY - firm, grey mottled orange brown sandy clay, humid to damp (ALLUVIUM)			3.45				
12	4								4
					4.5		3,3,2 N = 5		
	4.7	SAND - very loose, orange brown fine to medium grained sand with some silt, humid (ALLUVIUM)		S					
11	5				4.95				5
10	6								6
	6.0	SANDY CLAY - very stiff, slightly gravelly (medium to coarse sandstone) sandy clay, wet (RESIDUAL SOIL)		S	6.0		7,9/110mm,- refusal		
		- becoming firm to stiff below 6.42m			6.24				
	6.72	TUFFACEOUS SANDSTONE - extremely low to very low strength, extremely to highly weathered, orange brown tuffaceous sandstone							
9	7	- becoming very low to low strength below 7.24m							7
8	8								8
	8.57	Bore discontinued at 8.57m (refusal on low to medium strength sandstone)							
7	9								9

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** RJH **CASING:** -

TYPE OF BORING: SFA (v-bit) to 7.24m, SFA (TC-bit) to 8.57m

WATER OBSERVATIONS: Free groundwater observed at 6.0m, at 6.2m after 30 minutes

REMARKS: No well installed

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 16
EASTING: 293324
NORTHING: 6172066
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 48742
DATE: 02 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
16	0.2	TOPSOIL - brown clay with some roots and rootlets, humid							backfill
		CLAY - firm, dark orange brown grey clay with trace sand and rootlets, humid to damp (ALLUVIUM)		S	1.0		2,2,3 N = 5		bentonite
15	1				1.45				
14	2			S	2.0		2,1,1 N = 2		
	2.1	SAND - very loose, orange brown fine to medium sand with some silt, humid (ALLUVIUM)			2.45				case
13	3	- becoming very loose to loose, fine to coarse grained sand with some silt and trace medium to coarse gravel (quartz) below 3.0m		S	3.0		2,2,3 N = 5		
					3.45				
12	4								
		- becoming loose below 4.5m		S	4.5		3,3,3 N = 6	▼	sand
11	5				4.95				
		- becoming medium dense below 5.15m							
10	6								
	6.0				6.0		3,16,- refusal		
	6.15	CLAYEY SAND - medium dense, orange brown to grey slightly gravelly (medium to coarse sandstone) clayey fine to coarse grained sand, damp (RESIDUAL SOIL)		S	6.3				
9	7	TUFFACEOUS SANDSTONE - extremely low to very low strength, extremely to highly weathered, orange brown tuffaceous sandstone							screen
8	8								
	8.27	- becoming very low to low strength below 8.20m							
		Bore discontinued at 8.27m (refusal on low to medium strength sandstone)							
7	9								

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** RJH **CASING:** -

TYPE OF BORING: SFA (v-bit) to 8.20m, SFA (TC-bit) to 8.27m

WATER OBSERVATIONS: Free groundwater observed at 6.0m

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 16
EASTING: 294590
NORTHING: 6174429
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 48742
DATE: 25 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
16	0	SILTY SAND - brown silty fine grained sand, humid							bentonite
15	1								
	1.6	CLAY - stiff to very stiff, dark grey clay with some silt, humid							case
14	2								
13	3	- becoming damp to moist						▼	sand
12	4	4.0 SILTY CLAY - stiff, light grey silty clay, moist to wet							
		- saturated							
11	5								screen
10	6								
	6.4								
	6.48	SILTSTONE							
		Bore discontinued at 6.48m (TC-bit refusal)							
9	7								
8	8								
7	9								

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: Free groundwater observed at 4.5m

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 16
EASTING: 293216
NORTHING: 6173922
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 48742
DATE: 25 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
16	0.1	TOPSOIL - brown silt topsoil							
		CLAY - firm, brown clay with some roots and trace gravel							
	0.7	SILTSTONE - extremely low strength, moderately weathered, light grey siltstone							
15	1								1
14	2	- becoming dark grey							2
		- becoming light grey							
13	3	3.0 Bore discontinued at 3.0m (slow progress in shale)							3
12	4								4
11	5								5
10	6								6
9	7								7
8	8								8
7	9								9

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: No free groundwater observed

REMARKS: No well installed due to dry conditions and shallow rock.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 14
EASTING: 293220
NORTHING: 6174104
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 48742
DATE: 25 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
14	0	TOPSOIL - brown clayey silt with some rootlets							case
	0.3	SILTY CLAY - dark brown silty clay, humid							backfill
		- with some gravel							
13	1								bentonite
	1.1	SILTY SAND - light brown/yellow silty sand with some sandstone gravel, humid							
12	2								
	2.0	SILTY SANDY CLAY - light brown silty sandy clay with some sandstone gravel, damp							
	2.6	CLAY - light grey clay with trace silt, damp to moist							
11	3							▼	sand
		- becoming yellow with a trace of fine sand, damp							screen
10	4								
	4.0	CLAY - yellow brown clay with some sand and quartz gravel, wet							
9	5								
	5.0	SILTSTONE - low strength, extremely weathered siltstone							
	5.48	Bore discontinued at 5.48m (slow progress in siltstone)							
8	6								
7	7								
6	8								
5	9								

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 10
EASTING: 294387
NORTHING: 6173297
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 48742
DATE: 25 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
10	0	TOPSOIL - brown clay and silt with some rootlets							
	0.4	CLAY - very stiff, dark grey clay, humid							
9	1								1
	1.1	CLAY - very stiff, brown clay, damp							
8	2								2 backfill
		- becoming moist						▼	case
7	3								3
	3.4	SILTY CLAY - firm, yellow brown silty clay, moist							
6	4								4
									bentonite
5	5	- saturated							5
4	6	- with some fine grained sand							6 sand
3	7	- with some gravel							7 screen
2	8								8
	8.2	Bore discontinued at 8.2m (refusal on rock/gravel)							
1	9								9

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

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Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 10
EASTING: 294150
NORTHING: 6173129
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 48742
DATE: 25 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
10		TOPSOIL - brown silty clay topsoil with some rootlets							
	0.7	CLAY - stiff, brown clay, humid							backfill
9	1								
	1.6	CLAY - stiff, yellow brown clay, damp							bentonite
8	2	- with some silt and trace fine grained sand							
		- becoming moist						▼	case
7	3								
		- becoming saturated							
6	4								
									sand
5	5								
									screen
4	6								
3	7								
	7.7	Bore discontinued at 7.7m (target depth reached)							
2	8								
1	9								

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 19
EASTING: 292585
NORTHING: 6174410
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 48742
DATE: 26 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
19	0	TOPSOIL - brown clayey silt							backfill
	0.2	CLAYEY SILT - light grey clayey silt, humid							bentonite
	0.5	CLAY - firm, grey mottled yellow clay, damp							
18	1								case
17	2								
	2.3	CLAY - firm, brown clay, damp to moist						▼	
	2.7	CLAY - yellow brown clay with trace sand and gravel, moist							
16	3								sand
15	4	- sand content increasing, becoming saturated							screen
14	5	- gravel content increasing							
	5.5	SANDSTONE - low strength, extremely weathered sandstone							
	5.65	Bore discontinued at 5.65m (target depth reached)							
13	6								
12	7								
11	8								
10	9								

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: Free groundwater observed at 2.0m after installing piezometer

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 21
EASTING: 292990
NORTHING: 6172385
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 48742
DATE: 26 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
21	0.25	TOPSOIL - brown silty sandy clay topsoil							backfill
		CLAYEY GRAVEL - medium dense, 10mm sandstone gravel in a clay matrix, humid							case bentonite
20	1								
	1.8	GRAVELLY CLAY - brown sandstone gravelly clay with some sand, humid (weathered rock)							
19	2								sand
18	3							▼	screen
	3.9								
17	4	SANDSTONE							
	4.0	Bore discontinued at 4.0m (slow progress in weathered rock)							
16	5								
15	6								
14	7								
13	8								
12	9								

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 10
EASTING: 294108
NORTHING: 6172194
DIP/AZIMUTH: 90°/--

BORE No: 110
PROJECT No: 48742
DATE: 26 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
10		TOPSOIL - brown silty clay topsoil, humid							backfill
9	0.9 1	CLAY - stiff, dark grey clay, humid to damp							bentonite
	1.6	CLAY - stiff to very stiff, yellow brown mottled grey clay with some silt and trace sand, damp							case
8	2 2.2	SANDY CLAY - stiff, yellow brown sandy clay, damp to moist - gravel band							
7	3							▼	
6	4								
	4.6	CLAY - stiff, dark brown clay with some sand and silt, damp							
5	5	- becoming wet							sand
4	6	- gravel bands							screen
3	7								
2	8								
	8.4 8.5	SANDSTONE - extremely weathered, extremely low strength, sandstone							
1	9	Bore discontinued at 8.5m (slow progress in sandstone)							

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: Free groundwater observed at 1.4m after piezometer installation

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 13
EASTING: 293593
NORTHING: 6172311
DIP/AZIMUTH: 90°/--

BORE No: 111
PROJECT No: 48742
DATE: 25 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
13		SILT - loose, brown silt with trace sand, humid							
		- gravel bands (quartz)							
		- with some sand							
12	1	1.0 SAND - loose to medium dense, brown medium grained sand with some silt							
11	2								
10	3	3.3 SAND AND CLAY - fine grained sand and brown clay with trace fine gravel, moist to wet							
9	4	- becoming saturated							
8	5	- gravel bands							
		5.4							
		5.5 SANDSTONE - extremely weathered, extremely low strength sandstone							
		Bore discontinued at 5.5m							
7	6	(slow progress in sandstone)							
6	7								
5	8								
4	9								

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: No free groundwater observed

REMARKS: No well installed, gravel collapse at 1.5m and 3.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Delfin Lend Lease
PROJECT: Master Planning Geotechnical Study
LOCATION: Calderwood

SURFACE LEVEL: 12
EASTING: 293623
NORTHING: 6172339
DIP/AZIMUTH: 90°/--

BORE No: 112
PROJECT No: 48742
DATE: 26 Nov 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
12	0.0	TOPSOIL - loose, brown silt with trace sand, humid							backfill
	0.3	SAND - loose, brown medium grained sand with some silt							case
11	1								bentonite
10	2	- gravel bands							
9	3	- becoming wet							sand
8	4	- becoming saturated						▼	screen
7	5								
	5.5	Bore discontinued at 5.5m (target depth reached)							
6	6								
5	7								
4	8								
3	9								

RIG: Gemco 210B **DRILLER:** Paul Boers **LOGGED:** CCK **CASING:** -

TYPE OF BORING: 140mm SFA

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Water level dipped 4/12/09

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

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APPENDIX C

Laboratory Results

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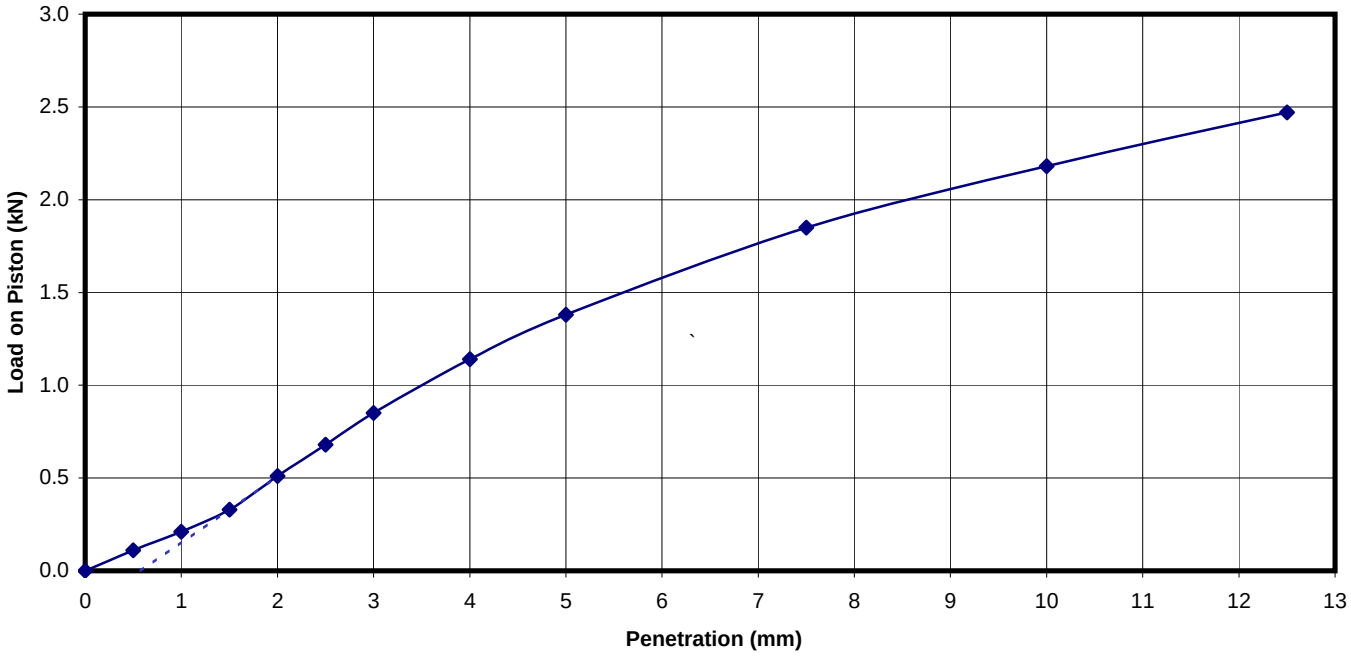
wollongong@douglaspartners.com.au

RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218N
Project :	Master Planning Geotech Study	**Report Date :**	4/12/2009
		Date Sampled :	9-13/11/2009
Location :	Calderwood	**Date of Test:**	30/11/2009
Test Location :	9		
Depth / Layer :	0.5 - 0.7m	**Page:**	1 of 1



Description: Brown silty clay

Test Method(s): AS 1289.6.1.1, AS 1289.2.1.1

Sampling Method(s): Sampled by Wollongong Engineering Department **Percentage > 19mm:** 0.0%

LEVEL OF COMPACTION: 100% of STD MDD **SURCHARGE:** 4.5 kg **SWELL:** 1.5%
MOISTURE RATIO: 100% of STD OMC **SOAKING PERIOD:** 4 days

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		24.4	1.49
After soaking		28.4	1.47
After test	Top 30mm of sample	30.5	-
	Remainder of sample	26.6	-
Field values		21.7	-
Standard Compaction		24.4	1.49

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**2.5 mm**	**7**
	5.0 mm	**8**

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ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory Number: 828
This Document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025

Approved Signatory:

Tested:	JB, TZ
Checked:	DE

David Evans
Laboratory Manager

Douglas Partners
Geotechnics · Environment · Groundwater

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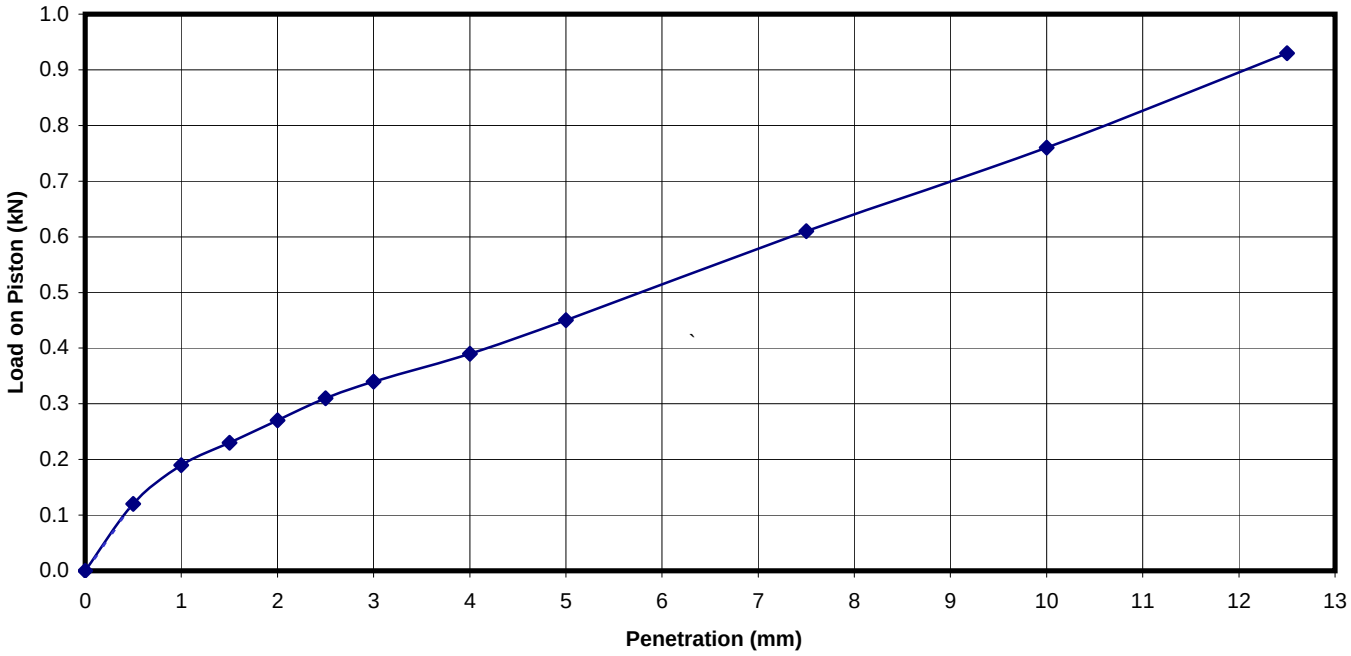
wollongong@douglaspartners.com.au

RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218O
Project :	Master Planning Geotech Study	**Report Date :**	4/12/2009
		Date Sampled :	9-13/11/2009
Location :	Calderwood	**Date of Test:**	30/11/2009
Test Location :	35		
Depth / Layer :	0.5 - 0.7m	**Page:**	1 of 1



Description: Light brown silty clay

Test Method(s): AS 1289.6.1.1, AS 1289.2.1.1

Sampling Method(s): Sampled by Wollongong Engineering Department **Percentage > 19mm:** 0.0%

LEVEL OF COMPACTION: 100% of STD MDD **SURCHARGE:** 4.5 kg **SWELL:** 3.3%
MOISTURE RATIO: 98% of STD OMC **SOAKING PERIOD:** 4 days

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		23.2	1.58
After soaking		26.8	1.53
After test	Top 30mm of sample	33.0	-
	Remainder of sample	24.2	-
Field values		21.2	-
Standard Compaction		23.6	1.57

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**2.5 mm**	**2.5**
	5.0 mm	**2.5**

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Approved Signatory:

Tested:	JB, TZ
Checked:	DE

David Evans
Laboratory Manager

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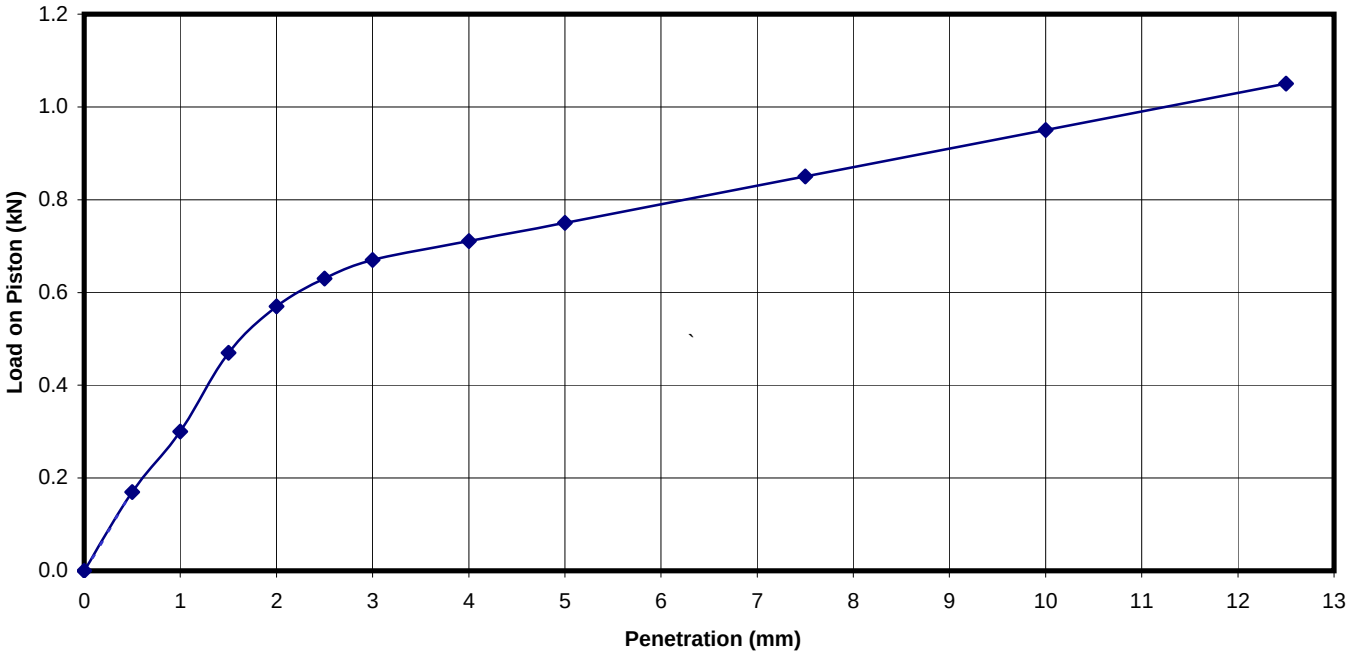
RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218P
Project :	Master Planning Geotech Study	**Report Date :**	4/12/2009
		Date Sampled :	9-13/11/2009
Location :	Calderwood	**Date of Test:**	30/11/2009
Test Location :	70		
Depth / Layer :	0.5 - 0.7m	**Page:**	1 of 1



Description: Brown silty clay

Test Method(s): AS 1289.6.1.1, AS 1289.2.1.1

Sampling Method(s): Sampled by Wollongong Engineering Department **Percentage > 19mm:** 0.0%

LEVEL OF COMPACTION: 101% of STD MDD **SURCHARGE:** 4.5 kg **SWELL:** 2.0%
MOISTURE RATIO: 98% of STD OMC **SOAKING PERIOD:** 4 days

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		36.2	1.30
After soaking		40.1	1.28
After test	Top 30mm of sample	42.1	-
	Remainder of sample	38.8	-
Field values		32.8	-
Standard Compaction		36.8	1.30

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**2.5 mm**	**5.0**
	5.0 mm	**4.0**

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Approved Signatory:

Tested:	JB, TZ
Checked:	DE

David Evans
Laboratory Manager

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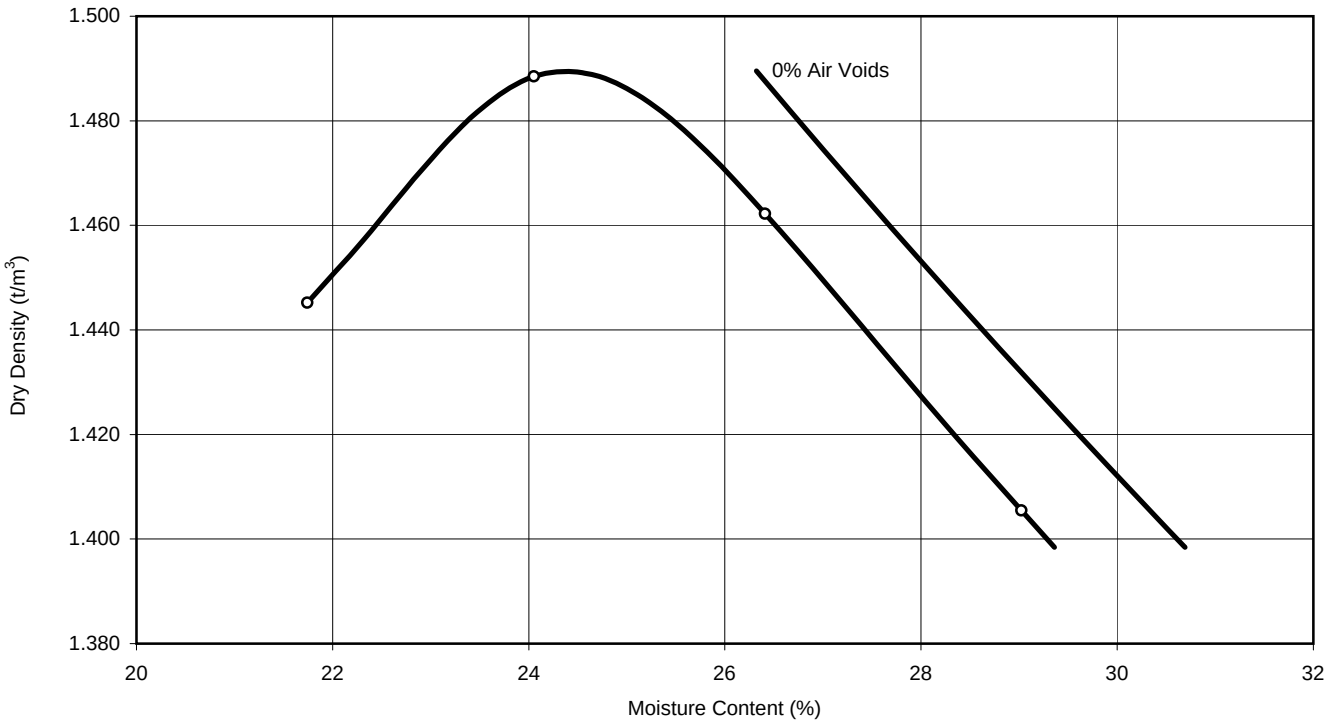
RESULTS OF COMPACTION TEST

Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218Q
Project :	Master Planning Geotech Study	**Report Date :**	4/12/2009
Location :	Calderwood	**Date of Test:**	23/11/2009
		Page:	1 of 1



Sample Details **Location:** 9
Depth: 0.5 - 0.7m

Particles > 19mm: 0%

Description: Brown silty clay

Maximum Dry Density:	**1.49 t/m^3**
Optimum Moisture Content:	**24.5 %**

Remarks: -

Test Methods: AS 1289.2.1.1, AS 1289. 5.1.1, AS 1289.5.2.1

Sampling Methods: Sampled by Wollongong Engineering Department

NATA Accredited Laboratory Number: 828
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Approved Signatory:

Tested:	JB
Checked:	DE

David Evans
Laboratory Manager

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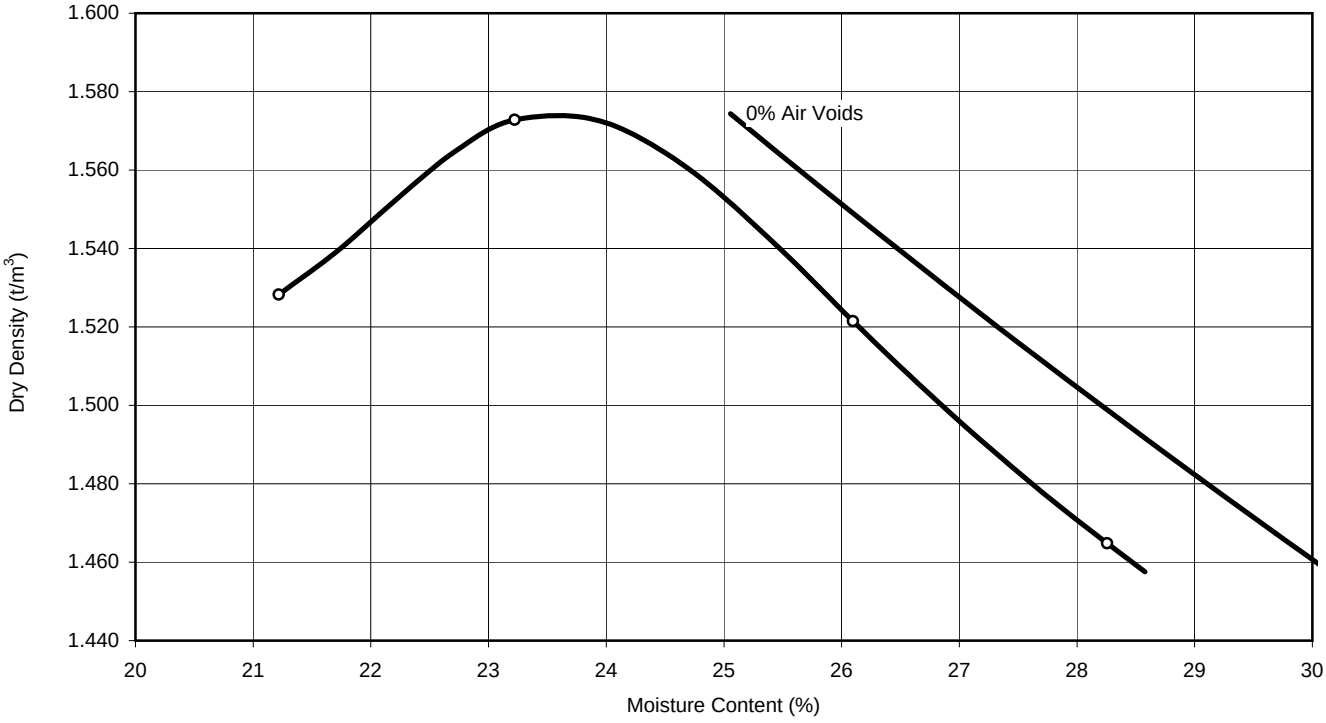
RESULTS OF COMPACTION TEST

Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218R
Project :	Master Planning Geotech Study	**Report Date :**	4/12/2009
Location :	Calderwood	**Date of Test:**	23/11/2009
		Page:	1 of 1



Sample Details **Location:** 35
Depth: 0.5 - 0.7m

Particles > 19mm: 0%

Description: Light brown silty clay

Maximum Dry Density:	**1.57 t/m^3**
Optimum Moisture Content:	**23.5 %**

Remarks: -

Test Methods: AS 1289.2.1.1, AS 1289. 5.1.1, AS 1289.5.2.1

Sampling Methods: Sampled by Wollongong Engineering Department

NATA Accredited Laboratory Number: 828
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Approved Signatory:

Tested:	JB
Checked:	DE

David Evans
Laboratory Manager

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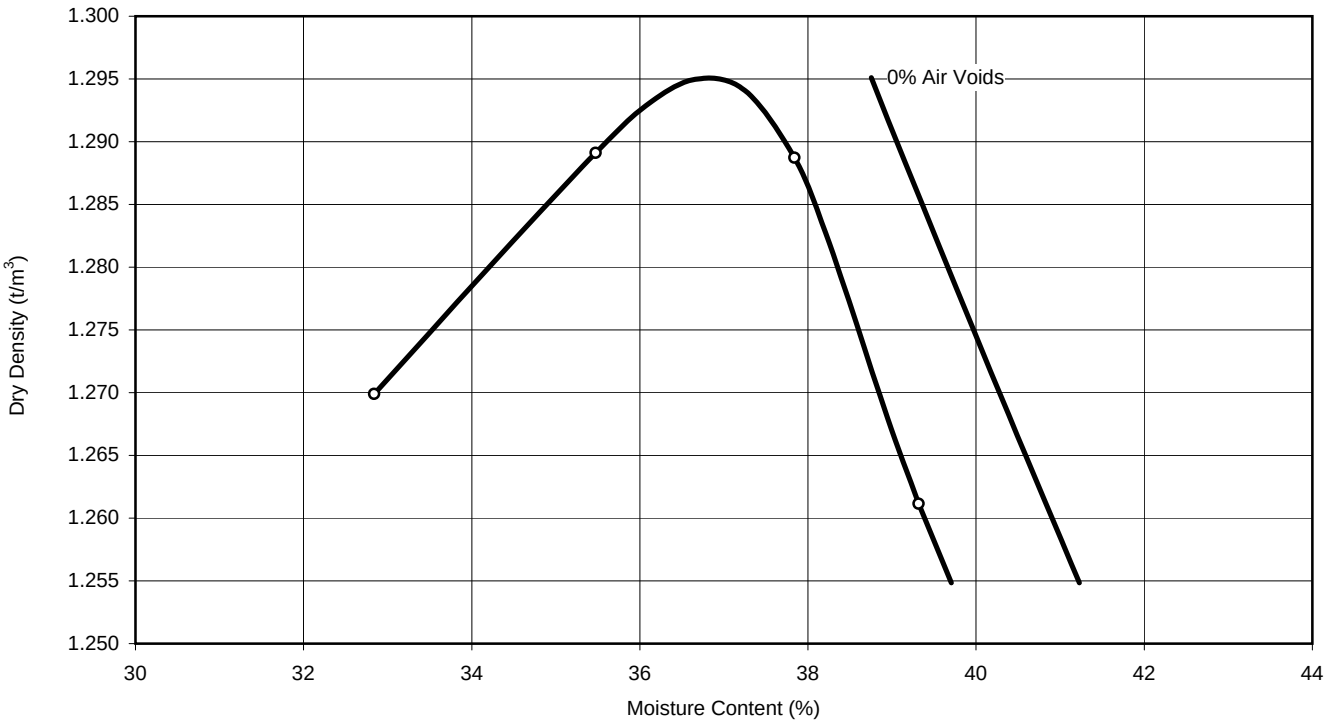
wollongong@douglaspartners.com.au

RESULTS OF COMPACTION TEST

Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218S
Project :	Master Planning Geotech Study	**Report Date :**	4/12/2009
Location :	Calderwood	**Date of Test:**	23/11/2009
		Page:	1 of 1



Sample Details **Location:** 70 **Particles > 19mm:** 0%
Depth: 0.5 - 0.7m

Description: Brown silty clay

Maximum Dry Density:	**1.30 t/m^3**
Optimum Moisture Content:	**37.0 %**

Remarks: -

Test Methods: AS 1289.2.1.1, AS 1289. 5.1.1, AS 1289.5.2.1

Sampling Methods: Sampled by Wollongong Engineering Department

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Approved Signatory:

Tested:	JB
Checked:	DE

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DETERMINATION OF EMERSON CLASS NUMBER OF SOIL

Client: **DELFIN LEND LEASE**

Project: Master Planning Geotech Study

Location: Calderwood

Project No: 48742
Report No: UL09-218A
Report Date: 3/12/2009

Date of Test: 23/11/2009
Page: 1 of 1

SAMPLE NO	DEPTH (m)	DESCRIPTION	WATER TYPE	WATER TEMP	CLASS NO.
39	0.9 - 1.0	Brown silty clay	Distilled	22°	4
40	0.5 - 0.6	Brown silty clay	Distilled	22°	4
47	0.4 - 0.6	Brown clay	Distilled	22°	4
22	0.5 - 0.6	Brown silty clay	Distilled	22°	4
31	0.5 - 0.7	Brown sandy silty clay	Distilled	22°	4
38	1.0 - 1.2	Brown clay	Distilled	22°	4
43	1.0 - 1.2	Brown silty clay	Distilled	22°	4
46	0.5 - 0.7	Brown clay	Distilled	22°	4
52	0.3 - 0.5	Brown gravelly silty clay	Distilled	22°	4
62	1.5 - 1.7	Brown gravelly silty clay	Distilled	22°	4
71	1.0 - 1.2	Brown silty clay	Distilled	22°	4
65	0.5 - 0.7	Dark brown gravelly silty sandy clay	Distilled	22°	4
88	0.5 - 0.7	Brown sandy clayey silt	Distilled	22°	4

Test Method(s): AS 1289 3.8.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

Approved Signatory:

NATA Accredited Laboratory Number: 828

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Checked: TZ

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RESULTS OF MOISTURE CONTENT TEST

Client:	DELFIN LEND LEASE	**Project No:**	48742
		Report No:	UL09-218T
Project:	Master Planning Geotech Study	**Report Date:**	4/12/2009
		Date Sampled:	9-13/11/2009
Location:	Calderwood	**Date of Test:**	20/11/2009
		Page:	1 of 2

TEST LOCATION	DEPTH (m)	DESCRIPTION	MOISTURE CONTENT (%)
40	0.5 - 0.6	Brown silty clay	28.0
41	1.0 - 1.1	Brown red grey silty clay	27.8
43	1.0 - 1.2	Brown silty clay	22.4
46	0.5 - 0.7	Brown clay	24.9
47	0.4 - 0.6	Brown clay	26.3
48	1.0 - 1.1	Brown red clay	22.1
52	0.3 - 0.5	Brown gravelly silty clay	19.6
53	0.5 - 0.7	Brown gravelly silty clay	21.5
55	2.0 - 2.2	Brown silty clay	29.3
58	1.0 - 1.2	Light brown silty clay	20.9
64	0.5 - 0.7	Light brown gravelly sandy clay	11.7
62	1.5 - 1.7	Brown gravelly silty clay	22.5
71	1.0 - 1.2	Brown silty clay	16.9
74	0.5 - 0.7	Brown gravelly silty clay	22.7
87	0.5 - 0.7	Orange brown silty clay	26.1
84	1.5 - 1.7	Brown gravelly silty clay	20.4
85	0.5 - 0.7	Brown clayey silt	16.4
3	1.0 - 1.2	Brown orange silty clay	31.8
14	2.4 - 2.5	Brown clayey silty sand	11.9
18	1.0 - 1.2	Light brown gravelly silty clay	17.1
89	0.5 - 0.7	Brown silty clay	34.6
6	1.0 - 1.1	Brown clayey silty sand	11.5
16	0.5 - 0.7	Brown orange grey sandy clay	17.3
23	0.9 - 1.0	Brown clay	37.1
30	1.0 - 1.2	Light brown silty clay	26.3
51	1.0 - 1.2	Brown clay	37.3
33	1.0 - 1.1	Brown clay	39.4
22	0.5 - 0.6	Brown silty clay	37.8
32	0.5 - 0.6	Brown silty clay	27.0
44	1.0 - 1.2	Brown clay	28.3
19	0.5 - 0.7	Brown clayey silt	17.7

Test Method(s): AS 1289.2.1.1, .2.1.2, .2.1.4, .2.1.5

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

NATA Accredited Laboratory Number: 828

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Approved Signatory:

Tested: TZ
Checked: TZ

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RESULTS OF MOISTURE CONTENT TEST

Client:	DELFIN LEND LEASE	**Project No:**	48742
		Report No:	UL09-218T
Project:	Master Planning Geotech Study	**Report Date:**	4/12/2009
		Date Sampled:	9-13/11/2009
Location:	Calderwood	**Date of Test:**	20/11/2009
		Page:	2 of 2

TEST LOCATION	DEPTH (m)	DESCRIPTION	MOISTURE CONTENT (%)
24	1.0 - 1.2	Brown silty clay	18.1
25	1.0 - 1.1	Orange brown silty clay	21.6
27	0.5 - 0.6	Brown sandy clay	12.9
28	1.0 - 1.2	Brown sandy silty clay	25.4
49	0.5 - 0.7	Brown silty clay	22.6
38	1.0 - 1.2	Brown clay	30.5
9	0.9 - 1.0	Brown silty clay	24.0

Test Method(s): AS 1289.2.1.1, .2.1.2, .2.1.4, .2.1.5

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

Approved Signatory:

Tested: TZ
Checked: TZ

Dave Evans
Laboratory Manager

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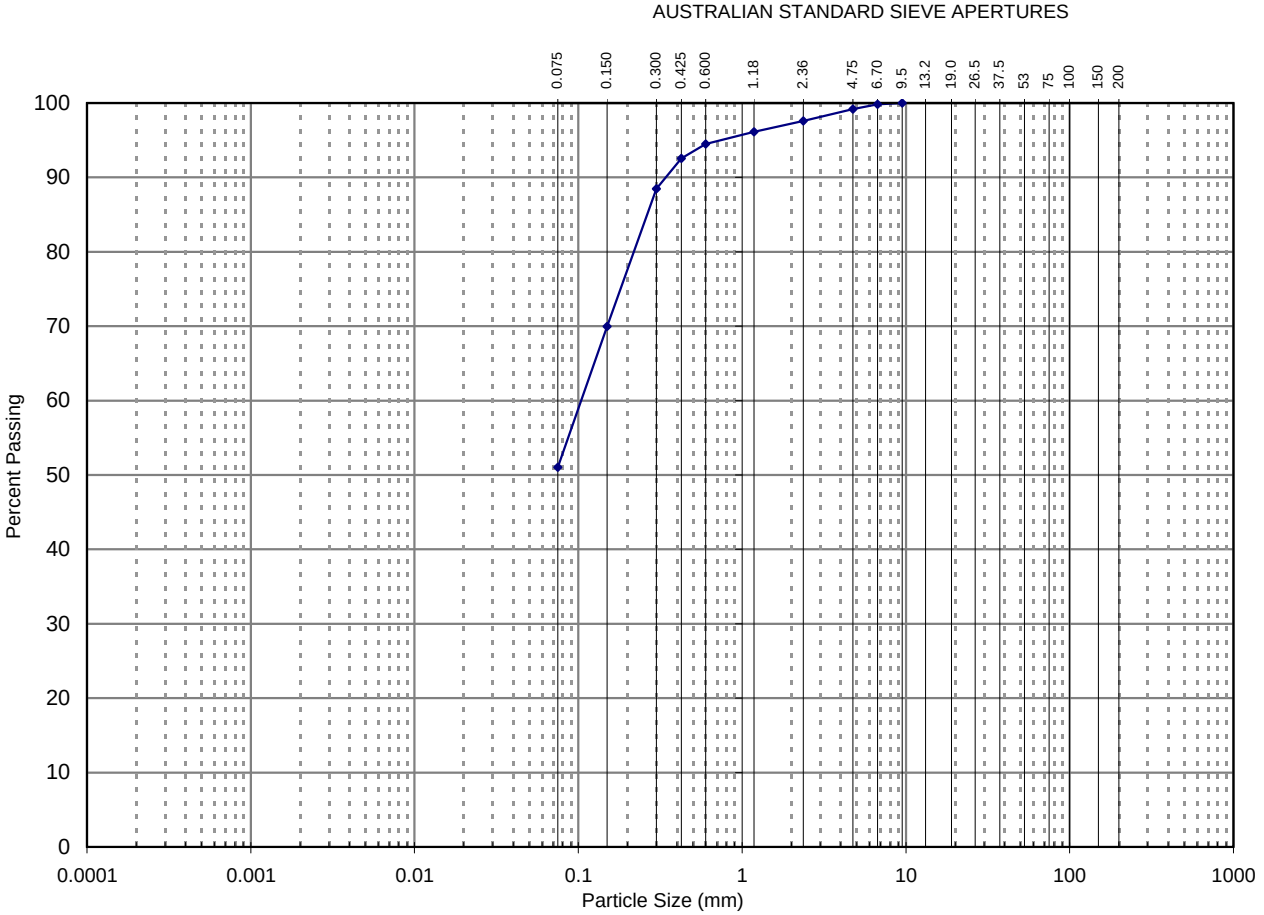
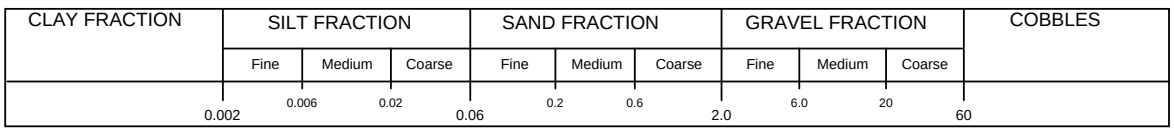
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	DELFIN LEND LEASE			**Project No. :**	48742
				Report No. :	UL09-218B
Project :	Master Geotech Study			**Report Date :**	03-Nov-09
				Date Sampled:	9-13-Nov-09
Location :	Calderwood			**Date of Test:**	23-Nov-09
Road No:	-	**Sample / Pit No:**	8	**Depth / Layer:**	1.0 - 1.1m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	-
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	**100%**
6.7	**100%**
4.75	**99%**
2.36	**98%**
1.18	**96%**
0.600	**95%**
0.425	**93%**
0.300	**88%**
0.150	**70%**
0.075	**51%**



Description: Brown silty sandy clay

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

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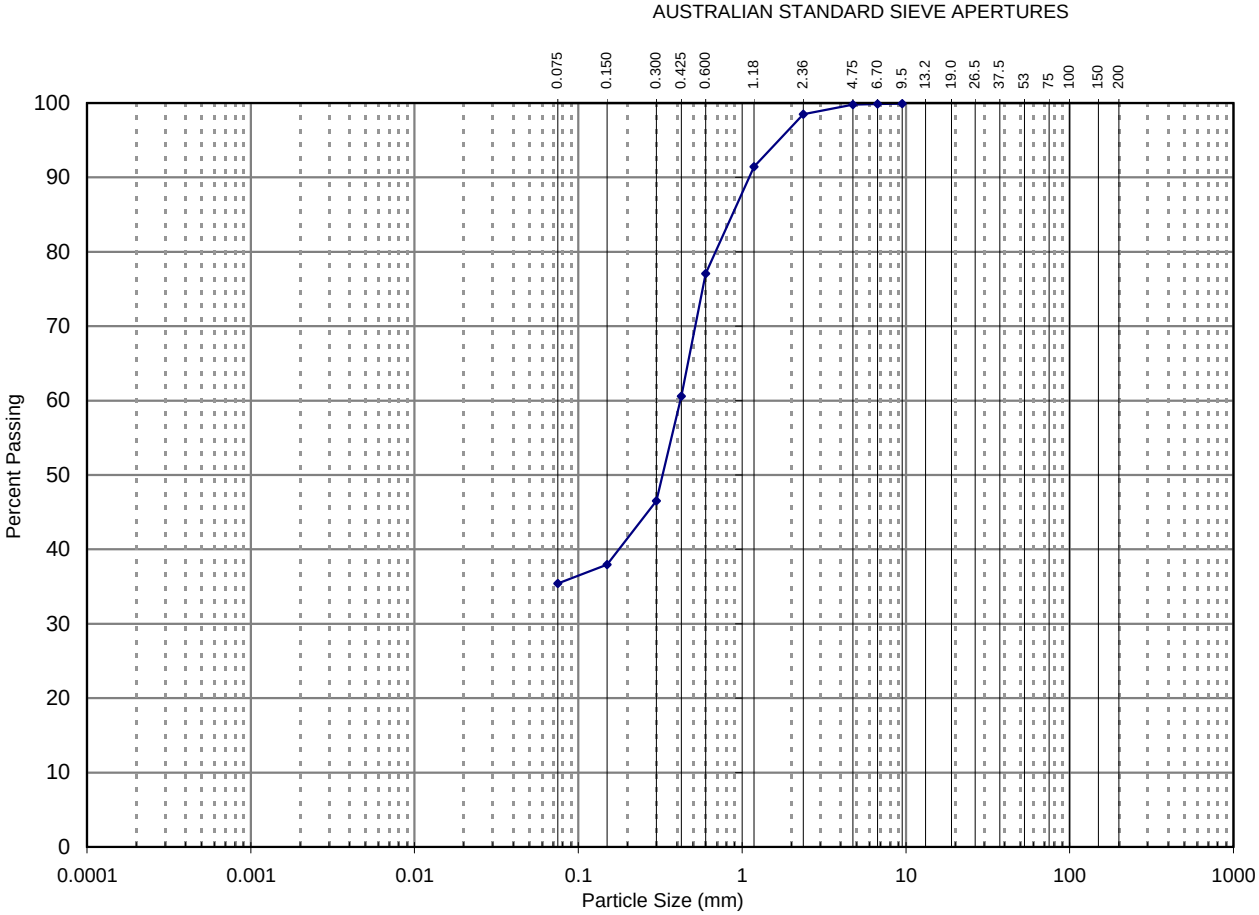
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	DELFIN LEND LEASE			**Project No. :**	48742
				Report No. :	UL09-218C
Project :	Master Geotech Study			**Report Date :**	03-Nov-09
				Date Sampled:	9-13-Nov-09
Location :	Calderwood			**Date of Test:**	23-Nov-09
Road No:	-	**Sample / Pit No:**	42	**Depth / Layer:**	1.0 - 1.1m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	-
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	**100%**
6.7	**100%**
4.75	**100%**
2.36	**98%**
1.18	**91%**
0.600	**77%**
0.425	**61%**
0.300	**47%**
0.150	**38%**
0.075	**35%**

Description: Orange brown silty clayey sand

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

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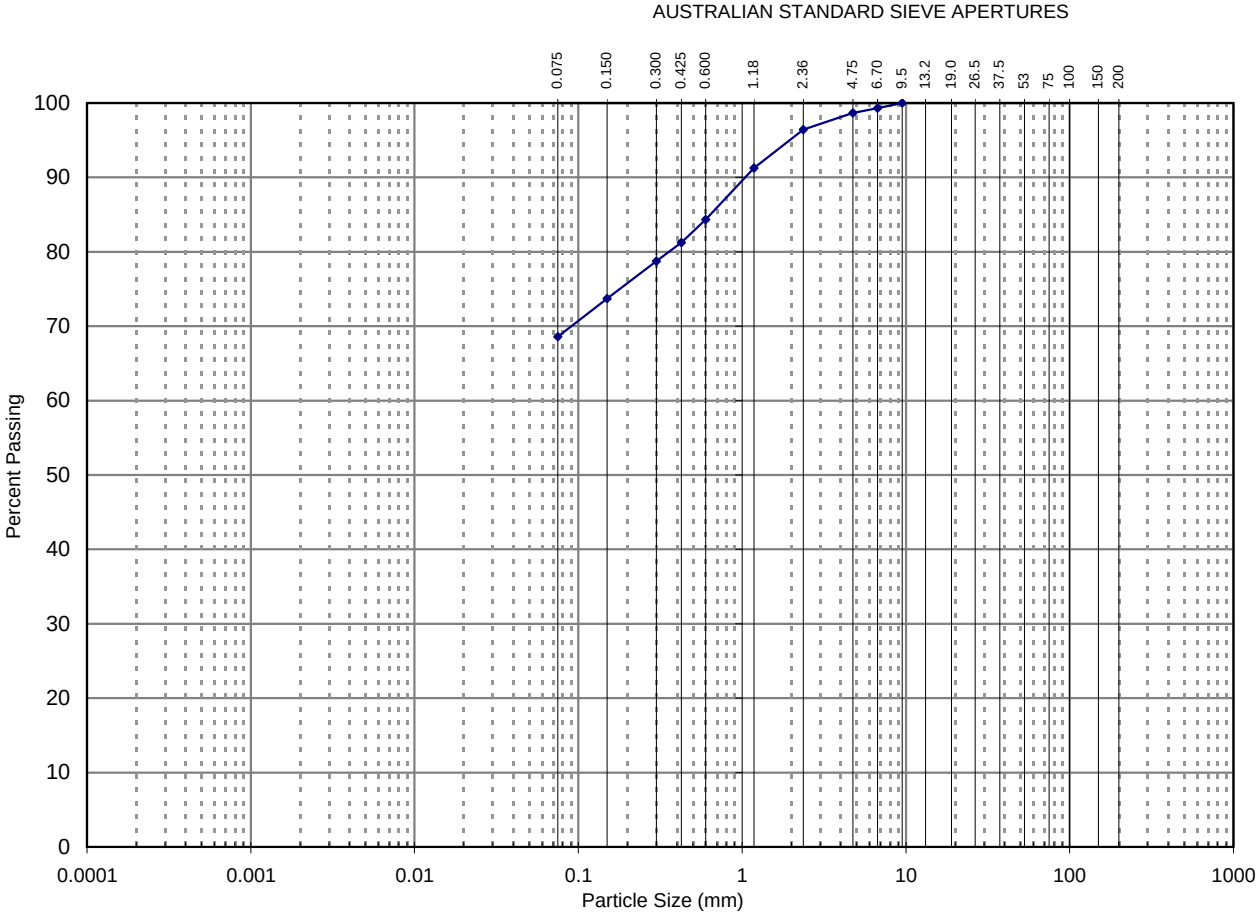
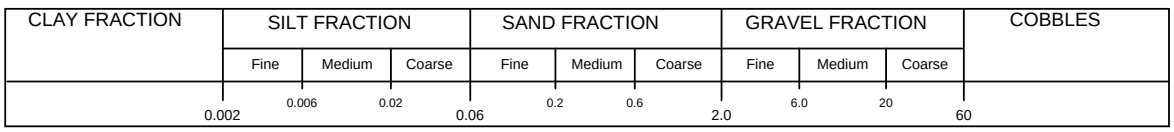
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	DELFIN LEND LEASE			**Project No. :**	48742
				Report No. :	UL09-218D
Project :	Master Geotech Study			**Report Date :**	03-Nov-09
				Date Sampled:	9-13-Nov-09
Location :	Calderwood			**Date of Test:**	23-Nov-09
Road No:	-	**Sample / Pit No:**	56	**Depth / Layer:**	0.5 - 0.7m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	-
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	**100%**
6.7	**99%**
4.75	**99%**
2.36	**96%**
1.18	**91%**
0.600	**84%**
0.425	**81%**
0.300	**79%**
0.150	**74%**
0.075	**69%**



Description: Brown sandy silty clay

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

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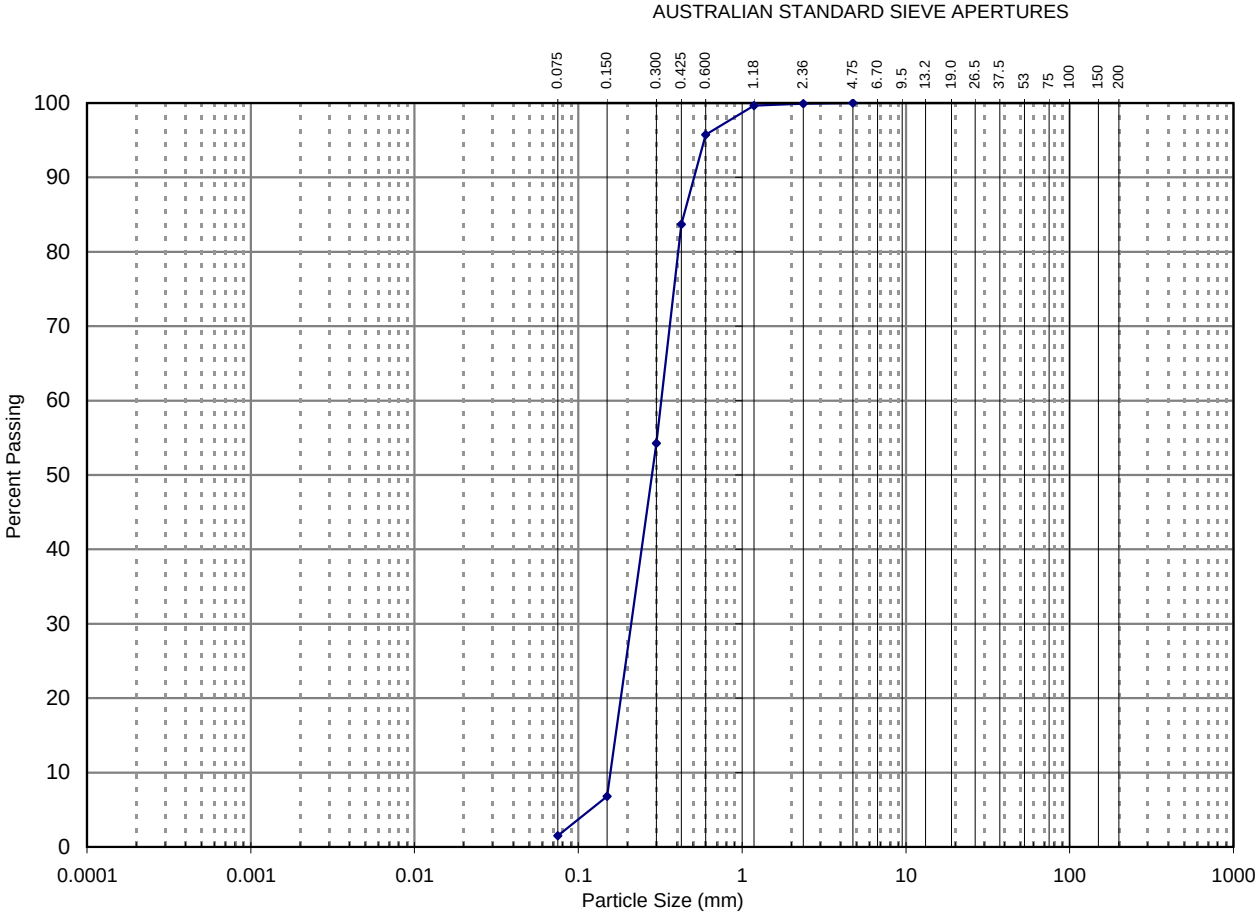
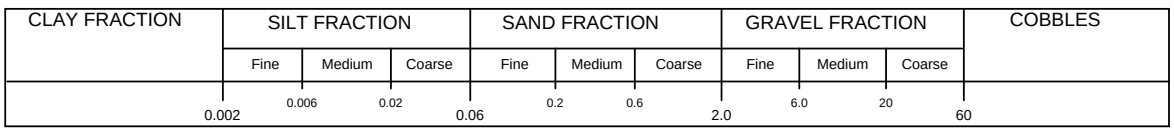
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	DELFIN LEND LEASE			**Project No. :**	48742
				Report No. :	UL09-218E
Project :	Master Geotech Study			**Report Date :**	03-Nov-09
				Date Sampled:	9-13-Nov-09
Location :	Calderwood			**Date of Test:**	23-Nov-09
Road No:	-	**Sample / Pit No:**	59	**Depth / Layer:**	0.5 - 0.7m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	-
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	**100%**
2.36	**100%**
1.18	**100%**
0.600	**96%**
0.425	**84%**
0.300	**54%**
0.150	**7%**
0.075	**2%**



Description: Brown sand

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

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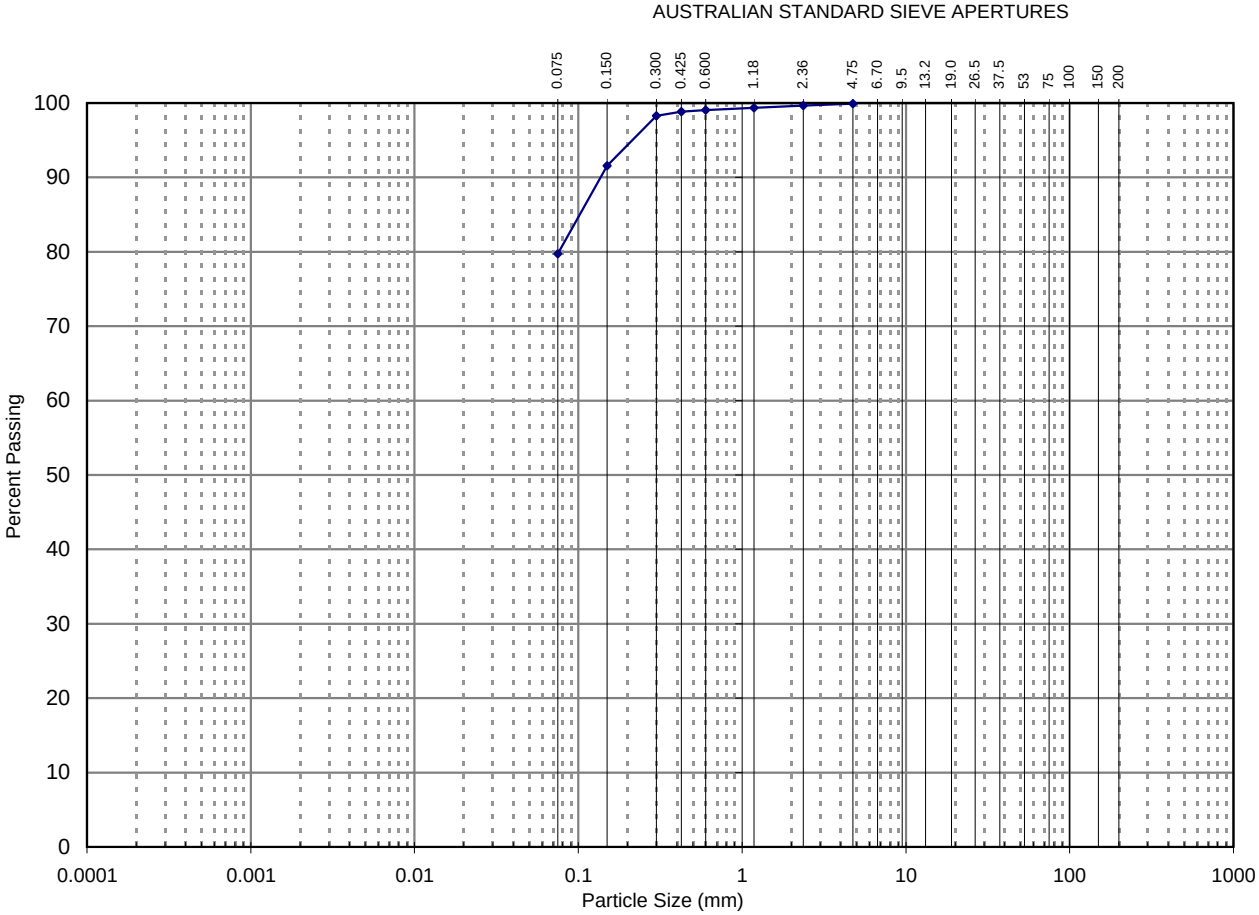
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	DELFIN LEND LEASE			**Project No. :**	48742
				Report No. :	UL09-218F
Project :	Master Geotech Study			**Report Date :**	03-Nov-09
				Date Sampled:	9-13-Nov-09
Location :	Calderwood			**Date of Test:**	23-Nov-09
Road No:	-	**Sample / Pit No:**	7	**Depth / Layer:**	0.9 - 1.0m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	-
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	**100%**
2.36	**100%**
1.18	**99%**
0.600	**99%**
0.425	**99%**
0.300	**98%**
0.150	**92%**
0.075	**80%**

Description: Orange brown sandy silty clay

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

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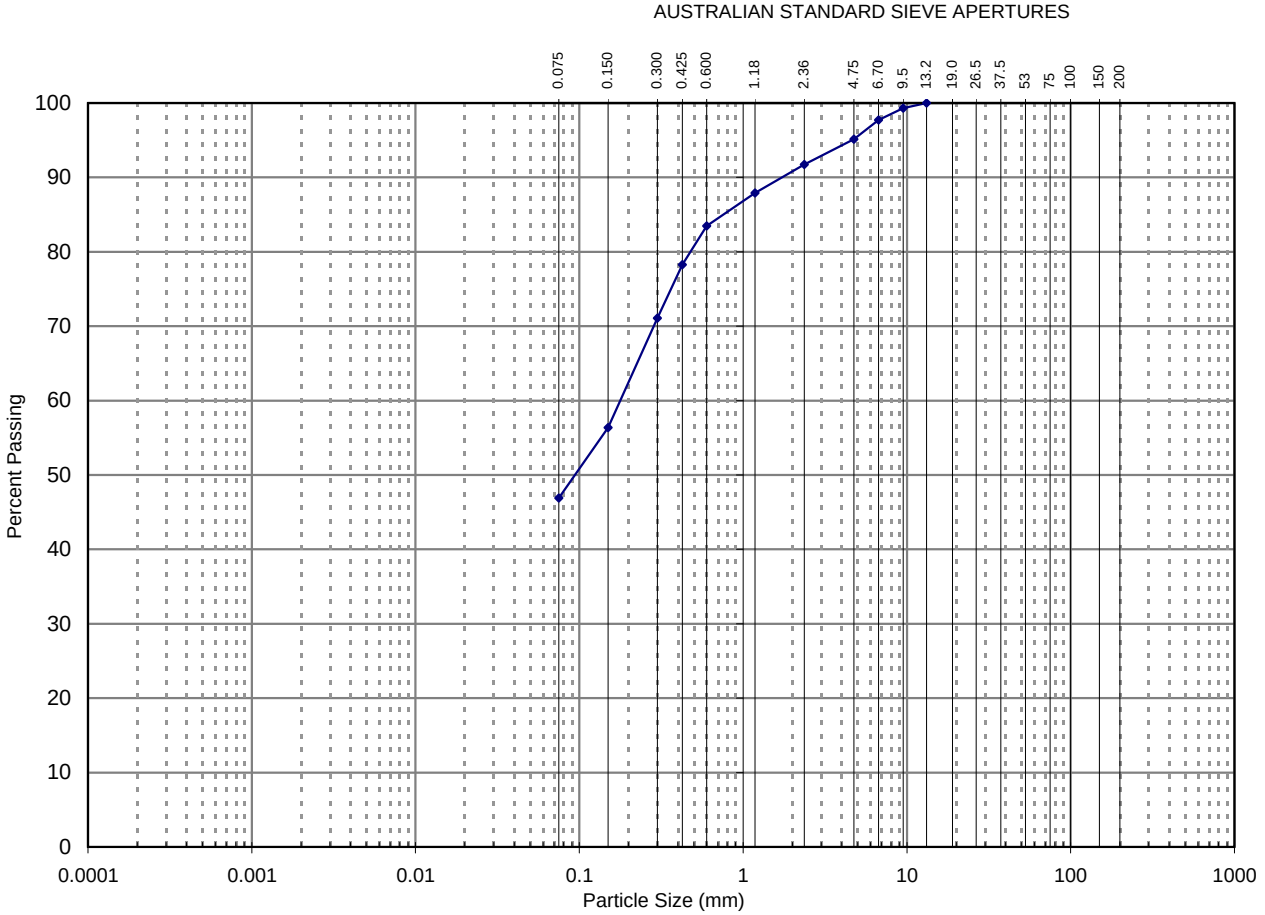
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	DELFIN LEND LEASE			**Project No. :**	48742
				Report No. :	UL09-218G
Project :	Master Geotech Study			**Report Date :**	03-Nov-09
				Date Sampled:	9-13-Nov-09
Location :	Calderwood			**Date of Test:**	23-Nov-09
Road No:	-	**Sample / Pit No:**	15	**Depth / Layer:**	1.0 - 1.1m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	-
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	**100%**
9.5	**99%**
6.7	**98%**
4.75	**95%**
2.36	**92%**
1.18	**88%**
0.600	**83%**
0.425	**78%**
0.300	**71%**
0.150	**56%**
0.075	**47%**

Description: Brown gravelly silty clayey sand

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

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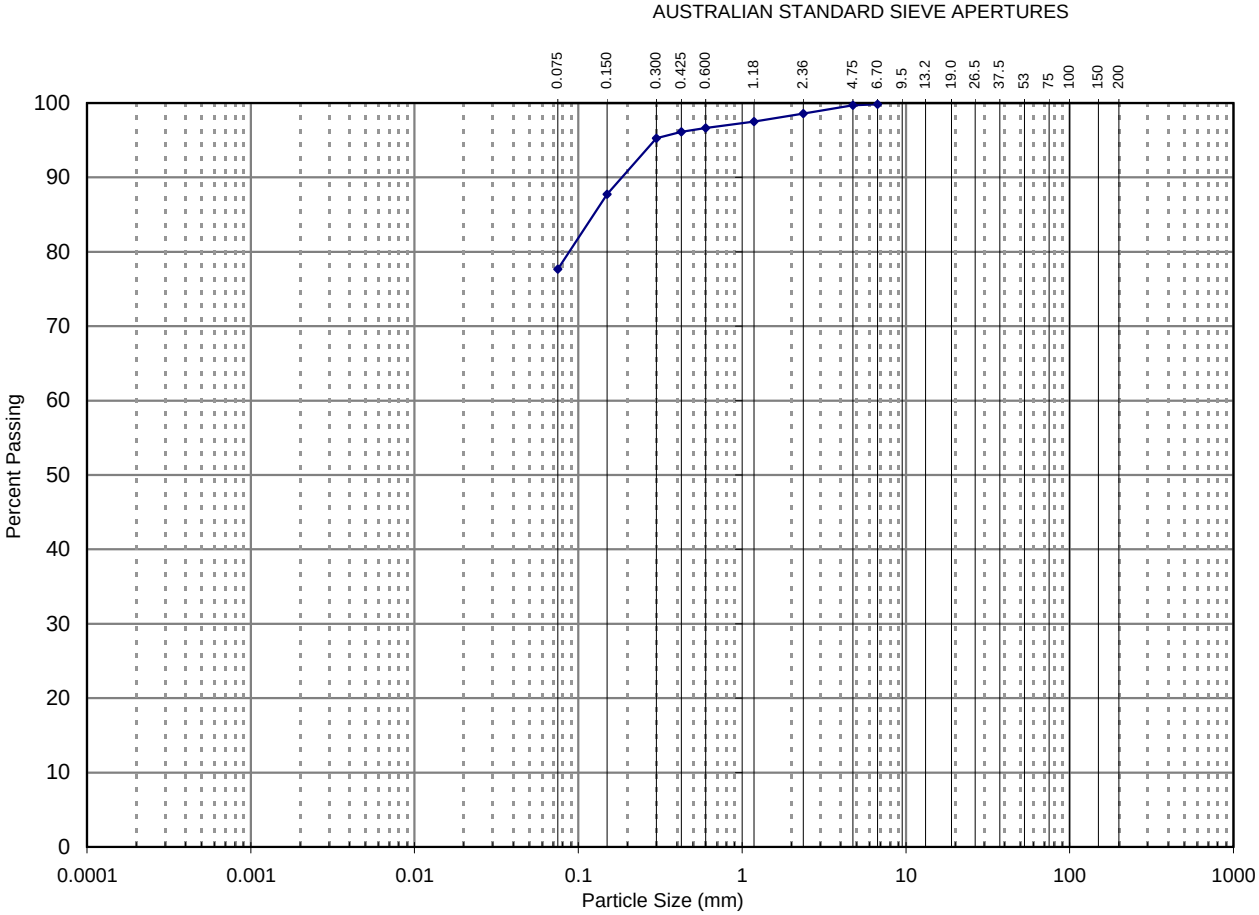
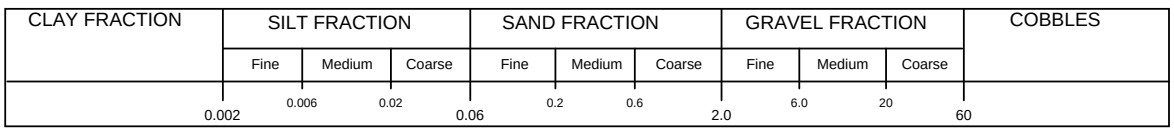
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	DELFIN LEND LEASE			**Project No. :**	48742
				Report No. :	UL09-218H
Project :	Master Geotech Study			**Report Date :**	03-Nov-09
				Date Sampled:	9-13-Nov-09
Location :	Calderwood			**Date of Test:**	23-Nov-09
Road No:	-	**Sample / Pit No:**	31	**Depth / Layer:**	0.5 - 0.7m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	-
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	**100%**
4.75	**100%**
2.36	**99%**
1.18	**98%**
0.600	**97%**
0.425	**96%**
0.300	**95%**
0.150	**88%**
0.075	**78%**



Description: Brown sandy silty clay

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

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RESULTS OF MOISTURE CONTENT, PLASTICITY AND LINEAR SHRINKAGE TESTS

Client: **DELFIN LEND LEASE**

Project: Master Planning Geotech Study

Location: Calderwood

Project No: 48742
Report No: UL09-218U
Report Date: 9/12/2009

Date Sampled: 9-13/11/2009
Date of Test: 7/12/2009
Page: 1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	CODE	W_F %	W_L %	W_P %	PI %	*LS %
32	0.5 - 0.6	Brown silty clay	2,3,5	27.0	62	25	37	16.5
33	1.0 - 1.1	Brown clay	2,3,5	39.4	97	35	62	22.0
23	0.9 - 1.0	Brown clay	2,3,5	37.1	90	35	55	21.5
30	1.0 - 1.2	Light brown silty clay	2,3,5	26.3	67	23	44	15.0
44	1.0 - 1.2	Brown clay	2,3,5	28.3	96	30	66	16.5
51	1.0 - 1.2	Brown clay	2,3,5	37.3	102	33	69	20

Legend:
W_F Field Moisture Content
W_L Liquid limit
W_P Plastic limit
PI Plasticity index
LS Linear shrinkage from liquid limit condition (Mould length 125mm)

Test Methods:
Moisture Content: AS 1289 2.1.1
Liquid Limit: AS 1289 3.1.2
Plastic Limit: AS 1289 3.2.1
Plasticity Index: AS 1289 3.3.1
Linear Shrinkage: AS 1289 3.4.1

Code
Sample history for plasticity tests
1. Air dried
2. Low temperature (<50ºC) oven dried
3. Oven (105ºC) dried
4. Unknown

Method of preparation for plasticity tests
5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

NATA Accredited Laboratory Number: 828

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Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR TECHNICAL COMPETENCE

Approved Signatory:

Tested: TZ, JR
Checked: DE

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RESULT OF SHRINK-SWELL INDEX DETERMINATION

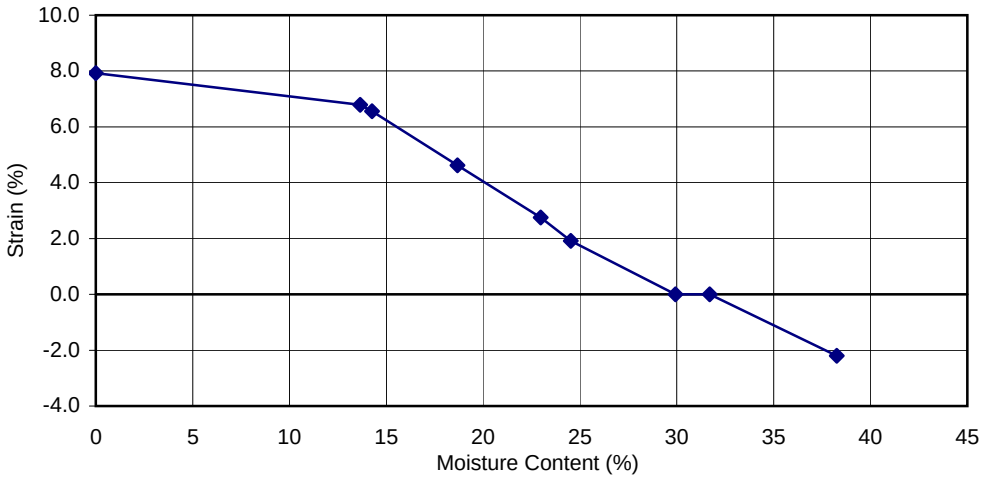
Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218K
Project :	Master Planning Geotech Study	**Report Date :**	3/12/2009
		Date Sampled :	9-13/11/2009
Location :	Calderwood	**Date of Test:**	23/11/2009
Test Location :	28		
Depth / Layer :	0.4 - 0.8m	**Page:**	1 of 1

CORE SHRINKAGE TEST

Shrinkage - air dried	6.8 %
Shrinkage - oven dried	7.9 %
Significant inert inclusions	0.0 %
Extent of cracking	HC
Extent of soil crumbling	0.0 %
Moisture content of core	31.7 %

SWELL TEST

Pocket penetrometer reading at initial moisture content	200 kPa
Pocket penetrometer reading at final moisture content	130 kPa
Initial Moisture Content	34.1 %
Final Moisture Content	38.3 %
Swell under 25kPa	2.2 %



SHRINK-SWELL INDEX Iss 5.0% per Δ pF

Description: Brown silty clay

Test Method(s): AS 1289.7.1.1, AS 1289.2.1.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Extent of Cracking:
UC - Uncracked
SC - Slightly cracked
MC - Moderately cracked
HC - Highly cracked
FR - Fractured

Remarks: -

Note that NATA accreditation does not cover the performance of pocket penetrometer readings

NATA Accredited Laboratory Number: 828
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Approved Signatory:

Tested:	TZ
Checked:	TZ

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RESULT OF SHRINK-SWELL INDEX DETERMINATION

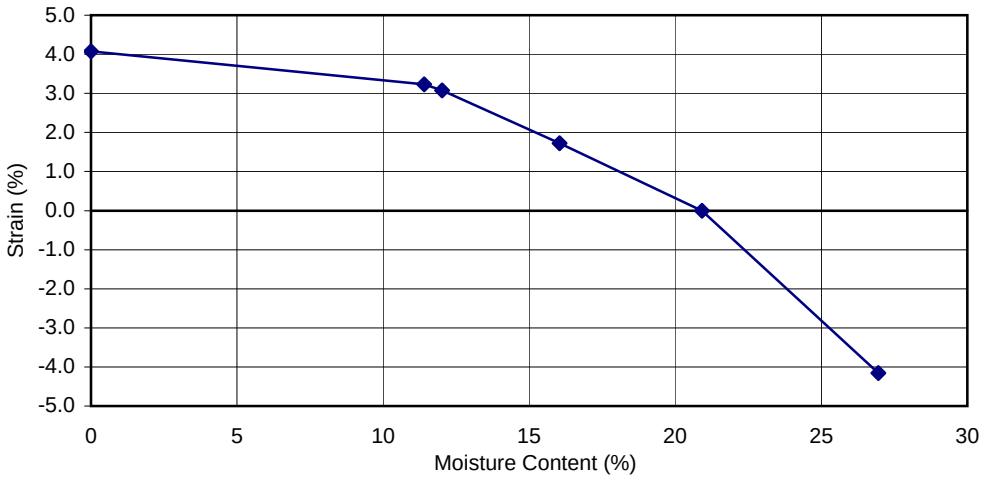
Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218L
Project :	Master Planning Geotech Study	**Report Date :**	3/12/2009
		Date Sampled :	9-13/11/2009
Location :	Calderwood	**Date of Test:**	23/11/2009
Test Location :	45		
Depth / Layer :	0.5 - 0.9m	**Page:**	1 of 1

CORE SHRINKAGE TEST

Shrinkage - air dried	3.2 %
Shrinkage - oven dried	4.1 %
Significant inert inclusions	3.0 %
Extent of cracking	SC
Extent of soil crumbling	0.0 %
Moisture content of core	20.9 %

SWELL TEST

Pocket penetrometer reading at initial moisture content	600 kPa
Pocket penetrometer reading at final moisture content	300 kPa
Initial Moisture Content	21.6 %
Final Moisture Content	27.0 %
Swell under 25kPa	4.2 %



SHRINK-SWELL INDEX Iss 3.4% per Δ pF

Description: Orange grey brown silty clay

Test Method(s): AS 1289.7.1.1, AS 1289.2.1.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Extent of Cracking:
UC - Uncracked
SC - Slightly cracked
MC - Moderately cracked
HC - Highly cracked
FR - Fractured

Remarks: -

Note that NATA accreditation does not cover the performance of pocket penetrometer readings

NATA ACCREDITED FOR TECHNICAL

NATA Accredited Laboratory Number: 828
This Document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025

Approved Signatory:

Tested:	TZ
Checked:	TZ

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RESULT OF SHRINK-SWELL INDEX DETERMINATION

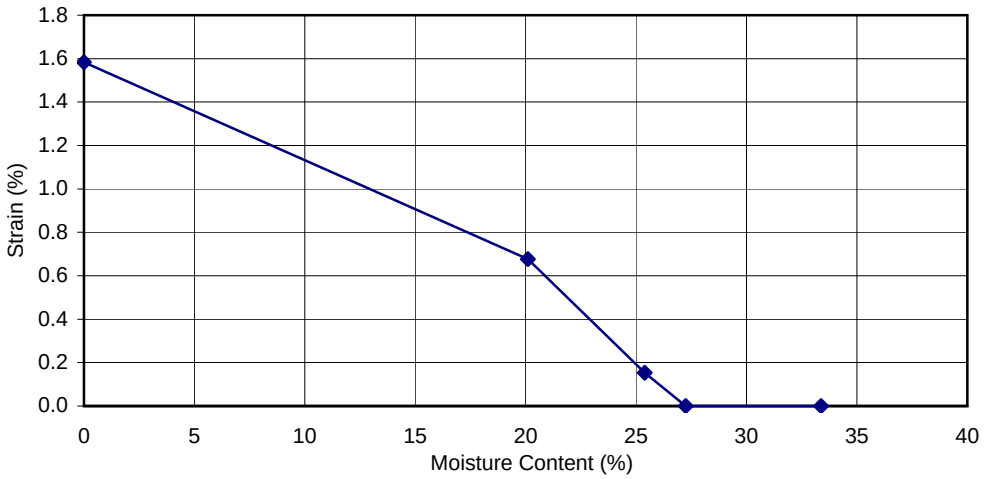
Client :	DELFIN LEND LEASE	**Project No. :**	48742
		Report No. :	UL09-218M
Project :	Master Planning Geotech Study	**Report Date :**	3/12/2009
		Date Sampled :	9-13/11/2009
Location :	Calderwood	**Date of Test:**	23/11/2009
Test Location :	65		
Depth / Layer :	0.7 - 1.1m	**Page:**	1 of 1

CORE SHRINKAGE TEST

Shrinkage - air dried	0.7 %
Shrinkage - oven dried	1.6 %
Significant inert inclusions	3.0 %
Extent of cracking	MC
Extent of soil crumbling	1.0 %
Moisture content of core	27.2 %

SWELL TEST

Pocket penetrometer reading at initial moisture content	70 kPa
Pocket penetrometer reading at final moisture content	80 kPa
Initial Moisture Content	32.2 %
Final Moisture Content	33.4 %
Swell under 25kPa	0.0 %



SHRINK-SWELL INDEX Iss 0.9% per Δ pF

Description: Dark brown silty sandy clay

Test Method(s): AS 1289.7.1.1, AS 1289.2.1.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Extent of Cracking:
UC - Uncracked
SC - Slightly cracked
MC - Moderately cracked
HC - Highly cracked
FR - Fractured

Remarks: -

Note that NATA accreditation does not cover the performance of pocket penetrometer readings

NATA Accredited Laboratory Number: 828
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Approved Signatory:

Tested:	TZ
Checked:	TZ

Dave Evans
Laboratory Manager

APPENDIX D

CSIRO Publication
Extracts from Australian Geomechanics Society

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

BTF 18
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- **Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.**
- **Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.**

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

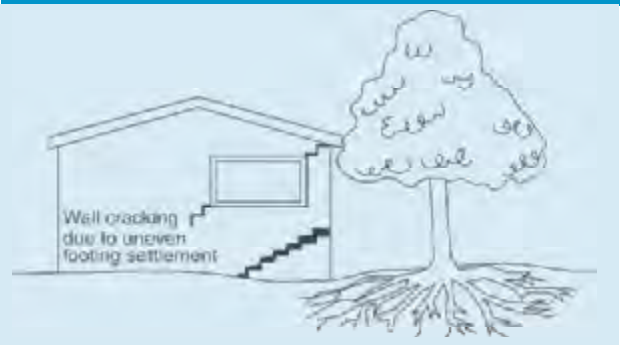
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

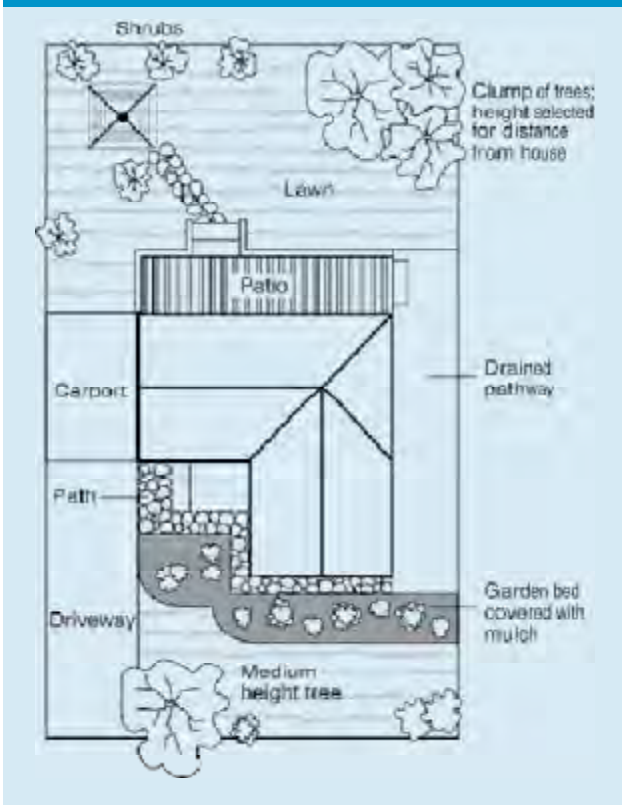
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	**1: CATASTROPHIC 200%**	**2: MAJOR 60%**	**3: MEDIUM 20%**	**4: MINOR 5%**	**5: INSIGNIFICANT 0.5%**
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		**Example Implications** (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

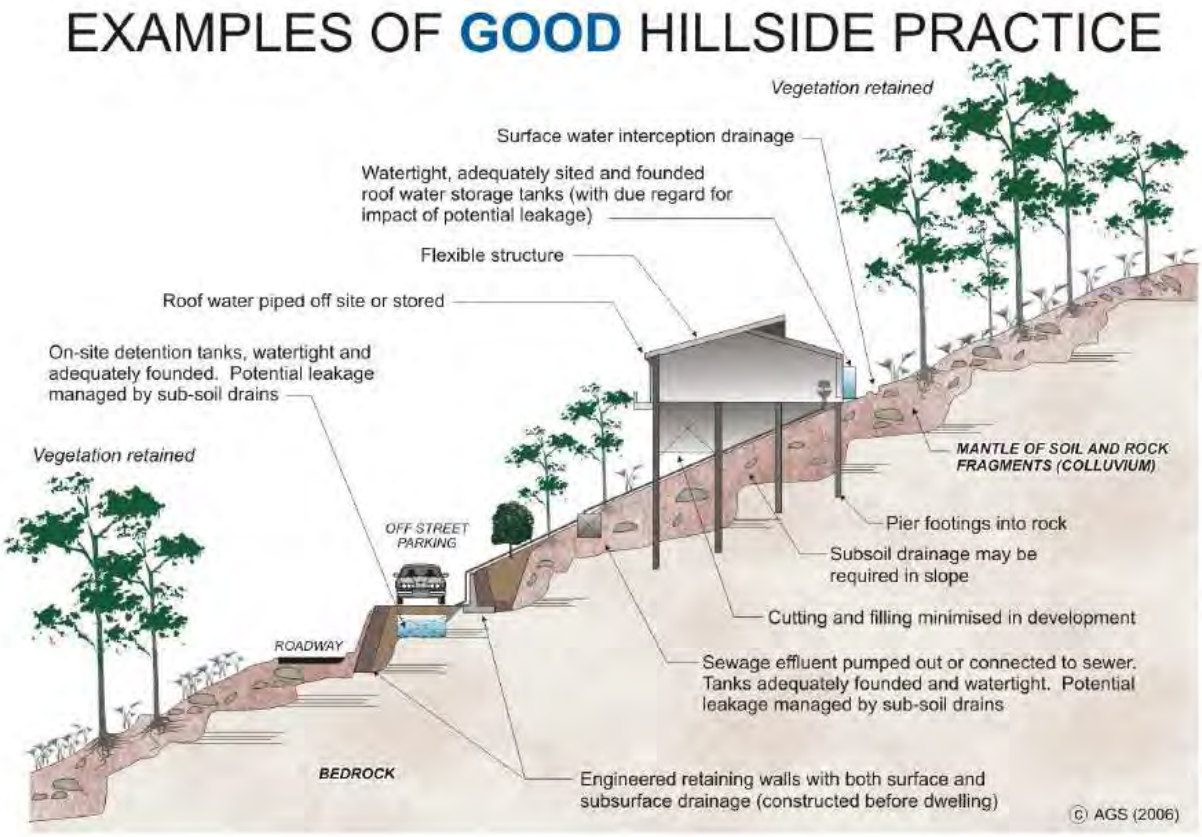
Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminatory bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	


EXAMPLES OF GOOD HILLSIDE PRACTICE
Vegetation retained
Surface water interception drainage
Watertight, adequately sited and founded roof water storage tanks (with due regard for impact of potential leakage)
Flexible structure
Roof water piped off site or stored
On-site detention tanks, watertight and adequately founded. Potential leakage managed by sub-soil drains
Vegetation retained
MANTLE OF SOIL AND ROCK FRAGMENTS (COLLUVIUM)
OFF STREET PARKING
Pier footings into rock
Subsoil drainage may be required in slope
Cutting and filling minimised in development
ROADWAY
Sewage effluent pumped out or connected to sewer. Tanks adequately founded and watertight. Potential leakage managed by sub-soil drains
BEDROCK
Engineered retaining walls with both surface and subsurface drainage (constructed before dwelling)
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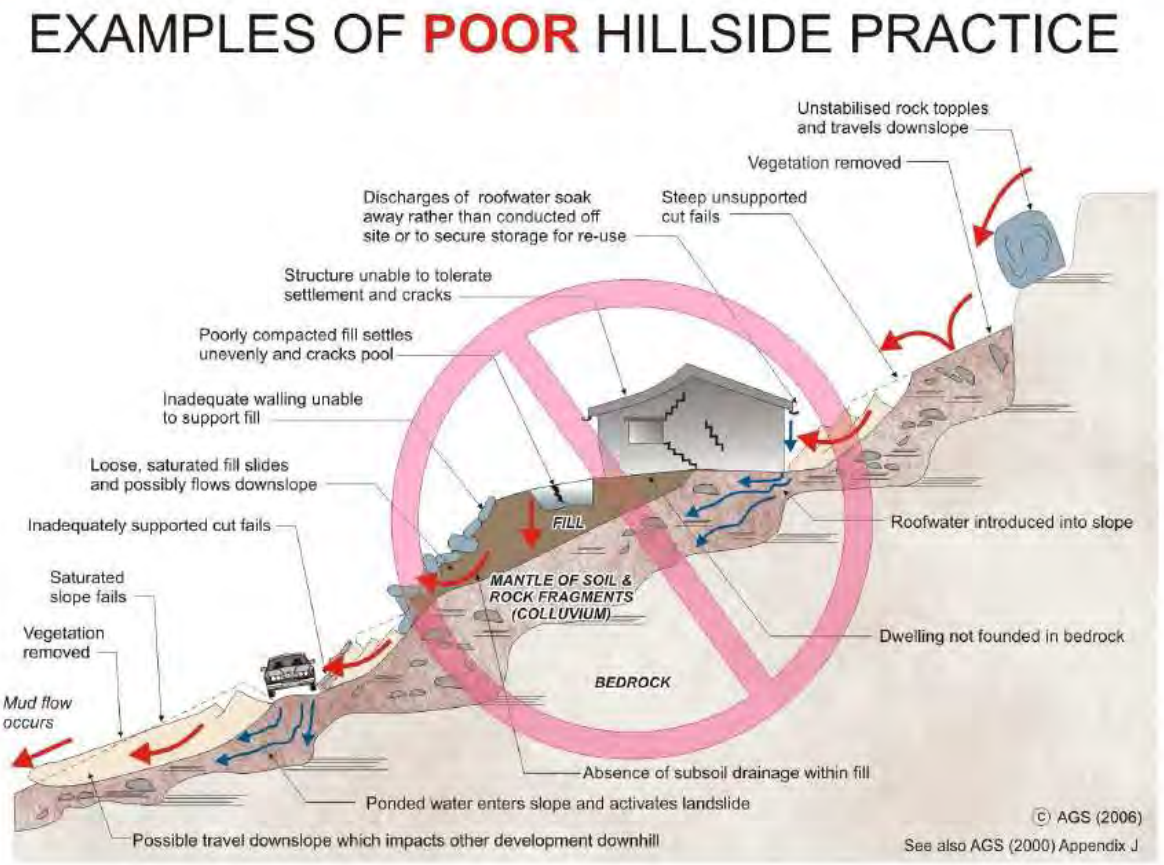
EXAMPLES OF POOR HILLSIDE PRACTICE
Unstabilised rock topples and travels downslope
Vegetation removed
Discharges of roofwater soak away rather than conducted off site or to secure storage for re-use
Steep unsupported cut fails
Structure unable to tolerate settlement and cracks
Poorly compacted fill settles unevenly and cracks pool
Inadequate walling unable to support fill
Loose, saturated fill slides and possibly flows downslope
Inadequately supported cut fails
FILL
Roofwater introduced into slope
Saturated slope fails
MANTLE OF SOIL & ROCK FRAGMENTS (COLLUVIUM)
Vegetation removed
Dwelling not founded in bedrock
BEDROCK
Mud flow occurs
Absence of subsoil drainage within fill
Ponded water enters slope and activates landslide
Possible travel downslope which impacts other development downhill
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See also AGS (2000) Appendix J