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REPORT
ON
PRELIMINARY GEOTECHNICAL ASSESSMENT

PROPOSED RESIDENTIAL SUBDIVISION
LOT 9765 ROYSTONEA AVENUE, DURACK, NT

Prepared for
CHARLES DARWIN UNIVERSITY

Project 48229.00
July 2009

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REPORT ON PRELIMINARY GEOTECHNICAL ASSESSMENT
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1. INTRODUCTION

This report presents the results of a preliminary geotechnical assessment carried out for the proposed residential development of Lot 9765 Roystonea Avenue, Durack, Northern Territory. The work was carried out by Douglas Partners (DP) at the request of Charles Darwin University (CDU), the owner of the lot.

A residential subdivision with internal roads is proposed, and this preliminary geotechnical assessment was carried out to provide subsurface information for delineation of terrain units, assessing the soils in these units and determining the viability of Lot 9675, or parts thereof, for residential subdivision.

The investigation comprised a review of existing terrain unit information, soil types, geology and aerial photographs, followed by a site walkover survey, excavation of test pits, then laboratory testing of representative soil samples. Details of the field and laboratory work are given in this report together with comments relating to geotechnical aspects of design and construction practice.

2. SITE DESCRIPTION

The site (Lot 9765) is located to the west of the intersection of Roystonea Avenue and Stuart Highway and occupies an irregular shaped area with maximum plan dimensions of about 1.5 km by 0.5 km, and an approximate area of 70 ha as shown on Drawing 1. The site is bounded by Tiger Brennan Drive Extension to the north, Roystonea Avenue to the northeast, the CDU Palmerston Campus to the southeast and by Fairway Waters subdivision to the south and southwest.

Reference to the Town of Palmerston 1:2,500 Series Photoimage Maps (Durack, Holtze and Pinelands Sheets) indicates that the site is divided into three drainage catchments (Catchments A, B and C as shown on Drawing 2) by two ridges. One ridge runs north-south across the centre of the site between Pinelands industrial estate to the north and Fairway Waters subdivision to the south. There is a prominent hill approximately 200 m east of the crown of this ridge. The second ridge runs northeast-southwest across the eastern part of the site from the intersection of Stuart Highway with Roystonea Avenue in the northeast to Fairway Waters subdivision in the southwest.

In Catchment A, ground surface levels fall from about RL30m (AHD) on the northern site boundary to RL19m (AHD) along the boundary with the Fairway Waters subdivision. In Catchment B, ground surface levels fall from about RL30-35m (AHD) on the north-eastern site boundary adjacent to Stuart Highway, to RL17m (AHD) in the north-eastern corner of the Fairway Waters subdivision. In Catchment C, ground surface levels fall from about RL35-40m (AHD) in the eastern part of this catchment adjacent to Roystonea Avenue to RL17 m (AHD) at the wide drainage swale on the eastern side of the Fairway waters subdivision.

At the time of the present investigation in June 2009, the site was primarily covered in moderately dense vegetation consisting of grass, “blackboys”, pandanus palms and semi-mature to mature eucalyptus trees. Gravel tracks leading from Roystonea Avenue and the other major boundary roads allowed 4WD vehicle access to the site.

3. GEOLOGY AND TERRAIN UNITS

Reference to the Bynoe 1:100 000 Geological Series map (Sheet 5072) indicates that the site is underlain by Tertiary age soils comprising unconsolidated sand; ferruginous, clayey, sandy and gravelly soil commonly containing limonite pisolites; or pisolitic and mottled laterite. In the lower lying areas, Quaternary age colluvial sediments comprising sand, silt and clay deposited by unconcentrated surface runoff predominate. These soils are underlain by Proterozoic age meta-sediments of the South Alligator Group, which consist of steeply dipping metamorphosed siltstone, shale and phyllite, commonly carbonaceous and pyritic with bands of quartzite.

Review of the Photoimage maps and the Greater Darwin Area Land Unit Map (Sheet 8) indicates that six distinct terrain units (1c, 2b1, 2b2, 3b, 4c and 6b) are present across the site ranging from rugged hills and slopes (Unit 1) to low rounded hills and gentle sideslopes (Units 2, 3 and 4) to broad lowland plains (Unit 6) . A description of each terrain unit is given in Section 5.

4. METHODS OF ASSESSMENT

4.1 Terrain Unit Mapping

The terrain units for Lot 9765 Durack which were originally mapped from stereo photos at a scale of 1:15,000 were published by the Department of Lands Planning and Environment (DLPE) on sheets at a scale of 1:25,000. Cautionary notes on DLPE Sheet 8 indicate that “land unit boundaries are in the process of being refined as additional data are collected” and that although “preliminary land requirements of specific land development proposals can be assessed from the general information derived from land unit information on this map”; “development should not proceed without site-specific investigation of relevant land data”.

Sheet 8 has therefore been used in conjunction with Photoimage maps titled Durack, Holtze and Pinelands at a scale of 1:2,500 to refine the terrain unit boundaries and thus prepare a terrain unit map for this report at a scale of approximately 1:6000. The site areas covered by each of

the 1:2,500 series Photoimage maps are shown on Drawing 2 and the revised terrain map is presented on Drawing 3.

It should be noted that a terrain unit is a relatively homogeneous portion of terrain in terms of landform, soils and vegetation, however, these features will vary continuously across the landscape and terrain units tend to merge with each other over a finite distance rather than being delineated by a narrow line on a map.

4.2 Land Capability

The proposed land uses in the Lot 9765 Roystonea Avenue subdivision will include Urban Residential and Public Open Spaces. Each terrain unit has been rated based on the physical properties of the unit, and classified into three classes corresponding to three levels of capability for the above uses. The classes are C_1 (high capability), C_2 (moderate capability) and L or N (low or no capability). However, factors other than physical characteristics may determine the suitability of some terrain units for specific land uses. Furthermore, limitations of some terrain units, such as steep slopes (Unit 1), seepage (Units 2 and 3) and imperfectly drained soils (Units 4 and 6) may be overcome by the adoption of engineering solutions such as retaining walls, subsoil drains and subgrade replacement, respectively.

The capability ratings for the proposed land use in Lot 9765 Roystonea Avenue are expressed in terms of "Factors Affecting Land Use" in the following Table 1. These ratings are for the broad subdivision areas only, and do not take into consideration engineering intervention which may be required to mitigate drainage, seepage or slope problems for roadworks, single residential lots, or groups of residential lots.

Table 1 : Capability Ratings for Urban Subdivision

Factors Affecting Land Use	High Capability (C_1)	Moderate Capability (C_2)	Low or Nil Capability (L or N)
Site Drainage	Moderate to Very Rapid	Moderate to Very Rapid	Slow or Very Slow
Soil Drainage	Moderate	Imperfect	Poor or Very Poor
Slope Gradient	0 to 4 %	4 to 6%	> 6%
Soil Depth	> 1 m	0.5 to 1.0 m	< 0.5 m

Factors Affecting Land Use	High Capability (C_1)	Moderate Capability (C_2)	Low or Nil Capability (L or N)
Gravel and Stone Content	< 20%	20 to 50%	> 50%
Rock Outcrop	< 5%	5 to 10%	> 10%

4.3 Field Work methods

Field work for the present investigation was carried out on 15 and 16 June 2009 and comprised a site walkover survey combined with excavation, logging, sampling and photographing of 24 test pits using a Hitachi 5t mini-excavator fitted with a 450 mm wide bucket.

The site walkover survey was carried out by a senior geotechnical engineer and a geo-environmental scientist to identify the terrain unit boundaries in the field as compared to those shown in the published information. Test pits were excavated at locations selected for "ground truthing" of subsurface strata mainly in the marginal 4c and 6b terrain units. The test pits were excavated to depths of between 0.26 and 1.9 m, logged and sampled by a geo-environmental scientist, photographed to record the soils and vegetation at each test pit location, then backfilled with the test pit spoil.

Where possible, Dynamic Cone Penetrometer (DCP) testing was carried out adjacent to each test pit location to provide an assessment of the relative strength and density of near surface soils. In this test, a 1000 mm length of 16 mm diameter steel rod with a 20 mm diameter cone tip is driven into the ground using a 9 kg hammer with a drop height of 510 mm. Blow counts were recorded as the whole number of blows for successive 100 mm penetrations in accordance with AS 1289 Method 6.3.2. DCP tests were terminated at refusal of the DCP in cemented gravelly soils defined as greater than 20 blows for 100 mm penetration.

The locations of all 24 test pits were surveyed for position using a hand held GPS and ground surface levels were interpolated from the 1 m contours on the 1:2,500 Photoimage maps.

5. RESULTS OF INVESTIGATION

5.1 Soils and Terrain Units

During this preliminary assessment, six terrain units (1c, 2a1, 2b1, 2b2, 4c, and 6b) were identified across the site area. Descriptions of each terrain unit, reproduced from the Greater Darwin Area Land Unit Map (Sheet 8), are given in Table 2 below. The test pit locations and estimated ground surface levels are listed in Table A1 in Appendix A. Detailed test pit reports are also presented in Appendix A, together with notes describing classification methods and descriptive terms.

The test pits encountered slightly different soil profiles, depending upon the terrain unit in which each pit was excavated. Photographs showing the typical soil profiles and vegetation at each test pit location are presented on Plates 1 to 24. The test pit numbers and associated terrain units are also presented in Table 2 below.

Table 2 : Terrain Unit Descriptions

Unit	Landform	Test Pits	Slope	Drainage	Soils	Vegetation
1c	Low scarps & short steep slopes	None	10 -15%	V Rapid	Shallow gravelly lithosols	Eucalypt woodland to minor open woodland
2b1	Gentle sideslopes	None	2 – 5%	Rapid	Moderately deep gravelly yellow massive earths	Eucalypt open woodland to woodland
2b2	Gentle sideslopes	22	2 – 5%	Rapid	Shallow gravelly massive earths and lithosols	Eucalypt low open to open woodland
3b	Flat to gently undulating upland surface	None	0.5 –2%	Moderate	Moderately deep gravelly massive earths	Eucalypt woodland
4c	Gentle lower slopes	3 to 8, 18 to 21, 23 & 24	0.5 –1%	Slow	Yellow massive earths	Eucalypt open forest, minor woodland
6b	Broad lowland plains	1, 2, & 9 to 17	< 0.5%	Slow	Moderately deep siliceous sands	Grevillea/melaleuca tall shrubland to minor open woodland

Groundwater was observed in only one of the 24 test pits at 1.3 m depth in TP12.

6. LABORATORY TESTING

Laboratory testing was carried out on 8 soil samples, representative of two of the six terrain units. The numbers of tests were in proportion to the possible restrictive nature of each of these two terrain units for urban development, and the breakdown of testing in the various terrain unit soils is listed in Table 3 below.

Table 3 : Test Pit Numbers for Soils Tested from each Terrain Unit

Terrain Unit	Terrain Unit Description (Landform)	Field Description of the Soils	Samples Tested from these pits.
1c	Low scarps & short steep slopes	Yellow-brown, clayey silty gravel with cobbles	None
2b1	Gentle sideslopes	Yellow-brown, clayey sand with gravel	None
2b2	Gentle sideslopes	Mottled yellow and red-brown, clayey sand with gravel	None
3b	Flat to gently undulating upland surface	Mottled yellow and red-brown, clayey sand with gravel	None
4c	Gentle lower slopes	Grey silty gravelly sand	TP6, TP21 & TP24**
6b	Broad lowland plains	Grey silty fine sand with some gravel at depth.	TP1, TP 9, TP12, TP14 & TP16

** Possibly 2b2 terrain unit

The samples were tested for determination of field moisture content, particle size distribution, Atterberg limits including linear shrinkage, compaction properties and California bearing ratio (CBR). All tests were carried out in the Douglas Partners NATA registered Darwin laboratory in accordance with the procedures described in AS1289-2006, “Methods of Testing Soils for Engineering Purposes”. The results of laboratory testing are summarised in Table 4 and the detailed laboratory test reports are presented in Appendix B.

Table 4: Summary of Laboratory Test Results

Test Pit	Depth (m)	Unified Soil Classification	FMC (%)	Fines (%)	LL (%)	PI (%)	LS (%)	OMC (%)	MMDD (t/m^3)	CBR (%)
1	0.5 – 0.8	Silty Sandy Gravel (GM)	7.8	32	25	6	3.5	9.0	2.26	12
6	0.3 – 0.5	Silty Sand (SM)	18.2	17	48	11	5.5	14.5	1.90	5
9	0.3 – 0.6	Sandy Clay (CL)	20.0	55	32	12	5.5	16.0	1.83	11
12	0.5 – 0.7	Clayey Sandy Gravel (GC)	18.5	40	52	20	12.5	-	-	-
14	0.3 - 0.5	Silty Sandy Gravel (GC)	21.3	40	41	14	6.0	16.0	1.84	4.5
16	0.6 – 0.9	Clayey Gravelly Sand (GC)	15.6	31	44	19	11.0	15.0	1.89	25
21	0.4 – 0.6	Sandy Clayey Gravel (GC)	8.0	15	-	-	-	9.5	2.23	40
24	0.5 – 0.8	Clayey Sandy Gravel (GC)	9.4	25	42	17	10.5	11.5	2.09	30

Legend:

FMC – Field Moisture Content
Fines – % passing 75 μm sieve
LL – Liquid Limit
PI – Plasticity Index
LS – Linear Shrinkage
OMC – Optimum Moisture Content
MMDD – Maximum Modified Dry Density
CBR – California Bearing Ratio @ 95% MMDD

7. ENGINEERING COMMENTS

7.1 Proposed Development

It is understood that it is proposed to subdivide Lot 9765 into a number of areas with land use designations varying from single urban dwelling to medium density, community infrastructure and public open space. However, at the time of writing this report, no details were provided for the designation or preferred locations for each of these areas.

7.2 Generalised Ground Conditions in Terrain Units

Ground conditions across the site and throughout the different terrain units were found to be relatively uniform, with the major variations relating to the thickness and type of topsoil encountered, the degree of cementation of the underlying mottled zone soils and the depth to refusal on the underlying low strength rock.

7.2.1 Topsoil Type and Thickness

The topsoil encountered in the 6b terrain unit (TP1, TP2 and TP9 to TP17) was 0.2 to 0.4 m thick and generally comprised dark grey silty clay or silty fine sand. The topsoil in terrain unit 4c comprised clayey gravel ranging in thickness from 0.1 m to 0.3 m and with an average thickness of approximately 0.2 m.

In terrain unit 2b1 (TP22), topsoil was around 0.1 m thick. In the remaining terrain units (1c, 2b2 and 3c) topsoil would be expected to comprise silty or sandy lateritic gravel, with the topsoil thickness ranging from 0.1 m to 0.2 m, and with an average topsoil thickness of about 0.15 m.

7.2.2 Subsoils

The subsoils (soils immediately below the topsoil that were tested in the laboratory) all classified as gravels, sands or clays with varying proportions of silt (non-plastic soils). The insitu moisture contents (early in the dry season) generally ranged from 2% dry of optimum to 5% wet of optimum moisture content for modified compaction. Soaked CBR's for the subsoils ranged from 4.5% to 40%, indicating that "unsuitable subgrade" soils with a CBR less than 6%, that will require replacement during pavement construction may extend over sisolated areas of the 6c and 4c land units. The lower soaked CBR's of 4.5% and 5%, were from the more clayey subsoils from TP6 and TP14 in the 4c and 6b terrain units respectively. The highest CBR of 40% was recorded for subsoil in an area of the 4c terrain unit enclosed by the 2b1 unit in the western part of the site.

Soils with a high plasticity clay fraction (LL > 50%) were encountered in only one of the 8 pits for which samples were tested (TP12), indicating that most excavated subsoils will be suitable for lot filling and that, after stripping of the topsoil, the unfilled residential lots can probably be classified as Class S sites (Terrain unit 4c) or Class A (Terrain units 1c, 2b1, 2b2 and 3b) when assessed in accordance with AS 2870 – 1996 'Residential slabs and footings – Construction'.

7.3 Land Use Evaluation – Capability Ratings

Land use evaluation for urban residential subdivision suitability for each of the terrain units identified on Durack Lot 9765 has been derived by combining the Land Capability Ratings in Table 1 with the Terrain Unit descriptions in Table 2 to arrive at the Land Use Capability rating for each terrain unit presented in Table 5. Also shown in Table 5 is the limiting physical characteristic of the terrain unit that principally determines the Capability Rating for that unit.

Table 5 : Land Use Capability Rating for Each Terrain Unit

Unit	Landform	Slope	Drainage	Urban Subdiv'n	Limiting Characteristic
1c	Low scarps & short steep slopes	10-15%	V Rapid	L	Surface stone and outcrop
2b1	Gentle sideslopes	2–5%	Rapid	C_2	Shallow gravelly soils
2b2	Gentle sideslopes	2–5%	Rapid	L	Shallow gravelly soils and laterite outcrop
3b	Flat to gently undulating upland surface	0.5 –2%	Moderate	C_2	Shallow gravelly soils
4c	Gentle lower slopes	0.5–1%	Slow	L	Site & soil drainage
6b	broad lowland plains	< 0.5%	Wet season inundation	N	Site drainage

The Land Use Capability ratings for four of the six terrain units listed above are either L or N, which indicate low or nil capability for urban residential subdivision purposes. In all terrain units, except possibly the 6b unit, these capability ratings can be modified by engineering intervention to improve site drainage and soil drainage, to stabilise slopes, to protect natural slopes from further erosion, to provide suitable subgrades for pavement construction and to mitigate possible seepage problems. The engineering intervention that may be required in some areas of the Lot 9765 subdivision to raise the capability ratings by one or two levels (from N or L to at least C_2) are discussed briefly in the following sections.

7.4 Engineering Intervention to Modify Capability Ratings

Based on the type and distribution of the terrain units encountered on the site, and the proposed broad land use of "urban residential development", the following additional site works may be required to raise the capability ratings in areas of terrain units 1c, 2b2, 4c and 6b.

7.4.1 Terrain Unit 1c

Terrain unit 1c in the central and far eastern parts of Lot 9765 as shown on Drawing 3, comprises low scarps and short steep slopes and will exhibit very rapid drainage. However, as a result of the low permeability of the shallow rock and rock outcrop, springs may occur under road pavements and on building lots at the footslopes of this unit for periods of up to two months or more in the early dry season. These springs may only be detectable after construction is completed and a full wet season rainfall has saturated the shallow rock in this terrain unit. Intrusive site investigation including boreholes and test pits will not necessarily reveal spring areas, even if the holes are drilled or excavated at the end of the wet season.

If springs are noted at the toe of cuttings for roads or on building lots after construction, corrective measures, including the installation of subsurface drains discharging to the stormwater system, may be required to mitigate the near surface flows. The installation of targeted subsurface drains, combined with the recontouring of cemented lateritic soils or low strength siltstone rock outcrop, can raise the capability rating of the 1c terrain unit from L up to C_2. Residential lots in the 1c terrain unit will then be classified as Class A or Class S sites when assessed in accordance with AS 2870-1996 "Residential Slabs and Footings – Construction".

7.4.2 Seepage Affecting Units Downslope of Unit 1c

After heavy wet season rainfall, and particularly towards the end of the wet season, seepage lines may form parallel to the ground surface contours at or below the boundary of the 1c terrain unit with adjacent downslope terrain units such as 2b1, 2b2, 4c and 6b. If these seepage lines produce significant surface flows, subsurface drains will be required along road kerbs to prevent a buildup of pore pressures under sealed pavements and subsequent softening and failure of the pavement gravels and sealed surface.

It may also be necessary to install relatively deep (up to about 1.2 m) subsoil drains on any individual lots or groups of lots below the 1c terrain units so that groundwater seepage is intercepted and directed to the stormwater drainage system before the seepage water can saturate and soften soils around building foundations. Unfortunately, the seepage areas are difficult to predict or accurately delineate because the extent and location of seepage will also depend on site earthworks carried out for roads, services and building lots during construction. The seepage areas can usually only be detected at the end of the first wet season after the subdivision civil works are completed, and when surface water has evaporated and shallow groundwater continues to flow downslope.

7.4.3 Terrain Unit 2b2

Significant areas of terrain unit 2b2 were delineated at the far western end of Lot 9765 and in the eastern part of the site. No significant laterite outcrop was noted during the site walkover survey and it is not expected that high strength laterite rock will be encountered on Lot 9765.

If low strength laterite outcrop is encountered at shallow depth in the 2b2 terrain unit, this issue can be addressed during road construction by excavation of the laterite, compaction of the exposed loosened surface and construction of the road pavement. However, although laterite outcrop may be an impediment to lot development on some sites, laterite rock and lateritic soils on Lot 9765 can be readily contoured and capped with topsoil from the adjacent 4c and 6b areas of the site to raise the capability rating from L up to a minimum of C_2.

7.4.4 Terrain Unit 4c

Terrain unit 4c, which is listed on the Department of Lands Planning and Environment (DLPE) “Seasonally Waterlogged Soils Maps” in the Category of Class 2 – Moderate to High level of Soil Waterlogging, covers a small area in the central western part of the site and a larger area in the central eastern part of the site. Development of these 4c unit areas would be crucial to the overall viability of the development of the site for urban residential purposes.

Test pits in the western 4c land unit revealed shallow topsoil (0.1 to 0.2 m) overlying dense or cemented mottled lateritic clayey gravel soils to a depth of at least 1.3 to 1.4 m. Test pits in the

eastern 4c land unit revealed deeper topsoil (0.2 to 0.3 m) also overlying dense or cemented mottled clayey gravel soils to depths of 1.0 to 1.6 m.

These areas of deep mottled yellow or grey massive earth soils will also be classified as "Imperfectly Drained" and may exhibit high wet season water tables. Invariably, site drainage is relatively slow due to the low slope gradient, possibly leading to run-on, wet season waterlogging and possible seepage daylighting in the downslope 6b terrain unit soils during the early part of the dry season.

For road construction, terrain unit 4c soils can be successfully traversed by excavating any "unsuitable subsoil" of low CBR (CBR < 6%) and replacing the unsuitable material with compacted select filling. The road pavement can then be constructed directly on the compacted filling. If the sealed pavement surface is lower than about 0.3 m above the surrounding natural surface, or entirely in cut, subsurface drains will be required under the roadside kerbs to intercept groundwater and direct the flows to the stormwater drainage system.

In terms of building lot development, the Land Use Capability of the 4c terrain unit soils can be raised by excavating and stockpiling the topsoil, contouring the underlying dense or cemented clayey gravel soils to the design levels to enhance drainage, then replacing the topsoil. The adoption of this "excavate, contour and replace" method of site development will ensure that the capability rating of the 4c land unit will be raised from L up to at least C_2, and the final developed lots will have a site classification for residential construction of Class S, provided there is control over the placement and testing of filling to a Level 1 standard in accordance with AS3798-2008.

7.4.5 Terrain Unit 6b

Terrain unit 6b occurs over a significant area in the centre of Lot 9765 and over two smaller areas on the southern and eastern boundaries of the lot. Currently, the Tiger Brennan Drive Extension is being constructed along the north-eastern boundary of Lot 9765. This construction comprises a major culvert under the road formation discharging into an existing "drain" running south through the central 6b land unit on Lot 9765 at about Ch714 350 mE. Due to the low lying nature of this land unit, the propensity for flooding, and the depth of topsoil and clayey subsoils, it is not expected that more than the very fringes of the central 6b land unit could be developed for urban residential land other than to have roads and services pass through the area.

It is possible that about half of the 6b land unit along the east-west boundary with the current Fairway Waters subdivision could be developed and the remaining half utilised as drainage swales and open space. The small section of 6b terrain unit in the south-eastern corner of Lot 9765 could be developed for residential use, providing it could be built-up above flooding levels and adequate drainage could be provided to direct overland flows along the eastern and south-eastern site boundaries.

When the subdivision is designed, roads and services will need to cross the 6b land units to link other higher sections of the subdivision. Roads crossing these broad drainage swales could be constructed either with reinforced floodway pavements or as engineered earthfill embankments with culvert drainage structures as required.

The Land Use Capability of small fringe areas of the 6b terrain unit soils can be raised by excavating and stockpiling the topsoil, replacing any underlying loose sandy or clay loam subsoils with engineered filling, then replacing the topsoil. The adoption of this "excavate and replace" method of site development will ensure that the capability rating of small areas adjacent to 2b2 and 4c terrain units will be raised from L up to at least C_2. Earthworks will ensure that the final lots may be classified for residential construction as Class S, provided there is control over the placement and testing of filling to a Level 1 standard and in accordance with AS3798-2008.

7.5 Pavement Design

The CBR tests carried out on the existing subgrade soils encountered in terrain units 4c and 6b during this investigation (Table 5) indicate typical soaked CBR values ranging from 11% to 40%, when re-compacted to 95% of the Modified maximum dry density at optimum moisture content. Two tests on clayey subsoils from TP6 in a 4c unit and TP14 in a 6b unit, gave significantly soaked CBR values of 4.5 and 5%.

For preliminary design of road pavements, it is suggested that a CBR value of 20% be adopted for terrain units 1c, 3b, 2b1 and 2b2, a CBR of 10% be adopted for terrain units 4c and 6b, assuming "unsuitable subsoils" are removed and replaced and that pavement subgrade preparation is carried out in general accordance with details given in Section 7.4.

When the suburb layout is finalised, additional CBR testing will be required on samples from subgrade level on actual road alignments which, in combination with the above results, may confirm higher CBR values for the detailed design of the subdivision roads. If imported selected filling is placed to a thickness greater than 0.5 m over the plan area of any road pavements, particularly in the 4c and 6b terrain units, then the CBR of the selected filling (>30%) could be used for design of the road pavement in these filled areas.

7.6 Groundwater

7.6.1 Shallow Groundwater

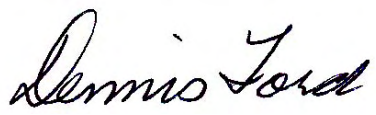
Groundwater was observed in only one test pit, TP12 at 1.3 m depth during field work for this investigation which was carried out in the mid dry season, about 2 months after the previous rainfall event. Site vegetation and surface conditions across the 6b terrain unit indicate that groundwater levels could be close to the natural surface level and water levels could be above ground level during the wet season. The relatively flat nature of terrain unit 6b and the current subdivision to the south of the site may also restrict drainage off site towards the south. Therefore, careful attention should be paid to the location, design and installation of roadways and open and subsurface stormwater drains in these 6b terrain unit areas.

7.7 Further Investigation

When the layout of the subdivision is finalised, further geotechnical investigation and laboratory testing will be required to confirm design parameters for detailed road pavement design, to investigate the subsurface conditions for any significant drainage structures, such as culverts, bridge crossings over drains and stormwater retention structures, and to test soils for aggressivity to concrete structures.

DOUGLAS PARTNERS PTY LTD

Reviewed by



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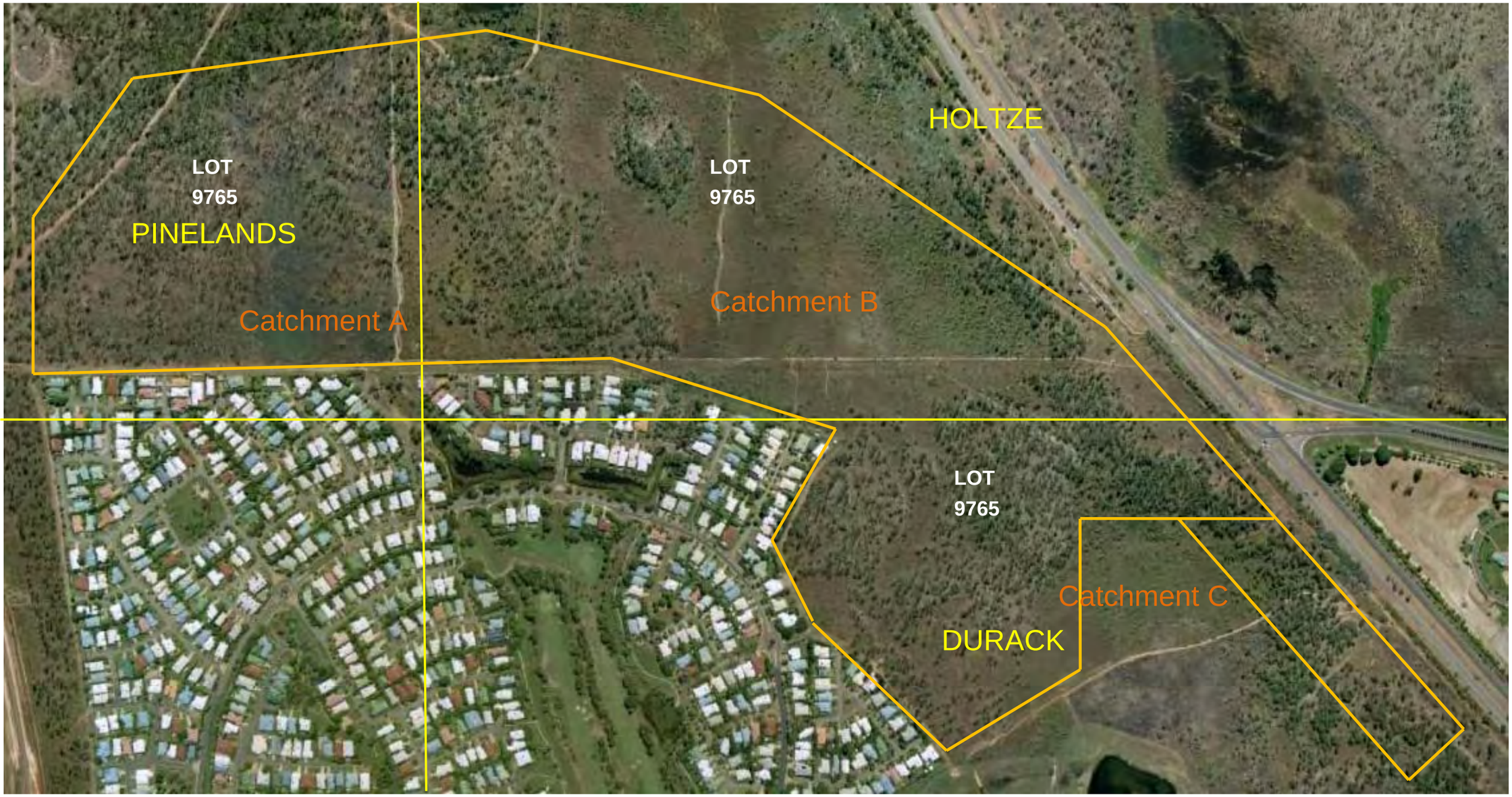
Douglas Partners *Geotechnics · Environment · Groundwater*	*Brisbane, Canberra Darwin, Melbourne Perth, Sydney*	*Cairns, Gold Coast Minto, Newcastle Sunshine Coast, Townsville Wollongong, Wyong*

TITLE: SITE LOCALITY PLAN
PROPOSED RESIDENTIAL SUBDIVISION
LOT 9765 ROYSTONEA AVENUE, DURACK, NT

CLIENT: CHARLES DARWIN UNIVERSITY			OFFICE: Darwin
DRAWN BY: DSF	SCALE: NTS	PROJECT No: 48229.00	DRAWING No: 1
APPROVED BY: DSF		DATE: June 2009	



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Brisbane, Canberra
Darwin, Melbourne
Perth, Sydney

Cairns, Gold Coast
Minto, Newcastle
Sunshine Coast, Townsville
Wollongong, Wyong

TITLE: LAYOUT OF ORTHOPHOTO MAPS
PROPOSED RESIDENTIAL SUBDIVISION
LOT 9765 ROYSTONEA AVENUE, DURACK, NT

CLIENT: CHARLES DARWIN UNIVERSITY

OFFICE: Darwin

DRAWN BY: DSF

SCALE: NTS

PROJECT No: 48229.00

APPROVED BY: DSF

DATE: JUNE 2009

DRAWING No: 2

Douglas Partners
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Brisbane, Canberra
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Cairns, Gold Coast
Minto, Newcastle
Sunshine Coast, Townsville
Wollongong, Wyong

TITLE: TERRAIN UNITS & SURFACE CONTOURS
PROPOSED RESIDENTIAL SUBDIVISION
LOT 9765 ROYSTONEA AVENUE, DURACK, NT

CLIENT: CHARLES DARWIN UNIVERSITY			OFFICE: Darwin
DRAWN BY: DSF	SCALE: NTS	PROJECT No: 48229.00	DRAWING No: 3
APPROVED BY: DSF		DATE: JUNE 2009	

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TITLE: LOCATIONS OF TEST PITS
PROPOSED RESIDENTIAL SUBDIVISION
LOT 9765 ROYSTONEA AVENUE, DURACK, NT

CLIENT: CHARLES DARWIN UNIVERSITY

OFFICE: Darwin

DRAWN BY: DSF

SCALE: NTS

PROJECT No: 48229.00

DRAWING No: 4

APPROVED BY: DSF

DATE: JUNE 2009

PLATE 1: Test Pit 1 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 2: Test Pit 2 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 3: Test Pit 3 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 4: Test Pit 4 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 5: Test Pit 5 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 6: Test Pit 6 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 7: Test Pit 7 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 8: Test Pit 8 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 9: Test Pit 9 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 10: Test Pit 10 ground conditions and typical vegetation (Terrain Unit 6c)

PLATE 11: Test Pit 11 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 12: Test Pit 12 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 13: Test Pit 13 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 14: Test Pit 14 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 15: Test Pit 15 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 16: Test Pit 16 ground conditions and typical vegetation (Terrain Unit 3c)

PLATE 17: Test Pit 17 ground conditions and typical vegetation (Terrain Unit 6b)

PLATE 18: Test Pit 18 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 19: Test Pit 19 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 20: Test Pit 20 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 21: Test Pit 21 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 22: Test Pit 22 ground conditions and typical vegetation (Terrain Unit 2b2)

PLATE 23: Test Pit 23 ground conditions and typical vegetation (Terrain Unit 4c)

PLATE 24: Test Pit 24 ground conditions and typical vegetation (Terrain Unit 4c)

APPENDIX A

NOTES RELATING TO THIS REPORT

RESULTS OF FIELD WORK

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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.

TABLE A1

TEST PIT LOCATIONS AND ESTIMATED SURFACE LEVELS

Test Pit No.	Easting (m)	Northing (m)	Surface Level (m) AHD
1	715535	8616254	17.2
2	715679	8616124	15.8
3	715865	8615978	12.8
4	715404	8616117	17.7
5	715599	8615959	16.5
6	715246	8616008	18.4
7	715466	8615871	17.7
8	715082	8615877	19.0
9	715270	8615666	15.7
10	715512	8615646	17.1
11	716242	8615545	10.5
12	716043	8615590	12.4
13	715958	8615437	11.0
14	715796	8615235	11.5
15	715740	8615438	13.5
16	715541	8615440	15.5
17	715557	8615215	16.0
18	715296	8614987	13.5
19	715155	8615188	7.0
20	715341	8615358	14.5
21	715039	8615315	8.5
22	715037	8615533	11.7
23	714763	8615547	17.5
24	715039	8615708	17.0
25	715737	8615767	14.5
26	715264	8615528	14.3
27	715266	8615878	18.0
28	714878	8615679	21.0
29	715361	8615189	13.2
30	716003	8615842	12.2

TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714800
NORTHING: 8620450
DIP/AZIMUTH: 90°/--

PIT No: TP1
PROJECT No: 48229.00
DATE: 15 Sep 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 100mm)
		TOPSOIL - grey brown, clayey gravel, small roots, humid							
	0.2	CLAYEY GRAVEL - dense to cemented, yellow brown and orange brown, clayey gravel, gravel is siltstone, small roots, humid to damp		D	0.3				
	0.5	CLAYEY GRAVEL - cemented, light grey, orange brown and yellow brown, clayey gravel, gravel is siltstone, damp ...from 0.6 m, gravel is siltstone and quartz		B	0.5 0.8				
	0.9	Pit discontinued at 0.9m, refusal							
1									1

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714850
NORTHING: 8620570
DIP/AZIMUTH: 90°/--

PIT No: TP2
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm)
		TOPSOIL - light grey, silty sand, small roots, humid							
	0.3	CLAYEY GRAVEL - dense, light grey and orange brown, clayey gravel, gravel is siltstone, damp		D	0.4				
		...cemented from 0.6 m			0.6				
	0.8	Pit discontinued at 0.8m, refusal							
	1								1

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

Douglas Partners
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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714700
NORTHING: 8620450
DIP/AZIMUTH: 90°/--

PIT No: TP3
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm)
		TOPSOIL - grey, clayey gravel, small roots, humid							
	0.3	CLAYEY GRAVEL - cemented, red brown, clayey gravel, gravel is siltstone and minor quartz, damp							
				D	0.6				
					0.8				
	1	...from 1.1 m, becoming light grey and orange brown, clayey gravel, gravel is weathered siltstone							1
	1.4	Pit discontinued at 1.4m, refusal							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714530
NORTHING: 8620550
DIP/AZIMUTH: 90°/--

PIT No: TP4
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm) 5 10 15 20
		TOPSOIL - grey brown, clayey gravel, small roots, humid							
	0.2	CLAYEY GRAVEL - cemented, red brown, clayey gravel, gravel is siltstone and quartz, humid to damp							
				D	0.4				
					0.6				
	1								1
		...from 1.2 m, light grey and orange brown, clayey gravel							
	1.6	Pit discontinued at 1.6m, target depth reached							

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714650
NORTHING: 8620860
DIP/AZIMUTH: 90°/--

PIT No: TP5
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - grey silty gravel, small roots, humid							
	0.3	CLAYEY GRAVEL - dense, red brown, orange brown and grey, clayey gravel, gravel is siltstone, damp		D	0.3				
		...cemented from 0.5 m			0.5				
	0.7	SILTSTONE - low strength, extremely weathered, orange brown, grey and purple brown, siltstone		D	0.9				
1	1.0	Pit discontinued at 1.0m, refusal							1

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

Douglas Partners
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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714660
NORTHING: 8621000
DIP/AZIMUTH: 90°/--

PIT No: TP6
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - grey brown, clayey gravel, small roots, humid							
	0.2	CLAYEY GRAVEL - cemented, orange brown and grey, clayey gravel, gravel is siltstone, humid to damp		B	0.3				
					0.5				
	0.7	SILTSTONE - low strength, extremely weathered, orange brown, grey and purple brown, siltstone		D	1.0				
1									1
	1.2	Pit discontinued at 1.2m, target depth reached							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714550
NORTHING: 8621030
DIP/AZIMUTH: 90°/--

PIT No: TP7
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm) 5 10 15 20
		TOPSOIL - grey, clayey gravel, small roots							
	0.3	CLAYEY GRAVEL - cemented, orange brown and light grey, clayey gravel, gravel is siltstone, damp		D	0.3				
	0.6	SILTSTONE - low strength, extremely weathered, orange brown, grey and purple brown, siltstone		D	0.6				
1				D	1.0				1
	1.4	Pit discontinued at 1.4m, target depth reached							

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714558
NORTHING: 8620847
DIP/AZIMUTH: 90°/--

PIT No: TP8
PROJECT No: 48229.00
DATE: 16 Jun 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
		TOPSOIL - grey, silty clay, small roots, humid							
	0.3	CLAYEY GRAVEL - cemented, orange brown and red brown, clayey gravel, gravel is siltstone and quartz		D	0.5				
		...from 0.7 m, becoming orange brown, red brown and grey, clayey gravel							
	0.8	Pit discontinued at 0.8m, refusal							
	1								1

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket
LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714360
NORTHING: 8620850
DIP/AZIMUTH: 90°/--

PIT No: TP9
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - grey, clayey gravel, small rootlets, damp							
	0.2	CLAYEY GRAVEL - medium dense, red brown, orange brown and grey, clayey gravel, gravel is siltstone, damp			0.3				
				B					
					0.6				
		...from 0.8 m, becoming cemented							
	1								1
	1.3	Pit discontinued at 1.3m, target depth reached							

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714450
NORTHING: 8620950
DIP/AZIMUTH: 90°/--

PIT No: TP10
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - firm, grey, silty clay, small roots, damp							
	0.3	CLAY - soft, orange brown and grey, clay, damp		D	0.4				
					0.6				
	1	...from 0.9 m, becoming stiff / medium dense, clayey gravel, siltstone gravel							
	1.3	SILTSTONE - low strength, extremely weathered, orange brown and grey, siltstone		D	1.4				
	1.6	Pit discontinued at 1.6m, target depth reached							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714330
NORTHING: 8621027
DIP/AZIMUTH: 90°/--

PIT No: TP11
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - firm, grey, silty clay, small roots to 0.2 m, damp							
	0.4	CLAYEY GRAVEL - medium dense, red brown, orange brown and light grey, clayey gravel, gravel is siltstone, damp		D	0.5				
					0.7				
		...cemented from 0.8 m							
	1.1	SILTSTONE - low strength, extremely weathered, orange brown and light grey, siltstone		D	1.2				
	1.4	Pit discontinued at 1.4m, near refusal							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20; 1

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714450
NORTHING: 8621140
DIP/AZIMUTH: 90°/--

PIT No: TP12
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - grey, silty clay, small roots to 0.2 m, damp							
	0.4	CLAYEY GRAVEL - loose to medium dense, grey and red brown, clayey gravel, gravel is siltstone, damp to moist		B	0.5				
					0.7				
		...cemented from 0.9 m							
	1								1
		...water encountered at 1.3 m							
	1.4	Pit discontinued at 1.4m, target depth reached							

5 10 15 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

WATER OBSERVATIONS: Groundwater encountered at 1.3 m

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714330
NORTHING: 8621248
DIP/AZIMUTH: 90°/--

PIT No: TP13
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - grey, silty clay, small roots, damp							
	0.2	CLAYEY GRAVEL - loose to medium dense, red brown and grey, clayey gravel, gravel is siltstone, damp			0.3				
				D					
					0.5				
		...cemented from 0.9 m							
1	1.0	SILTSTONE - low strength, extremely weathered, light grey and orange brown, siltstone							1
	1.1	Pit discontinued at 1.1m, refusal							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714230
NORTHING: 8621220
DIP/AZIMUTH: 90°/--

PIT No: TP14
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - grey, silty clay, small roots, damp							
	0.2	CLAYEY GRAVEL - medium dense, orange brown, red brown and grey, clayey gravel, gravel is siltstone, damp		B	0.3				
		...cemented from 0.5 m			0.5				
	0.7	Pit discontinued at 0.7m, refusal							
	1								1

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714040
NORTHING: 8620900
DIP/AZIMUTH: 90°/--

PIT No: TP15
PROJECT No: 48229.00
DATE: 16 Jun 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 100mm)
		TOPSOIL - grey, clayey gravel, small roots, humid to damp							
	0.4	CLAYEY GRAVEL - medium dense, orange brown and red brown, clayey gravel, gravel is siltstone, damp			0.5				
				B					
					0.7				
		...cemented from 0.9 m							
	1								1
		...from 1.2, becoming red brown, grey brown and orange brown, clayey gravel, gravel is siltstone							
	1.5	Pit discontinued at 1.5m, target depth reached							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 713800
NORTHING: 8620900
DIP/AZIMUTH: 90°/--

PIT No: TP16
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm)
		TOPSOIL - light grey, clayey sand/sandy clay, small roots, damp							
	0.4	CLAYEY GRAVEL - dense, orange brown and light grey, clayey gravel, gravel is siltstone, damp			0.6				
		...from 0.7 m, becoming orange brown, clayey gravel		B					
		...cemented from 0.9 m			0.9				
	1								1
	1.1	Pit discontinued at 1.1m, refusal							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 713780
NORTHING: 8621020
DIP/AZIMUTH: 90°/--

PIT No: TP17
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm)
		SANDY CLAY - soft to firm, grey and orange brown, sandy clay, small roots, humid							
	0.5	CLAYEY GRAVEL - dense, orange brown and red brown, clayey gravel, gravel is siltstone, damp		D	0.6				
		...cemented from 0.8 m			0.8				
	1								1
	1.3	Pit discontinued at 1.3m, target depth reached							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 713970
NORTHING: 8621060
DIP/AZIMUTH: 90°/--

PIT No: TP18
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm)
		TOPSOIL - grey, clayey gravel, small roots, humid							
	0.2	CLAYEY GRAVEL - dense, orange brown, clayey gravel, gravel is siltstone and quartz, humid to damp							
		...from 0.4 m, becoming orange brown and red brown, clayey gravel		B	0.4				
		...cemented from 0.6 m			0.6				
	1.3	Pit discontinued at 1.3m, target depth reached							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20; 1

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 713870
NORTHING: 8621070
DIP/AZIMUTH: 90°/--

PIT No: TP19
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm)
		CLAYEY GRAVEL - loose, yellow brown and orange brown, clayey gravel, humid, gravel is siltstone and sub-rounded, small roots to 0.3 m, humid							
	0.5	CLAYEY GRAVEL - cemented, red brown, orange brown and grey, clayey gravel, gravel is siltstone, humid to damp		D	0.5				
	1				0.7				
	1.4	Pit discontinued at 1.4m, target depth reached							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

Douglas Partners
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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 713675
NORTHING: 8620891
DIP/AZIMUTH: 90°/--

PIT No: TP20
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm) 5 10 15 20
		TOPSOIL - grey brown, clayey gravel, small roots, humid							
	0.3	CLAYEY GRAVEL - cemented, orange brown and red brown, clayey gravel, gravel is siltstone, humid to damp		D	0.3				
					0.5				
1									1
	1.2	Pit discontinued at 1.2m, target depth reached							

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 713540
NORTHING: 8620990
DIP/AZIMUTH: 90°/--

PIT No: TP21
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm) 5 10 15 20
		TOPSOIL - light grey, clayey gravel, small roots, humid							
	0.3	CLAYEY GRAVEL - cemented, orange brown, clayey gravel, gravel is siltstone and sub-rounded			0.4				
				B					
					0.6				
	1	...from 1.0 m, becoming red brown and orange brown clayey gravel							1
		...from 1.8 m, becoming red brown, orange brown and grey, clayey gravel							
	1.9	Pit discontinued at 1.9m, target depth reached							

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 713630
NORTHING: 8621060
DIP/AZIMUTH: 90°/--

PIT No: TP22
PROJECT No: 48229.00
DATE: 15 Jun 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
		TOPSOIL - grey brown, clayey gravel, small roots							
	0.1	CLAYEY GRAVEL - cemented, orange brown, clayey gravel, gravel is siltstone and sub-rounded		D	0.2				
	0.26	Pit discontinued at 0.26m, refusal							
	1								1

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 713900
NORTHING: 8620980
DIP/AZIMUTH: 90°/--

PIT No: TP23
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm)
		TOPSOIL - grey, clayey gravel, small roots, humid							
	0.2	CLAYEY GRAVEL - dense, orange brown, red brown and light grey, clayey gravel, gravel is siltstone, damp							
					0.4				
		...cemented from 0.5 m		D					
					0.6				
	1								1
	1.3	Pit discontinued at 1.3m, target depth reached							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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TEST PIT LOG

CLIENT: Charles Darwin University
PROJECT: Proposed Residential Subdivision
LOCATION: Part of Lot 9765 Roystonea Avenue Durack, NT

SURFACE LEVEL: --
EASTING: 714580
NORTHING: 8620700
DIP/AZIMUTH: 90°/--

PIT No: TP24
PROJECT No: 48229.00
DATE: 15 Jun 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 100mm)
		TOPSOIL - grey, clayey gravel, small roots, humid							
	0.3	CLAYEY GRAVEL - cemented, red brown, clayey gravel, gravel is siltstone, humid to damp							
				B	0.5				
					0.8				
		...siltstone and quartz gravel from 0.9 m							
	1								1
		...from 1.4 m, becoming light grey, clayey gravel							
	1.5	Pit discontinued at 1.5m, target depth reached							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne mini-excavator with 450 mm bucket

LOGGED: JMD

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:	D. Ford
Date:	3/7/09

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APPENDIX B

RESULTS OF LABORATORY TESTING

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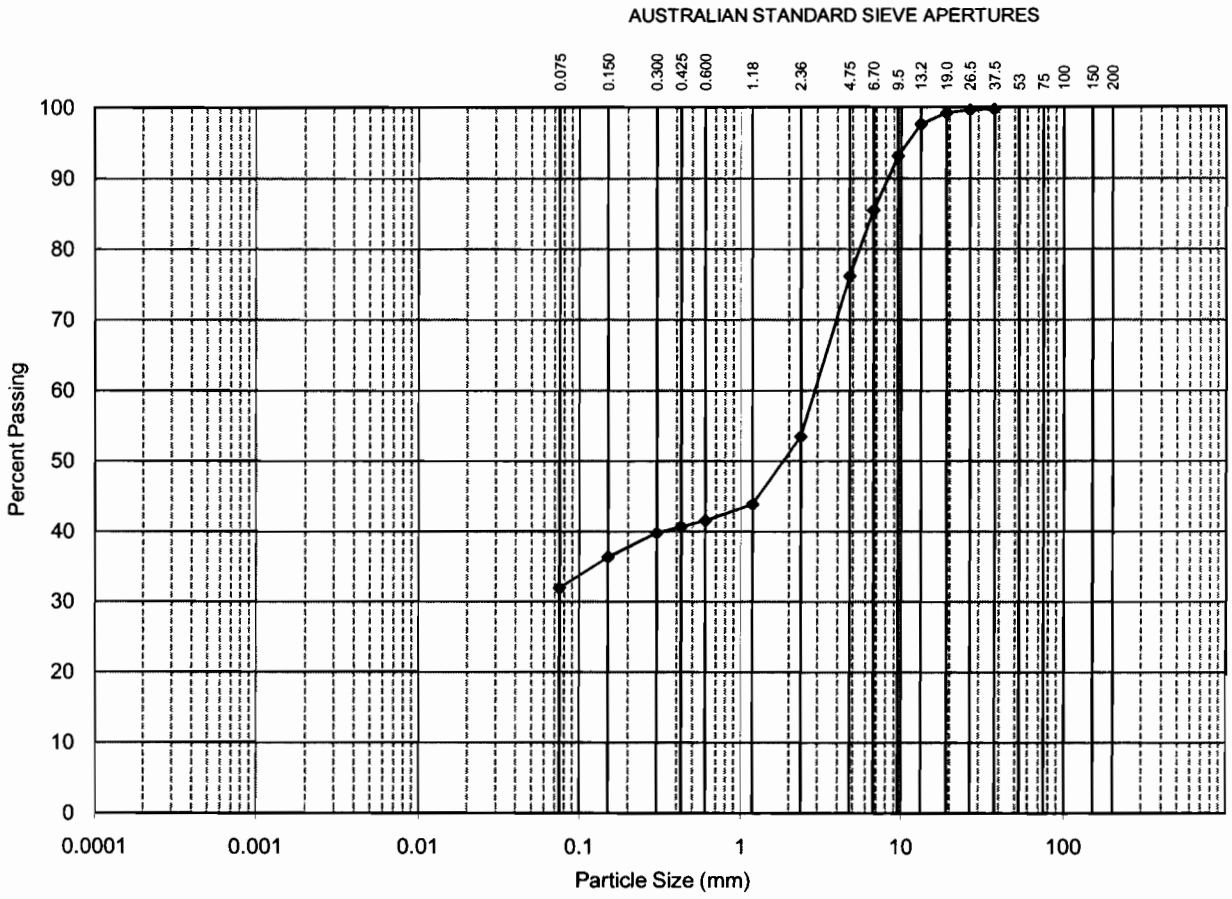
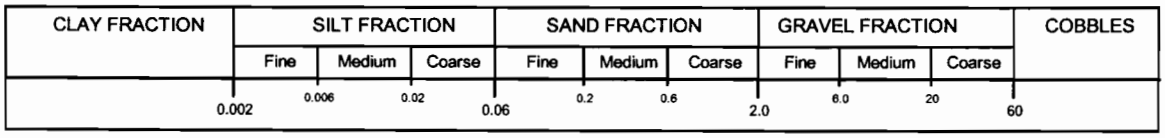
RESULTS OF PARTICLE SIZE DISTRIBUTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-203A
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled:**	16/06/2009
Test Location :	1	**Date of Test:**	24/06/2009
Depth / Layer :	0.5 - 0.8 m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	**100%**
26.5	**100%**
19.0	**99%**
13.2	**98%**
9.5	**93%**
6.7	**85%**
4.75	**76%**
2.36	**54%**
1.18	**44%**
0.600	**42%**
0.425	**41%**
0.300	**40%**
0.150	**36%**
0.075	**32%**



Description: Clayey Sandy Gravel, Light Grey

Test Method(s): AS1289.3.6.1 - 2009

Sampling Method(s): Sampled by Client

Method of Dispersion:

Remarks:

NATA Accredited Laboratory Number: 828

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Approved Signatory:

Tested:	AB
Checked:	JH

J. Hollebone
Laboratory Manager

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RESULTS OF MOISTURE CONTENT, PLASTICITY AND LINEAR SHRINKAGE TESTS

Client: Charles Darwin University

Project: Proposed Residential Subdivision

Location: Durack, NT

Project No: 67252/48229
Report No: DL09-203 B
Report Date: 06/07/09
Date Sampled: 15 &16/06/09
Date of Test: 23/06/09
Page: 1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	CODE	W_F %	W_L %	W_P %	PI %	*LS %
1	0.5 - 0.8	**Clayey Sandy Gravel, Light-Grey**	1,6	-	25	19	6	3.5
6	0.3 – 0.5	**Clayey Gravel, Orange-Brown**	1,6	-	48	37	11	5.5
9	0.3 – 0.6	**Sandy Clay, Red-Brown**	1,6	-	32	20	12	5.5
12	0.5 – 0.7	**Clayey Sandy Gravel, Red-Brown**	1,6	-	52	32	20	12.5
14	0.3 – 0.5	**Clayey Gravel, orange brown**	1,6	-	41	27	14	6.0
16	06 – 0.9	**Clayey Gravel, Orange-Brown**	1,6	-	44	25	19	11
24	0.5 – 0.8	**Clayey Sandy Gravel, Red-Brown**	1,6	-	42	25	17	10.5

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 250mm)

Test Methods:
Moisture Content: AS 1289 2.1.1 - 2005
Liquid Limit: AS 1289 3.1.2 - 1995
Plastic Limit: AS 1289 3.2.1 - 1995
Plasticity Index: AS 1289 3.3.1 - 1995
Linear Shrinkage: AS 1289 3.4.1 - 1995
Cone Liquid Limit: N/A

Code
Sample history for plasticity tests
1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) 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 Client

Remarks:

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Tested: KB
Checked: JH

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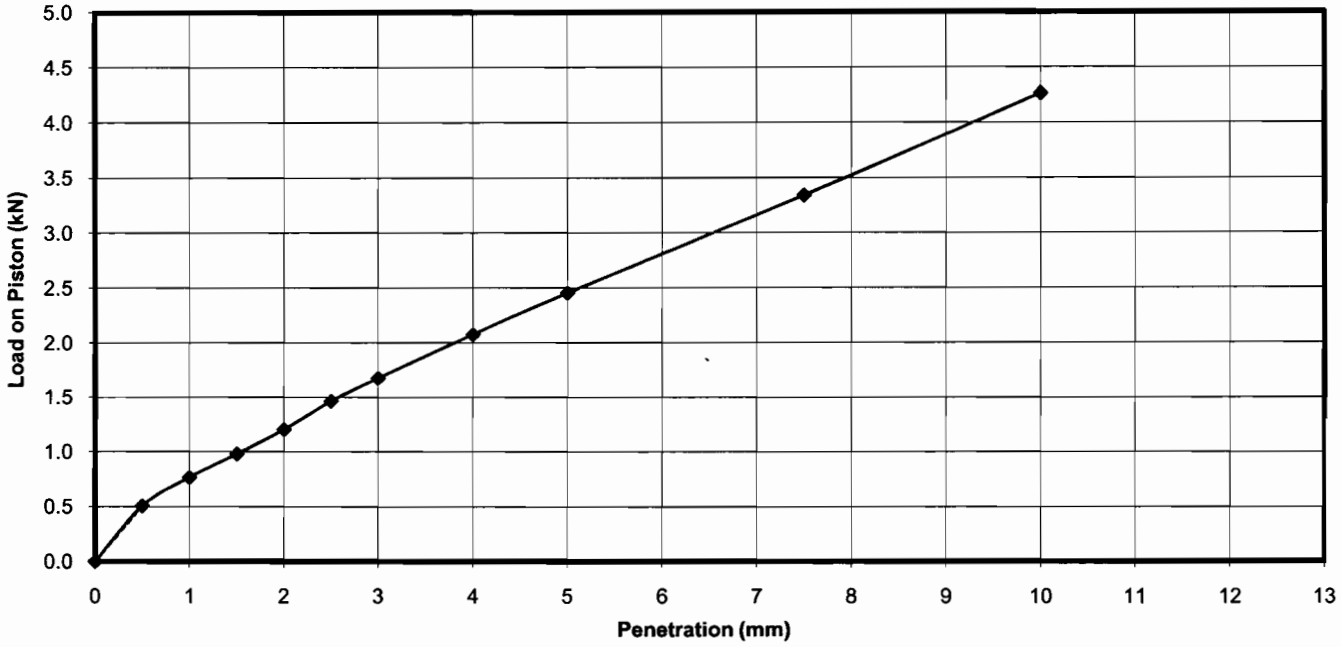
RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-203C
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled :**	15/06/2009
Test Location :	1	**Date of Test:**	24/06/2009
Depth / Layer :	0.5 - 0.8 m	**Page:**	1 of 1



Description: Clayey Sandy Gravel, Light Grey

Test Method(s): AS1289.6.1.1-1998, AS1289.2.1.1-2005

Sampling Method(s): Sampled by Client **Percentage > 19mm:** 0.0%

LEVEL OF COMPACTION: 95% of MOD MDD **SURCHARGE:** 4.5 kg **SWELL:** 5.8%
MOISTURE RATIO: 100% of MOD OMC **SOAKING PERIOD:** 4 days

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		9.2	2.16
After soaking		12.8	2.04
After test	Top 30mm of sample	12.9	-
	Remainder of sample	11.4	-
Field values		7.4	-
Modified Compaction		9.2	2.26

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**2.5 mm**	**11**
	5.0 mm	**12**

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Approved Signatory:

Tested:	ABB
Checked:	JH

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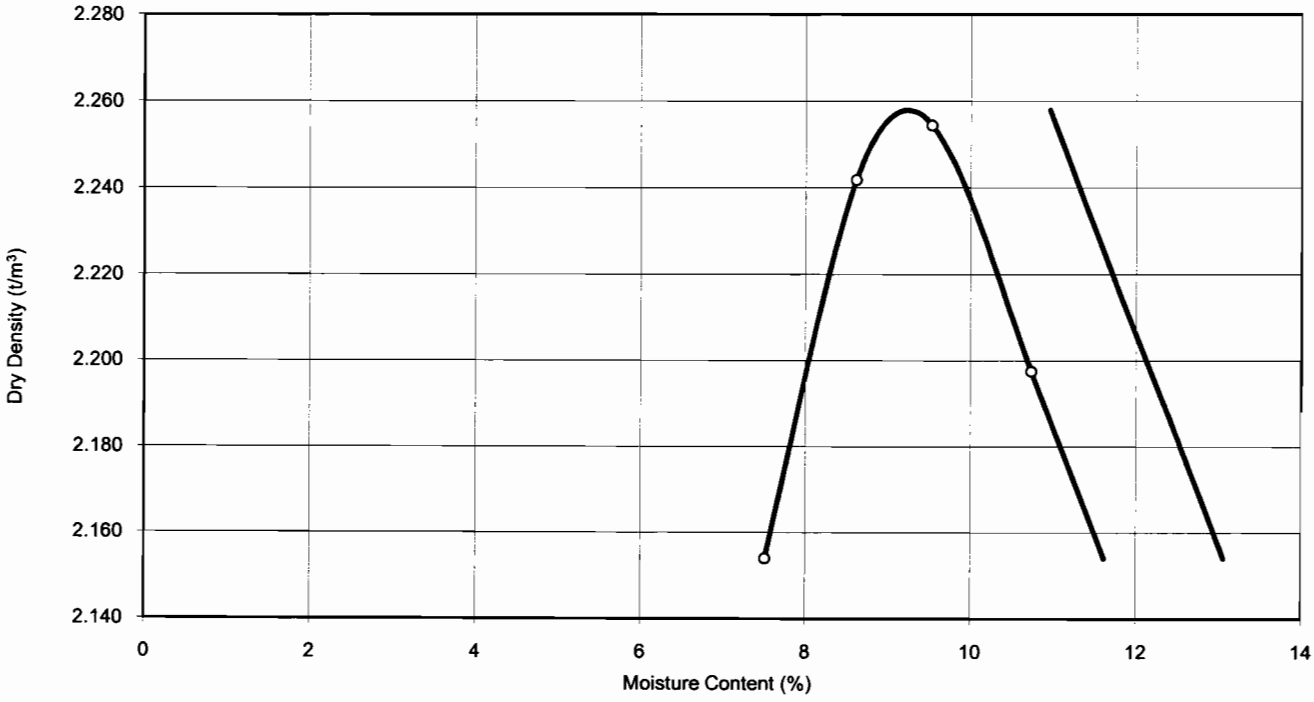
RESULTS OF COMPACTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-203D
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date of Test:**	17/06/2009
		Page:	1 of 1



Sample Details **Location:** 1
Depth: 0.5 - 0.8 m

Particles > 19mm: 0%

Description: Clayey Sandy Gravel, Light Grey

Maximum Dry Density:	**2.26 t/m^3**
Optimum Moisture Content:	**9.0 %**

Remarks:

Test Methods: AS 1289.5.2.1-2003 (MOD), AS 1289.2.1.1-1998

Sampling Methods: Sampled by Client

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Approved Signatory:

Tested:	MO
Checked:	JH

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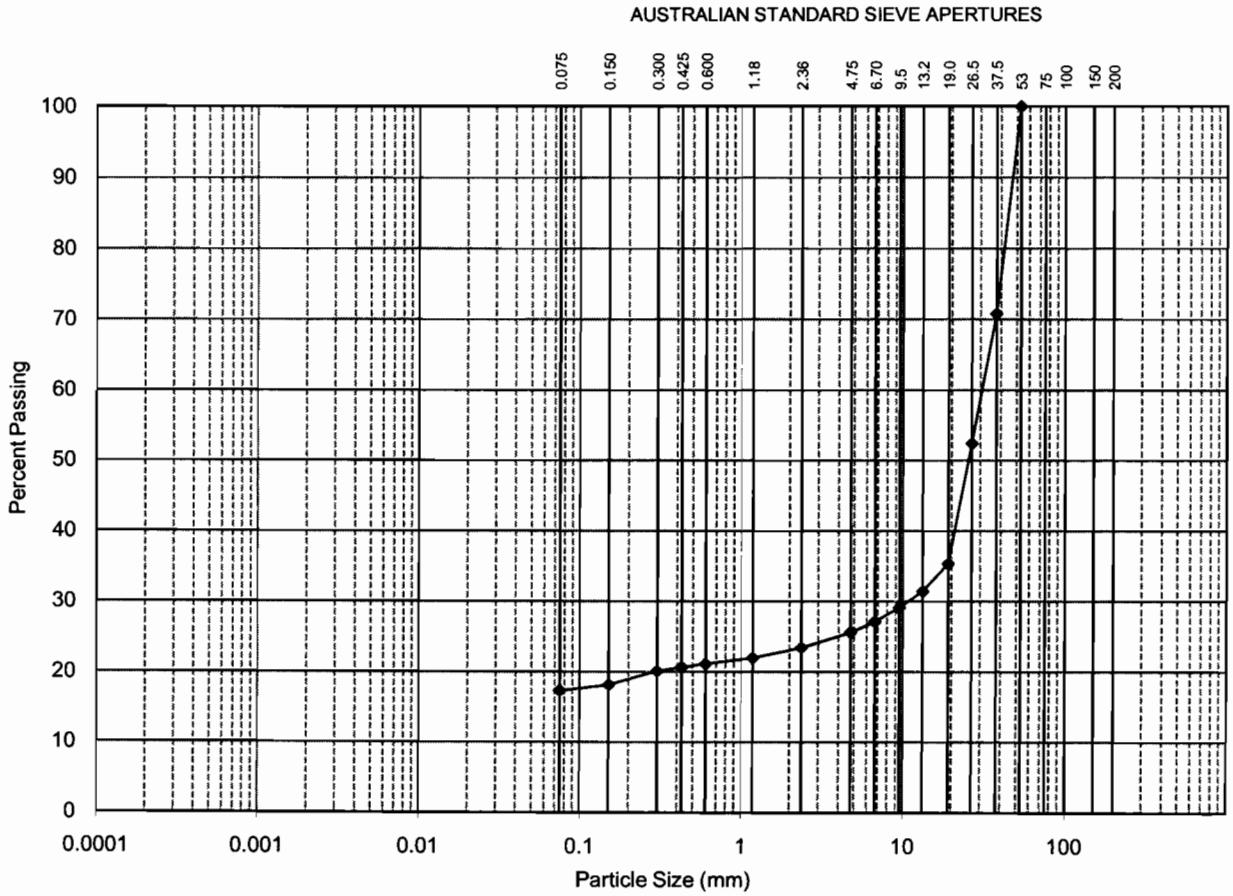
RESULTS OF PARTICLE SIZE DISTRIBUTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-204A
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled:**	16/06/2009
Test Location :	6	**Date of Test:**	2/07/2009
Depth / Layer :	0.5 - 0.8 m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	**100%**
37.5	**71%**
26.5	**52%**
19.0	**35%**
13.2	**31%**
9.5	**29%**
6.7	**27%**
4.75	**26%**
2.36	**23%**
1.18	**22%**
0.600	**21%**
0.425	**21%**
0.300	**20%**
0.150	**18%**
0.075	**17%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Clayey Gravel, Orange Brown

Test Method(s): AS1289.3.6.1 - 2009

Sampling Method(s): Sampled by Client

Method of Dispersion:

Remarks:

NATA Accredited Laboratory Number: 828

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Approved Signatory:

Tested:	AB
Checked:	JH

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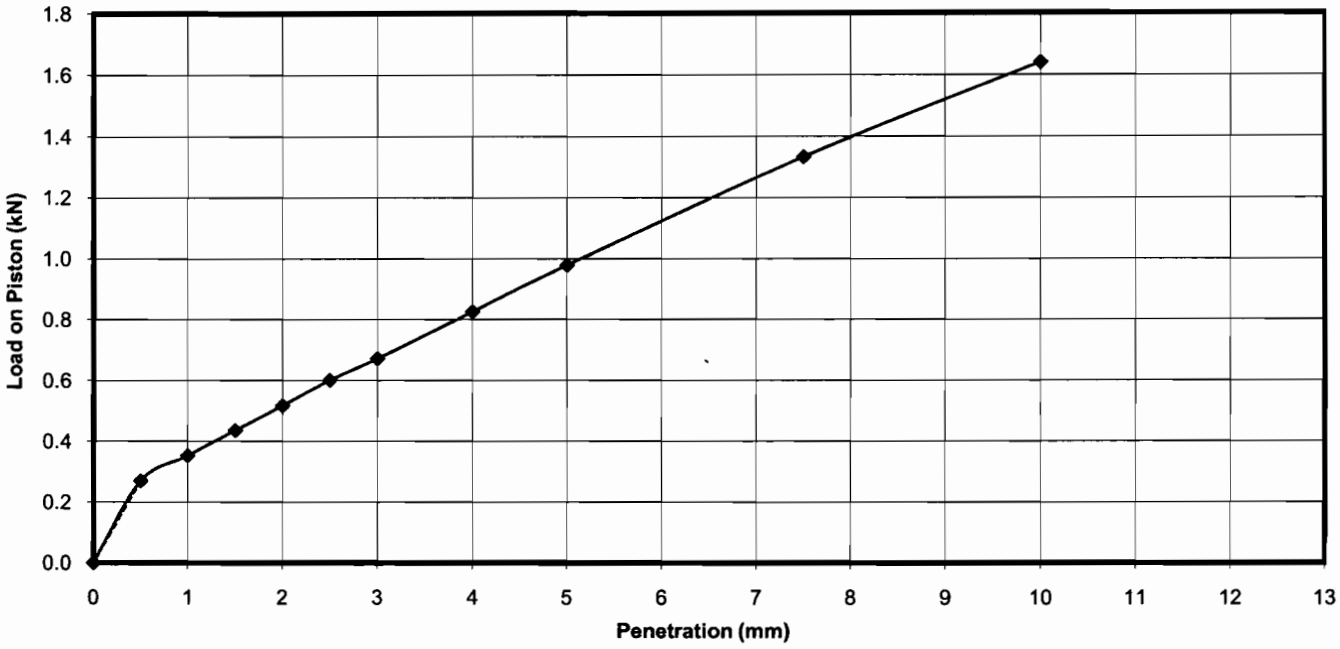
RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-204C
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled :**	15/06/2009
Test Location :	6	**Date of Test:**	30/06/2009
Depth / Layer :	0.3 - 0.5 m	**Page:**	1 of 1



Description: Clayey Gravel, Orange Brown

Test Method(s): AS1289.6.1.1-1998, AS1289.2.1.1-2005

Sampling Method(s): Sampled By Client

Percentage > 19mm: 0.0%

LEVEL OF COMPACTION: 95% of MOD MDD
MOISTURE RATIO: 98% of MOD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 4.6%

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		14.2	1.80
After soaking		22.7	1.72
After test	Top 30mm of sample	23.3	-
	Remainder of sample	18.9	-
Field values		17.7	-
Modified Compaction		14.5	1.90

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**2.5 mm**	**4.5**
	5.0 mm	**5.0**

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Approved Signatory:

Tested:	BR
Checked:	JH

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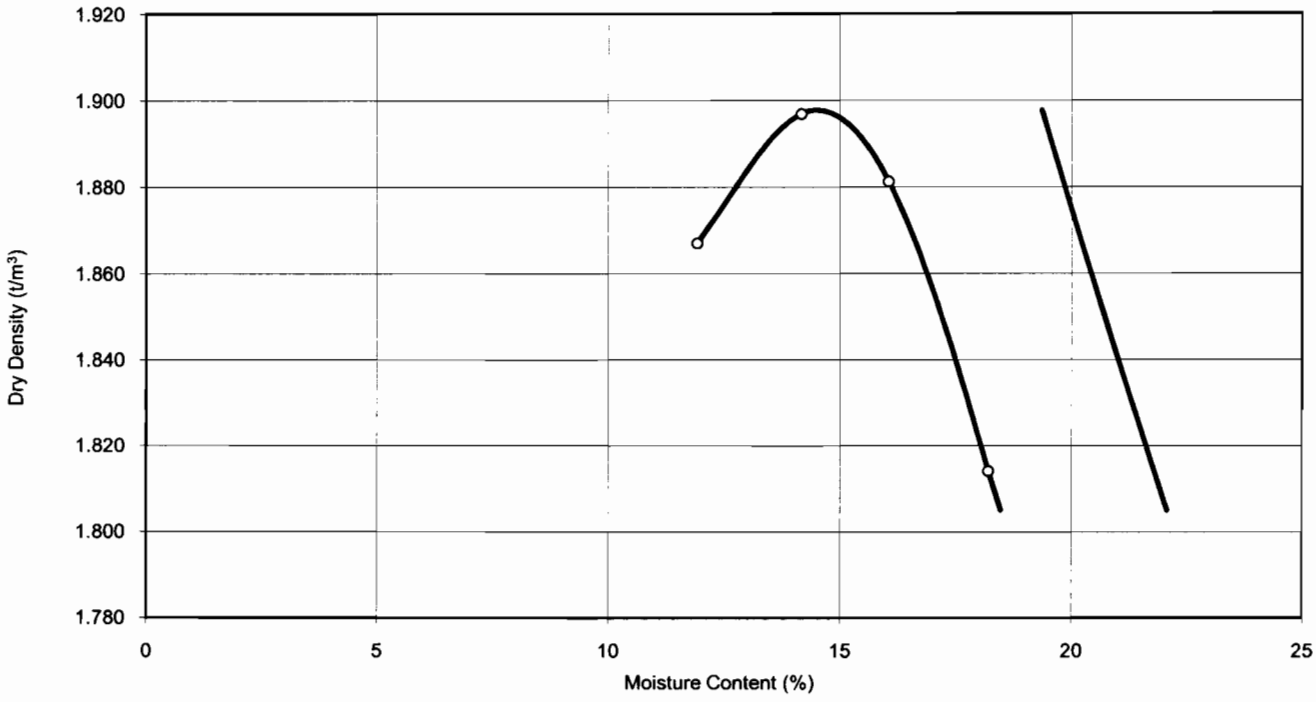
RESULTS OF COMPACTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-204D
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date of Test:**	17/06/2009
		Page:	1 of 1



Sample Details **Location:** 6 **Particles > 19mm:** 0%
Depth: 0.3 - 0.5 m

Description: Clayey Gravel, Orange Brown

Maximum Dry Density:	**1.90 t/m³**
Optimum Moisture Content:	**14.5 %**

Remarks:

Test Methods: AS 1289.5.2.1-2003 (MOD), AS 1289.2.1.1-1998

Sampling Methods: Sampled by Client

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Approved Signatory:

Tested:	MO
Checked:	JH

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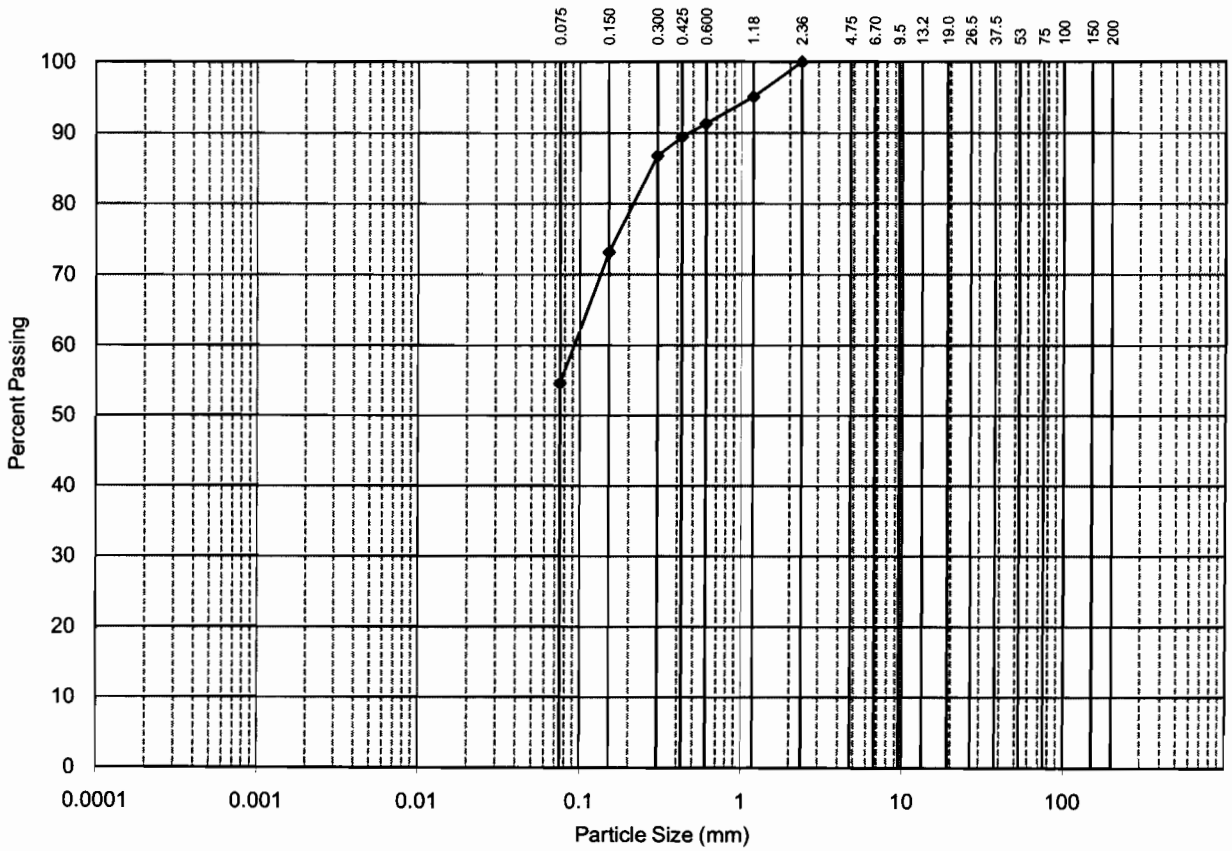
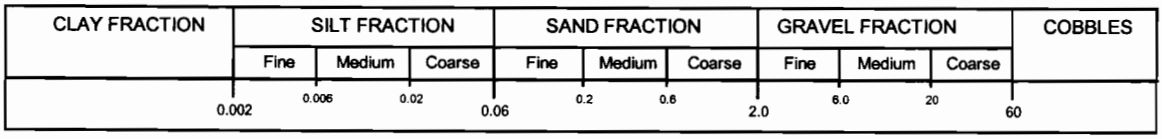
RESULTS OF PARTICLE SIZE DISTRIBUTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-205A
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled:**	16/06/2009
Test Location :	9	**Date of Test:**	30/06/2009
Depth / Layer :	0.3 - 0.6 m	**Page:**	1 of 1

AUSTRALIAN STANDARD SIEVE APERTURES



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	~
2.36	100%
1.18	95%
0.600	91%
0.425	89%
0.300	87%
0.150	73%
0.075	55%



Description: Sandy Clay, Red-Brown

Test Method(s): AS1289.3.6.1 - 2009

Sampling Method(s): Sampled by Client

Method of Dispersion:

Remarks:

NATA Accredited Laboratory Number: 828

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Approved Signatory:

Tested:	AB
Checked:	JH

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Laboratory Manager

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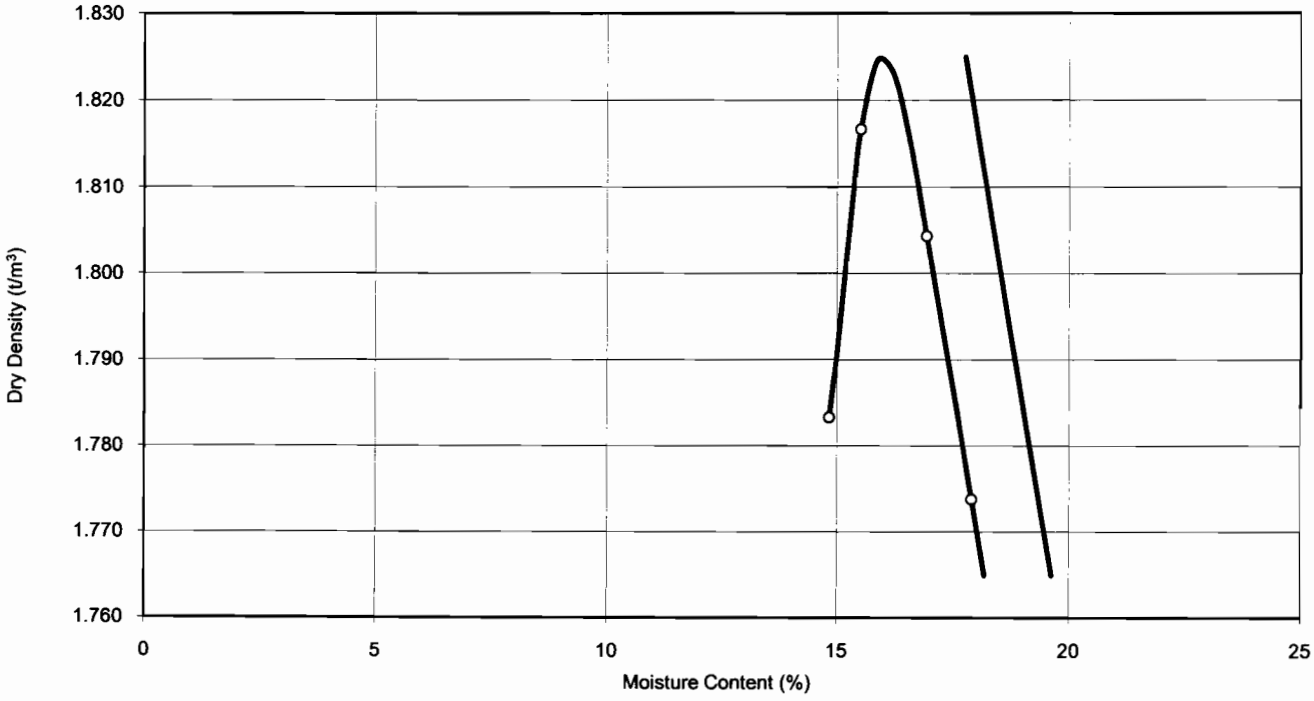
RESULTS OF COMPACTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-205D
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date of Test:**	17/06/2009
		Page:	1 of 1



Sample Details **Location:** 9
Depth: 0.3 - 0.6 m

Particles > 19mm: 0%

Description: Sandy Clay, Red-Brown

Maximum Dry Density:	**1.82 t/m³**
Optimum Moisture Content:	**16.0 %**

Remarks:

Test Methods: AS 1289.5.2.1-2003 (MOD), AS 1289.2.1.1-1998

Sampling Methods: Sampled By Client

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Approved Signatory:

Tested:	MO
Checked:	JH

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Laboratory Manager

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ABN 31 077 518 168

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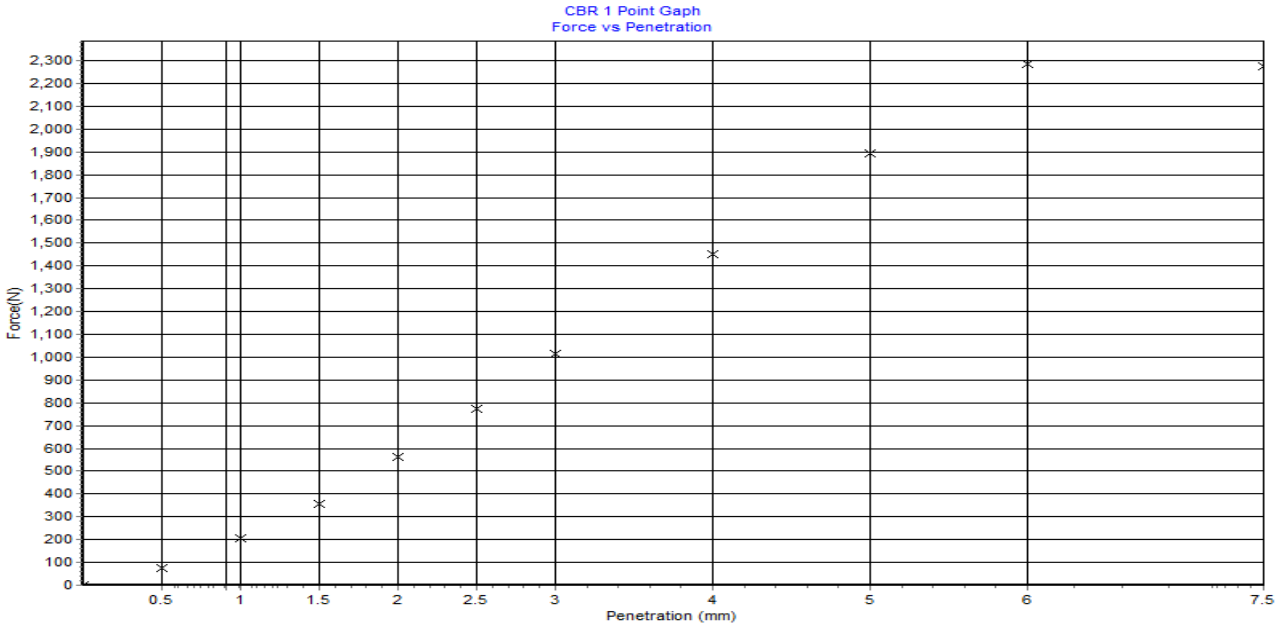
California Bearing Ratio Report (1 Point)

Client:	**Douglas Partners**	Report Number:	**JN630 - 1**
Client address:	**3/59 Winnellie Road Winnellie NT 820**		
Job Number:	**JN630**	Report Date:	**10/07/2009**
Project:	**Quality Control**	Order Number:	**83275**
Location	**Darwin Area , Darwin**		**Page 1 of 1**
Lab No:	**TN 58495**	Sample Location	
Date Sampled:	**02/07/2009**	**CDU Proposed**	
Date Tested:	**07/07/2009**	**Residential S/Division**	
Sampled By:	**Client**	**TP9**	
Sample Method:	**As Received**	**0.3-0.9**	
Material Source:	**Natural**	Test Method :	AS1289.6.1.1
For Use As:	**Insitu**	Lot Number:	**-**
Remarks:	**-**	Item Number :	**-**



Maximum Dry Density - MDD (t/m³) :	**1.825**	Dry Density after Soak (t/m³) :	**1.719**
Optimum Moisture Content - OMC (%) :	**16.0**	Moisture Content after Soak (%) :	**21.2**
Compactive Effort :	**modified**	Density Ratio after Soak (%) :	**94**
Nominated % Maximum Dry Density Compaction :	**95**	Field Moisture Content (%) :	**-**
Nominated % Optimum Moisture Content Compaction :	**100**	Moisture Content (Top) after Penetration (%) :	**22.2**
Achieved Dry Density before Soak (t/m³) :	**1.731**	Moisture Content (Total) after Penetration (%) :	**20.1**
Achieved Percentage of Maximum Dry Density (%) :	**95**	CBR 2.5mm (%) :	**9**
Achieved Moisture Content (%) :	**16.1**	CBR 5.0mm (%) :	**11**
Achieved Percentage of Optimum Moisture Content (%) :	**101**	Minimum Specified CBR Value (%) :	**-**
Test Condition (Soaked/Unsoaked) / Soaking Period (Days) :	**Soaked / 4 days**	Oversize (%) :	N/A
Swell (%) / Surcharge (kg):	**0.7 / 4.5 kg**	**CBR Value (%) :**	**11.0**

Soil Description :

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Approved Signatory

Darryl Tinning
NATA Accred No:11869

Form Number

CBR_1_3-1-34

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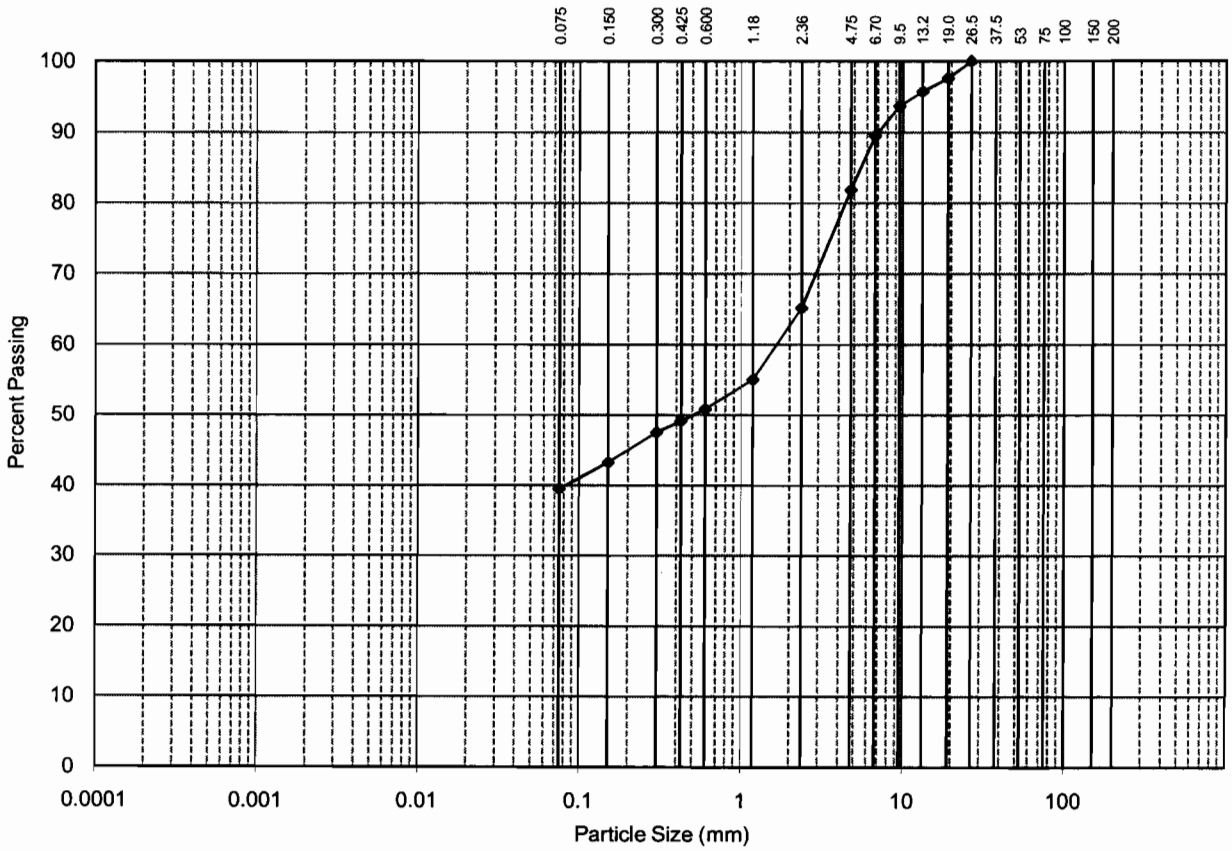
RESULTS OF PARTICLE SIZE DISTRIBUTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-206A
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled:**	16/06/2009
Test Location :	12	**Date of Test:**	17/06/2009
Depth / Layer :	0.4 - 0.6 m	**Page:**	1 of 1

AUSTRALIAN STANDARD SIEVE APERTURES



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	**100%**
19.0	**98%**
13.2	**96%**
9.5	**94%**
6.7	**89%**
4.75	**82%**
2.36	**65%**
1.18	**55%**
0.600	**51%**
0.425	**49%**
0.300	**48%**
0.150	**43%**
0.075	**40%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Clayey Sandy Gravel, Red-Brown

Test Method(s): AS1289.3.6.1 - 2009

Sampling Method(s): Sampled by Client

Method of Dispersion:

Remarks:

NATA Accredited Laboratory Number: 828

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Approved Signatory:

Tested: AB
Checked: JH

J. Hollebone
Laboratory Manager

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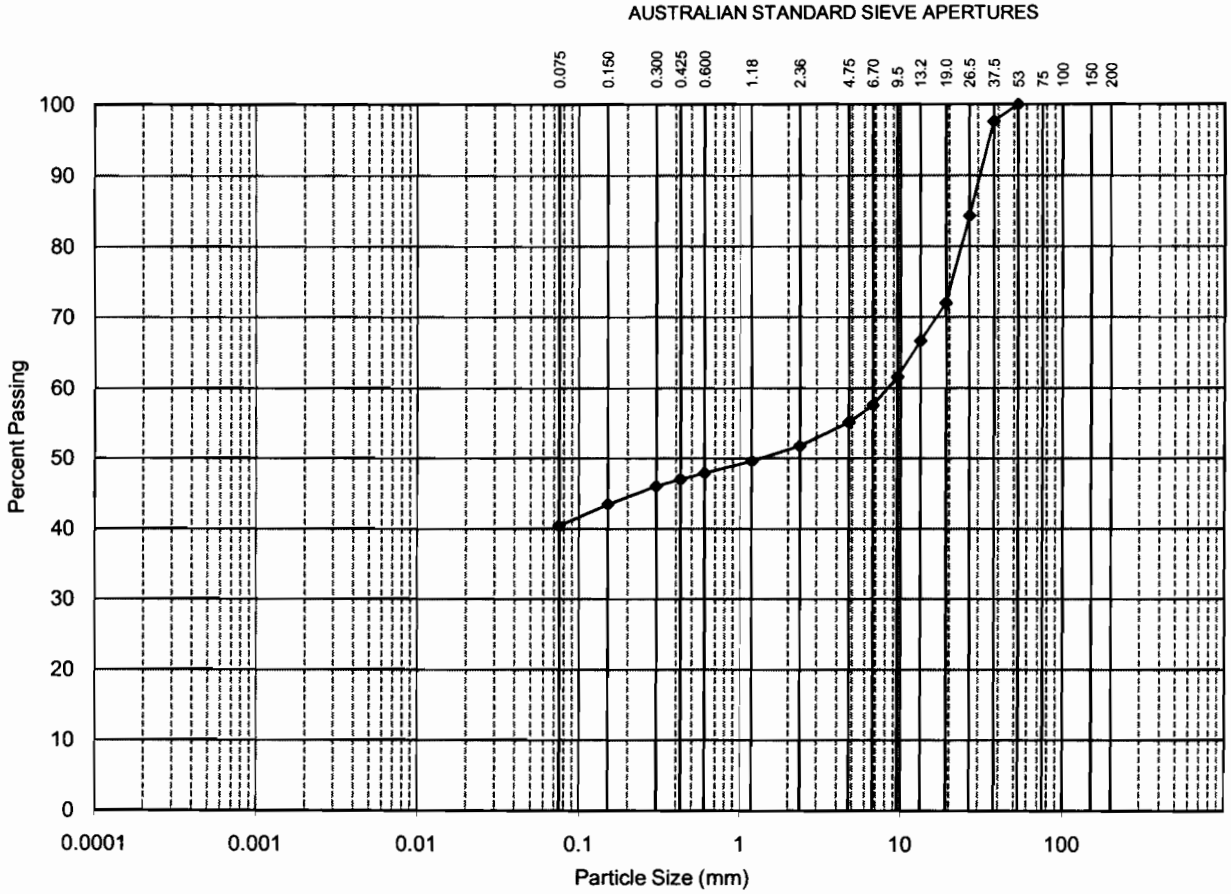
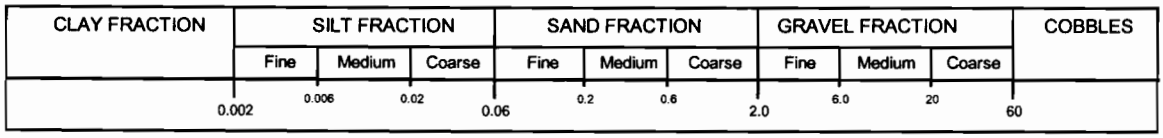
RESULTS OF PARTICLE SIZE DISTRIBUTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-207A
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled:**	16/06/2009
Test Location :	14	**Date of Test:**	24/06/2009
Depth / Layer :	0.3 - 0.5 m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	100%
37.5	98%
26.5	84%
19.0	72%
13.2	67%
9.5	62%
6.7	58%
4.75	55%
2.36	52%
1.18	50%
0.600	48%
0.425	47%
0.300	46%
0.150	43%
0.075	40%



Description: Clayey Sandy Gravel, Orange-Brown

Test Method(s): AS1289.3.6.1 - 2009

Sampling Method(s): Sampled by Client

Method of Dispersion:

Remarks:

NATA Accredited Laboratory Number: 828

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Checked:	JH

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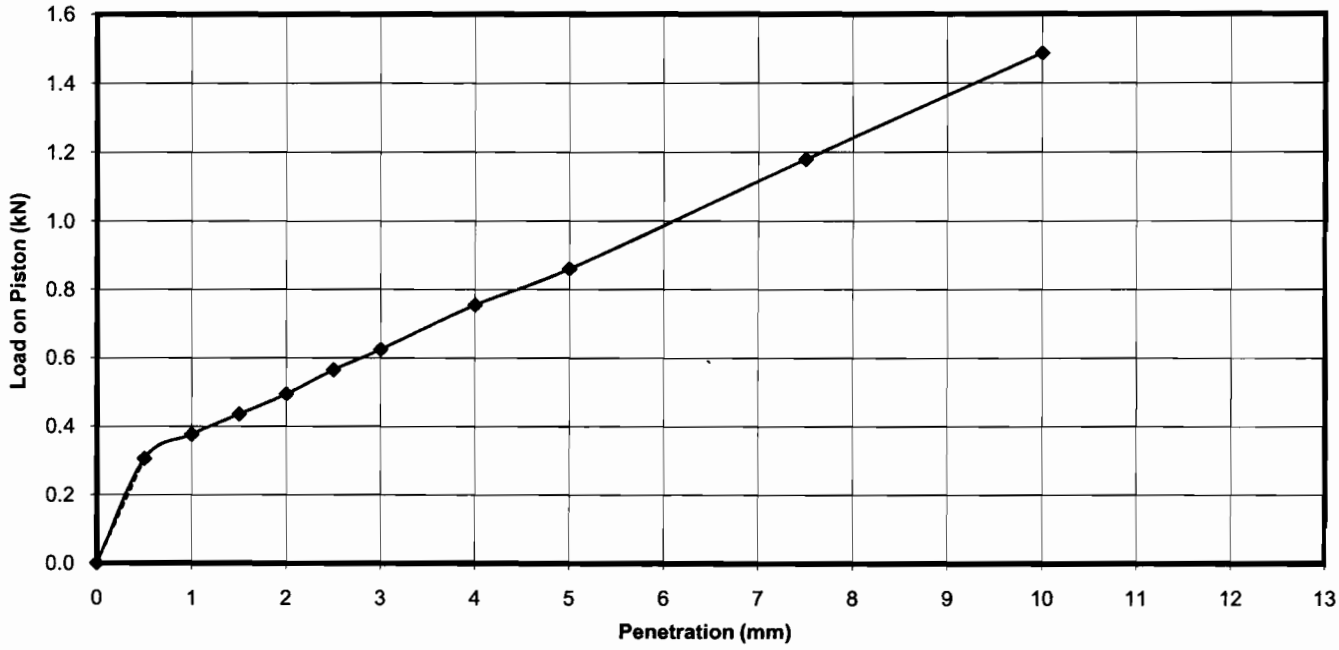
RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-207C
Project :	Proposed Residential Subdivision	**Report Date :**	7/06/2009
Location :	Durack, NT	**Date Sampled :**	15/06/2009
Test Location :	014	**Date of Test:**	30/06/2009
Depth / Layer :	0.3 - 0.5	**Page:**	1 of 1



Description: Clayey Sandy Gravel, Orange-Brown

Test Method(s): AS1289.6.1.1-1998, AS1289.2.1.1-2005

Sampling Method(s): Sampled by Client **Percentage > 19mm:** 0.0%

LEVEL OF COMPACTION: 95% of MOD MDD **SURCHARGE:** 4.5 kg **SWELL:** 4.0%
MOISTURE RATIO: 99% of MOD OMC **SOAKING PERIOD:** 4 days

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		16.0	1.76
After soaking		22.1	1.69
After test	Top 30mm of sample	21.7	-
	Remainder of sample	20.7	-
Field values		20.3	-
Modified Compaction		16.2	1.84

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**2.5 mm**	**4.5**
	5.0 mm	**4.5**

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Approved Signatory:

Tested:	BR
Checked:	JH

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Laboratory Manager

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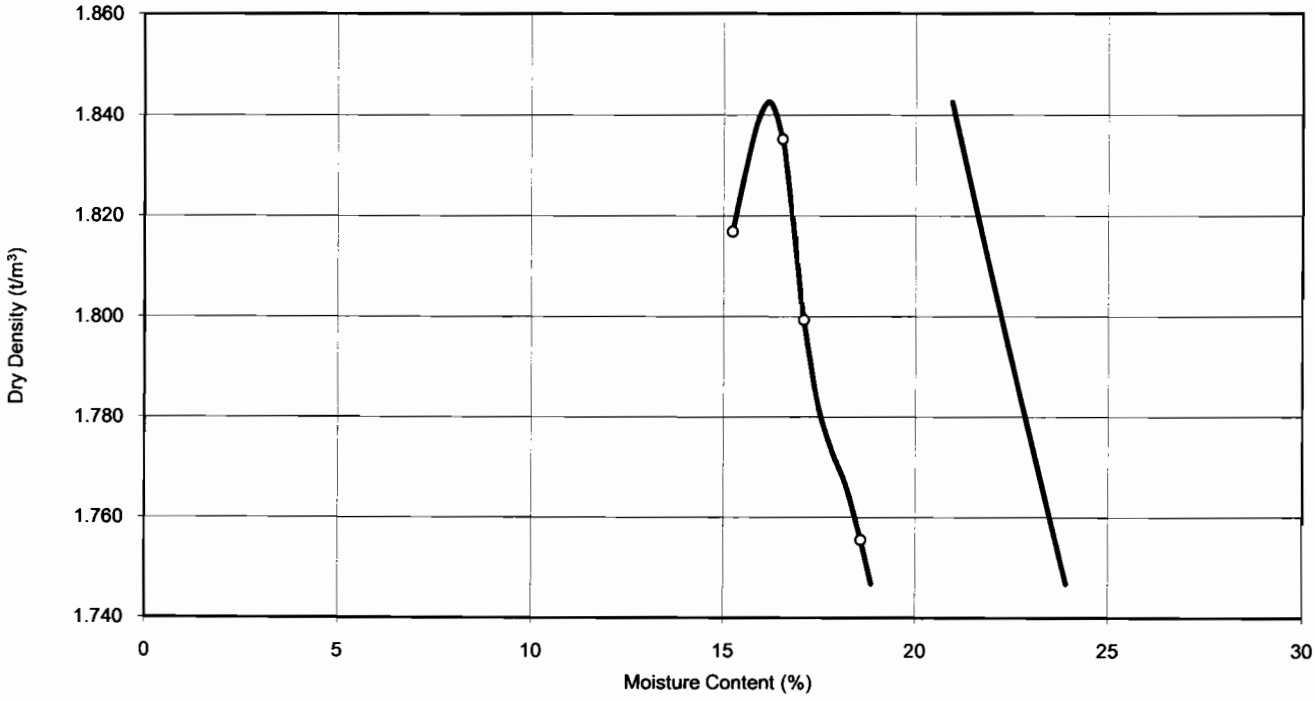
RESULTS OF COMPACTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-207D
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date of Test:**	18/06/2009
		Page:	1 of 1



Sample Details **Location:** 14
Depth: 0.3 - 0.5 m

Particles > 19mm: 0%

Description: Clayey Sandy Gravel, Orange-Brown

Maximum Dry Density:	**1.84 t/m³**
Optimum Moisture Content:	**16.0 %**

Remarks:

Test Methods: AS 1289.5.2.1-2003 (MOD), AS 1289.2.1.1-1998

Sampling Methods: Sampled By Client

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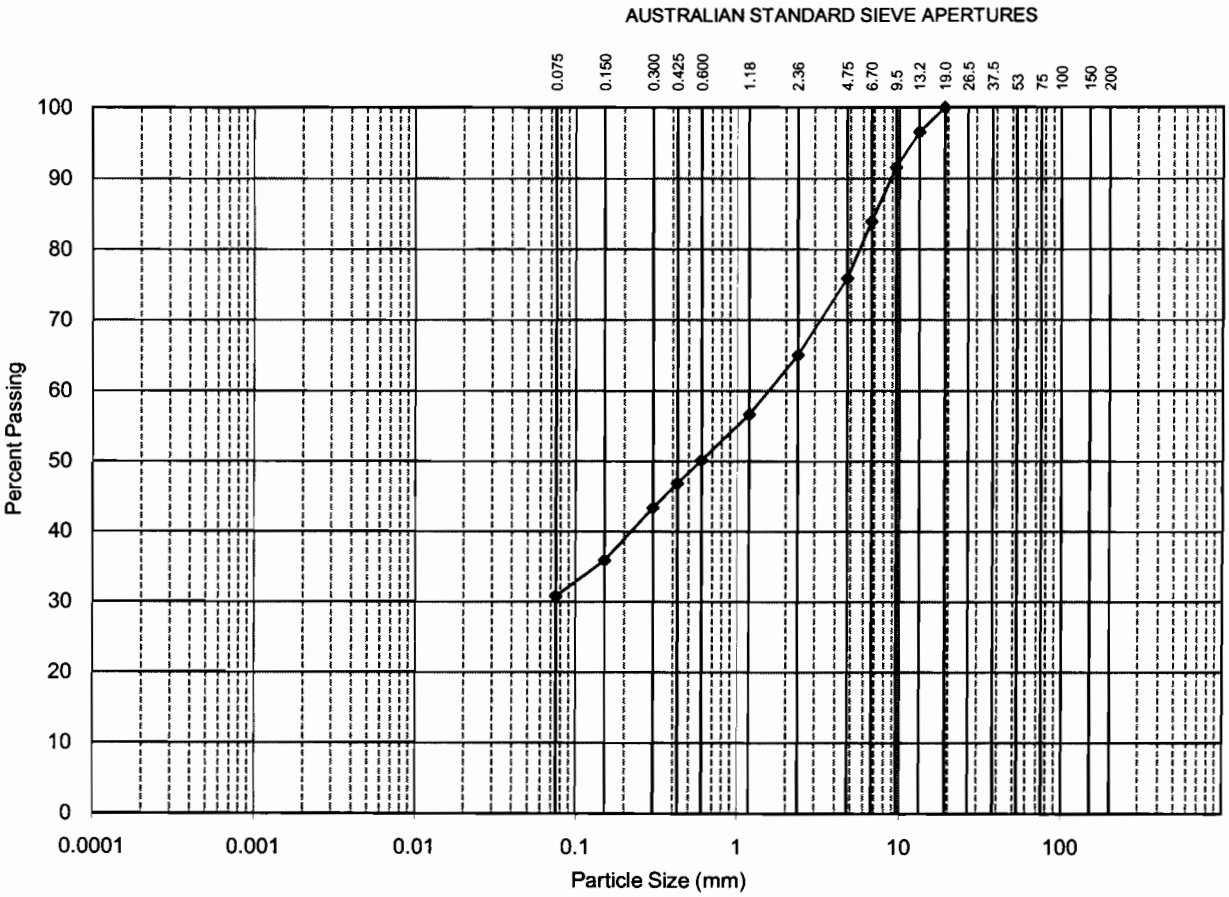
RESULTS OF PARTICLE SIZE DISTRIBUTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-208A
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled:**	16/06/2009
Test Location :	16	**Date of Test:**	17/06/2009
Depth / Layer :	0.6 - 0.9 m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	100%
13.2	97%
9.5	92%
6.7	84%
4.75	76%
2.36	65%
1.18	57%
0.600	50%
0.425	47%
0.300	43%
0.150	36%
0.075	31%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Clayey Sandy Gravel, Orange-Brown

Test Method(s): AS1289.3.6.1 - 2009

Sampling Method(s): Sampled By Client

Method of Dispersion:

Remarks:

NATA Accredited Laboratory Number: 828

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Approved Signatory:

Tested:	AB
Checked:	JH

J. Hollebone
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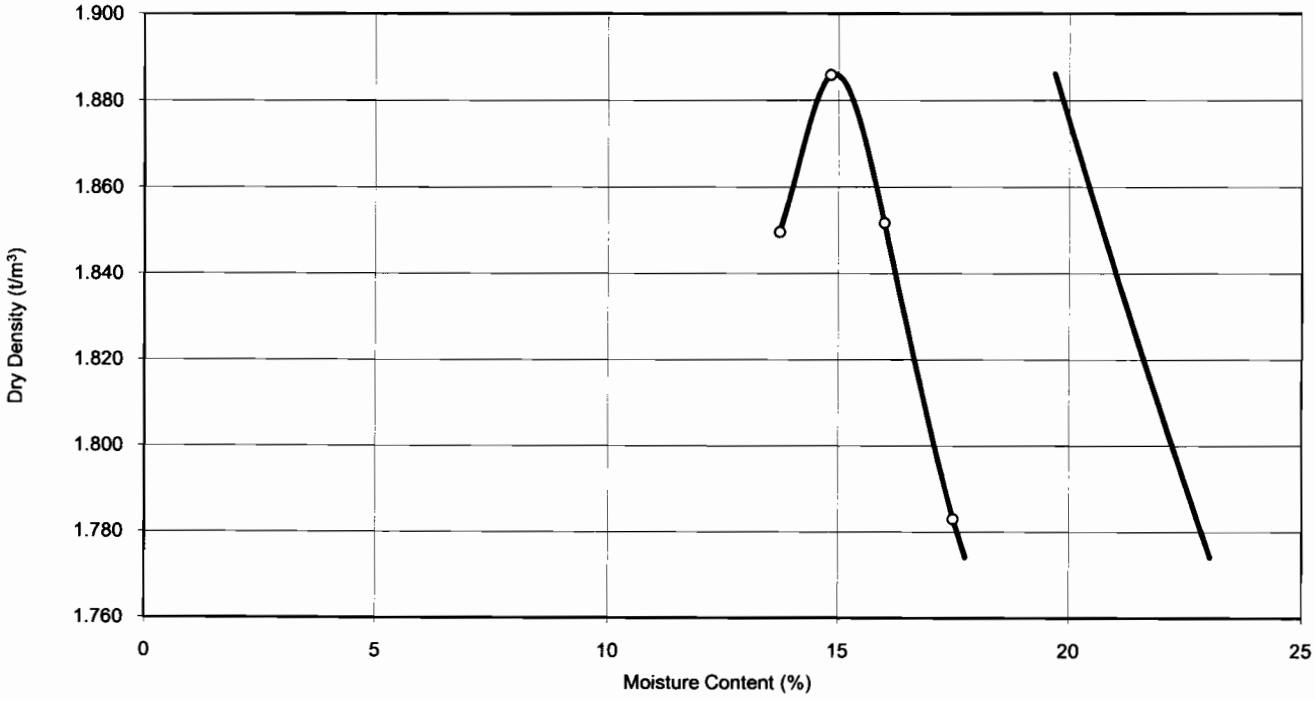
RESULTS OF COMPACTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-208D
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date of Test:**	18/06/2009
		Page:	1 of 1



Sample Details **Location:** 16
Depth: 0.6 - 0.9 m

Particles > 19mm: 0%

Description: Clayey Sandy Gravel, Orange-Brown

Maximum Dry Density:	**1.89 t/m³**
Optimum Moisture Content:	**15.0 %**

Remarks:

Test Methods: AS 1289.5.2.1-2003 (MOD), AS 1289.2.1.1-1998

Sampling Methods: Sampled By Client

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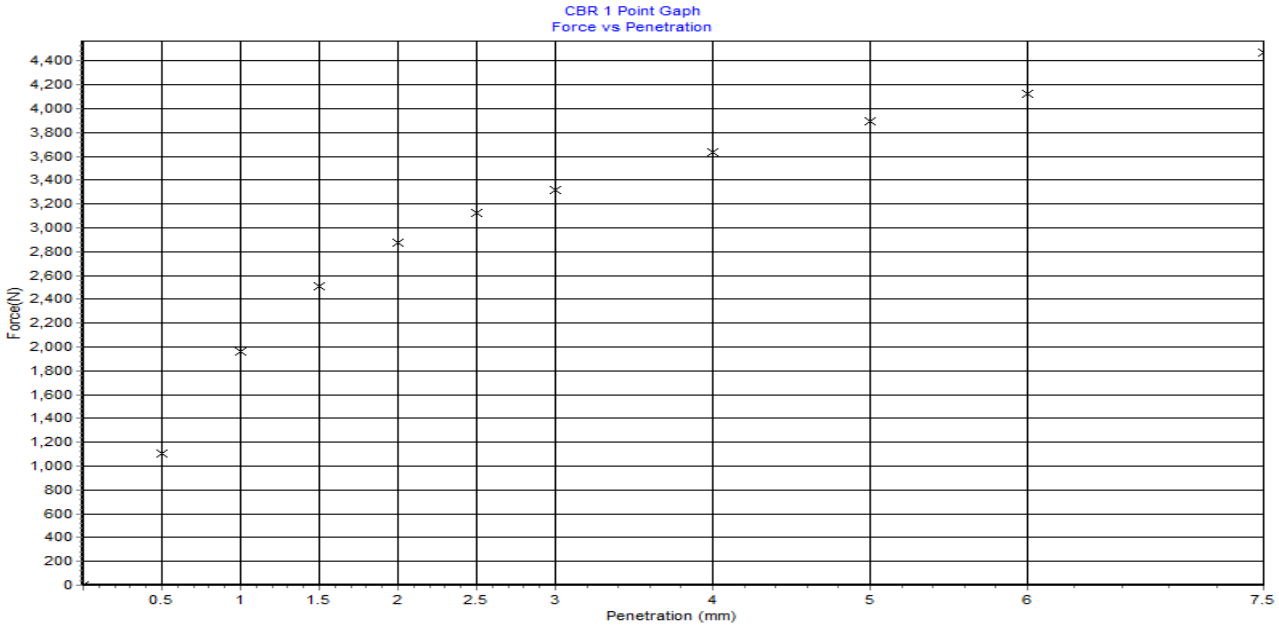
California Bearing Ratio Report (1 Point)

Client:	**Douglas Partners**	Report Number:	**JN630 - 2**
Client address:	**3/59 Winnellie Road Winnellie NT 820**		
Job Number:	**JN630**	Report Date:	**10/07/2009**
Project:	**Quality Control**	Order Number:	**83275**
Location	**Darwin Area , Darwin**		**Page 1 of 1**
Lab No:	**TN 58496**	Sample Location	
Date Sampled:	**02/07/2009**	**CDU Proposed**	
Date Tested:	**07/07/2009**	**Residential S/Division**	
Sampled By:	**Client**	**TP16**	
Sample Method:	**As Received**	**0.6-0.9**	
Material Source:	**Natural**	Test Method :	AS1289.6.1.1
For Use As:	**Insitu**	Lot Number:	**-**
Remarks:	**-**	Item Number :	**-**



Maximum Dry Density - MDD (t/m³) :	**1.890**	Dry Density after Soak (t/m³) :	**1.784**
Optimum Moisture Content - OMC (%) :	**14.6**	Moisture Content after Soak (%) :	**18.1**
Compactive Effort :	**modified**	Density Ratio after Soak (%) :	**94**
Nominated % Maximum Dry Density Compaction :	**95**	Field Moisture Content (%) :	**-**
Nominated % Optimum Moisture Content Compaction :	**100**	Moisture Content (Top) after Penetration (%) :	**19**
Achieved Dry Density before Soak (t/m³) :	**1.793**	Moisture Content (Total) after Penetration (%) :	**17.7**
Achieved Percentage of Maximum Dry Density (%) :	**95**	CBR 2.5mm (%) :	**25**
Achieved Moisture Content (%) :	**14.4**	CBR 5.0mm (%) :	**20**
Achieved Percentage of Optimum Moisture Content (%) :	**99**	Minimum Specified CBR Value (%) :	**-**
Test Condition (Soaked/Unsoaked) / Soaking Period (Days) :	**Soaked / 4 days**	Oversize (%) :	N/A
Swell (%) / Surcharge (kg):	**0.5 / 4.5 kg**	**CBR Value (%) :**	**25.0**

Soil Description :

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Approved Signatory

Darryl Tinning
NATA Accred No:11869

Form Number

CBR_1_3-1-34

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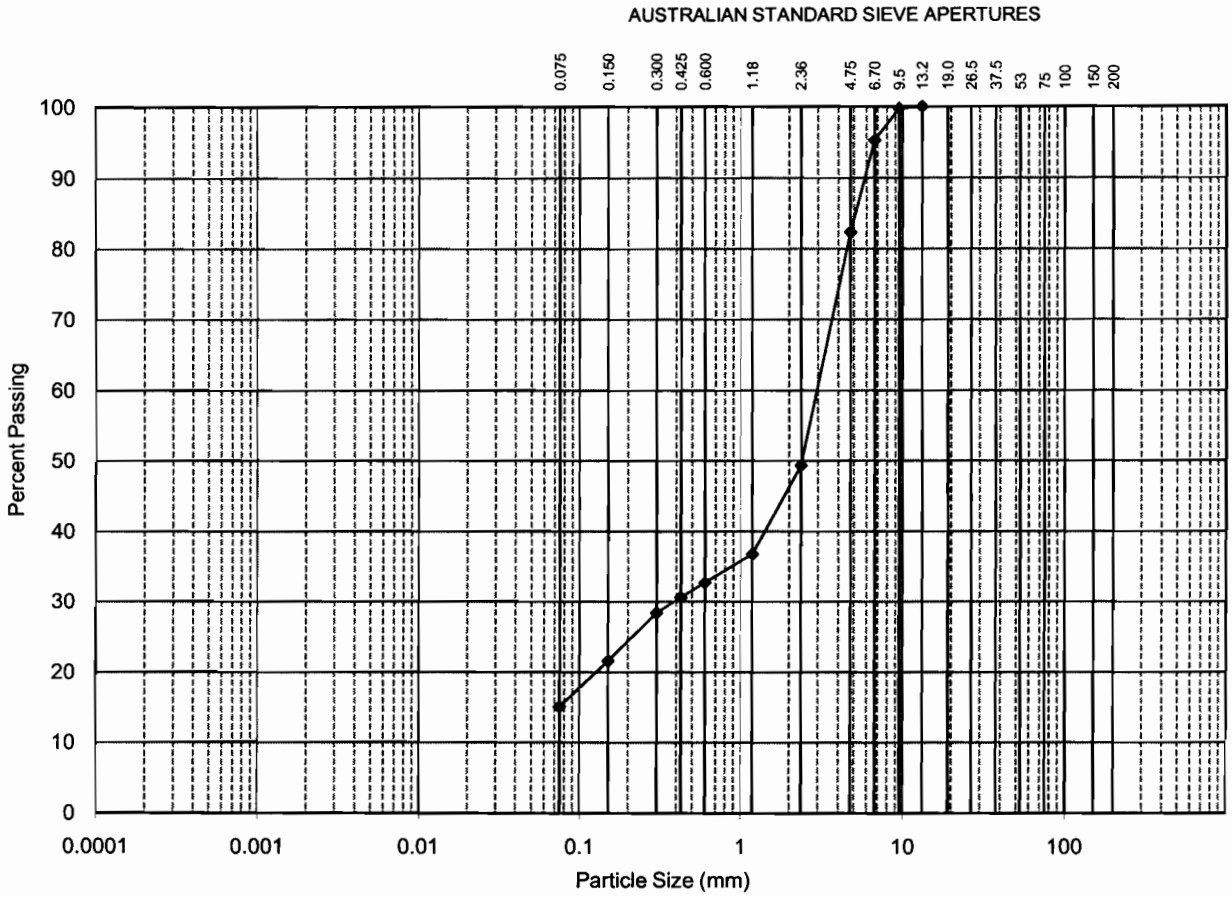
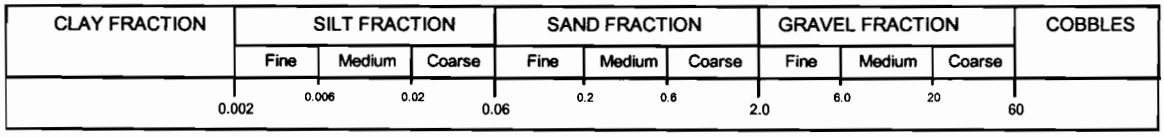
RESULTS OF PARTICLE SIZE DISTRIBUTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-209A
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled:**	16/06/2009
Test Location :	21	**Date of Test:**	17/06/2009
Depth / Layer :	0.4 - 0.6 m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	**100%**
9.5	**100%**
6.7	**95%**
4.75	**82%**
2.36	**49%**
1.18	**37%**
0.600	**33%**
0.425	**31%**
0.300	**28%**
0.150	**22%**
0.075	**15%**



Description: Sandy Clayey Gravel, Orange-Brown

Test Method(s): AS1289.3.6.1 - 2009

Sampling Method(s): Sampled By Client

Method of Dispersion:

Remarks:

NATA Accredited Laboratory Number: 828

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Approved Signatory:

Tested:	AB
Checked:	JH

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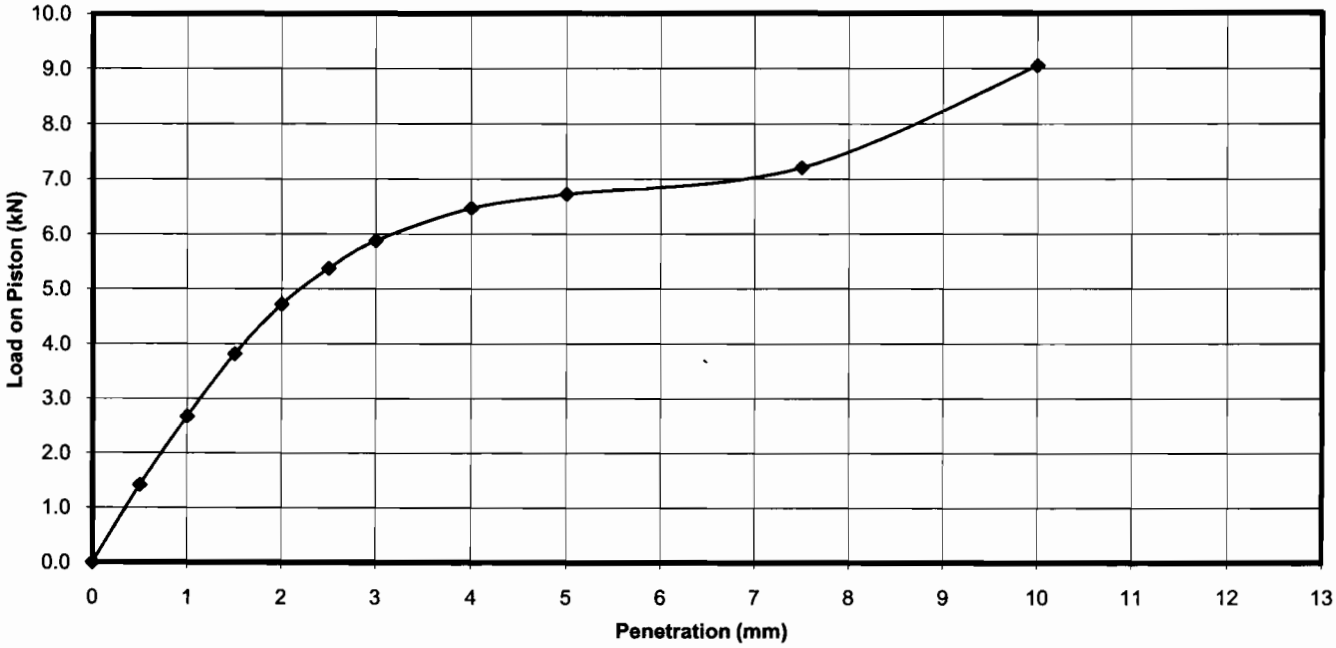
RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-209C
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled :**	15/06/2009
Test Location :	21	**Date of Test:**	30/06/2009
Depth / Layer :	0.4 - 0.6 m	**Page:**	1 of 1



Description: Sandy Clayey Gravel, Orange-Brown

Test Method(s): AS1289.6.1.1-1998, AS1289.2.1.1-2005

Sampling Method(s): Sampled by Client

Percentage > 19mm: 0.0%

LEVEL OF COMPACTION: 95% of MOD MDD
MOISTURE RATIO: 102% of MOD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.2%

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		9.5	2.11
After soaking		13.4	2.11
After test	Top 30mm of sample	13.4	-
	Remainder of sample	12.1	-
Field values		8.0	-
Modified Compaction		9.3	2.23

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**2.5 mm**	**40**
	5.0 mm	**35**

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Approved Signatory:

Tested:	BR
Checked:	JH

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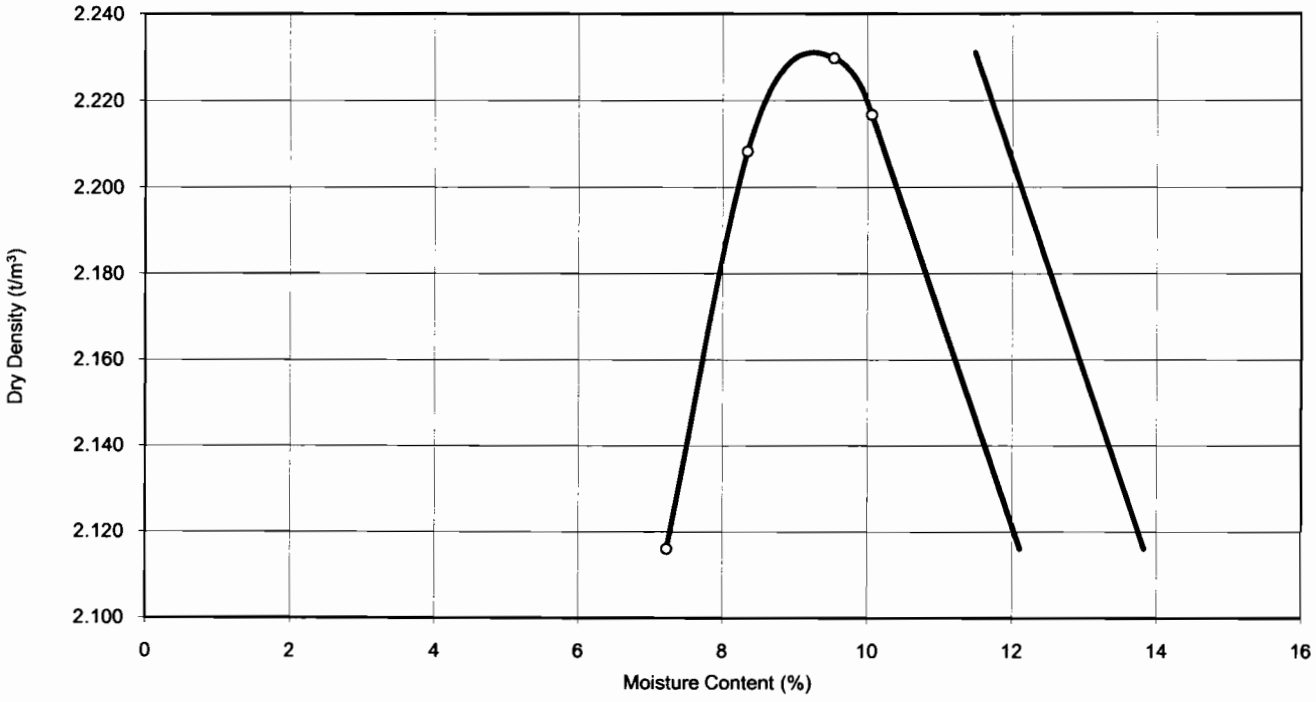
RESULTS OF COMPACTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-209D
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date of Test:**	17/06/2009
		Page:	1 of 1



Sample Details **Location:** 21
Depth: 0.4 - 0.6 m

Particles > 19mm: 0%

Description: Sandy Clayey Gravel, Orange-Brown

Maximum Dry Density:	**2.23 t/m³**
Optimum Moisture Content:	**9.5 %**

Remarks:

Test Methods: AS 1289.5.2.1-2003 (MOD), AS 1289.2.1.1-1998

Sampling Methods: Sampled By Client

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Approved Signatory:

Tested:	MO
Checked:	JH

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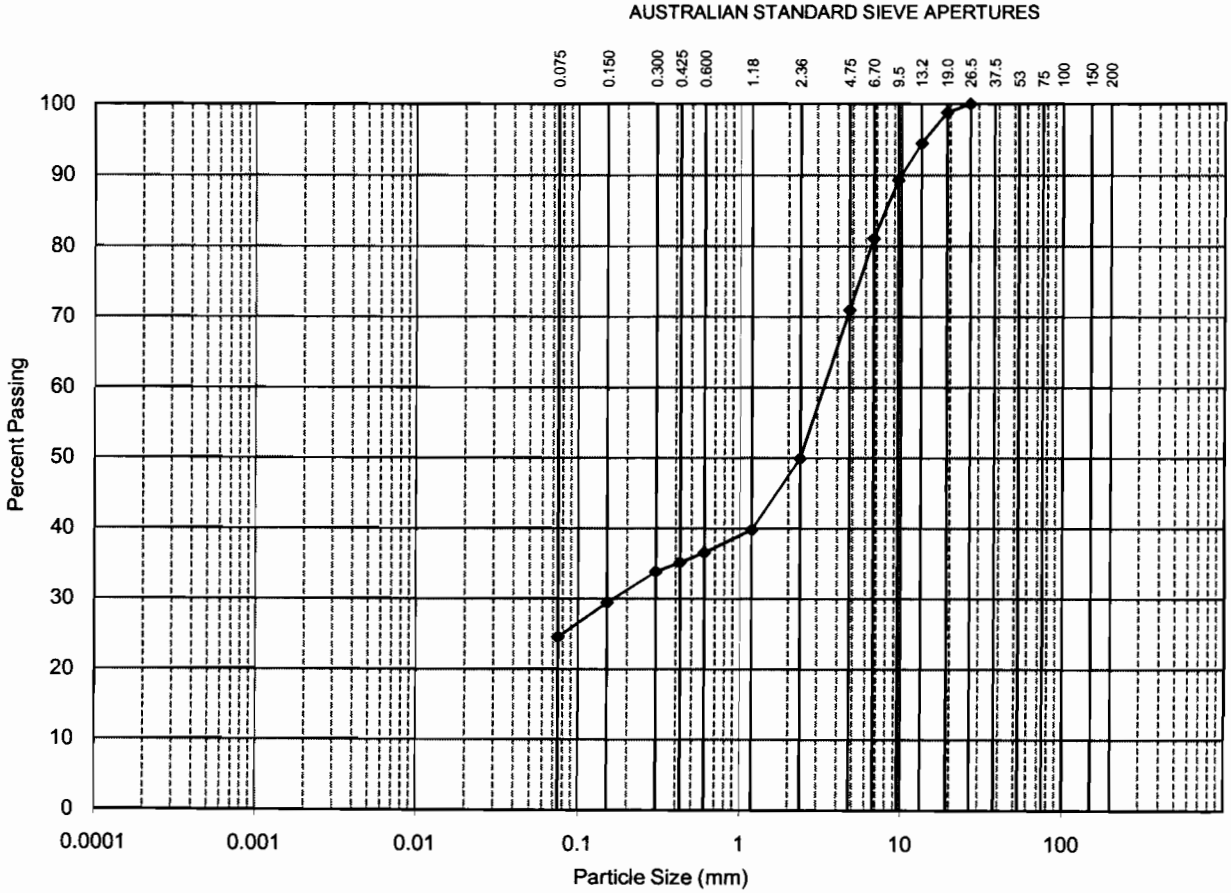
RESULTS OF PARTICLE SIZE DISTRIBUTION TEST

Client :	Charles Darwin University	**Project No. :**	67252/48229
		Report No. :	DL09-210A
Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date Sampled:**	16/06/2009
Test Location :	24	**Date of Test:**	17/06/2009
Depth / Layer :	0.5 - 0.8 m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	**100%**
19.0	**99%**
13.2	**94%**
9.5	**89%**
6.7	**81%**
4.75	**71%**
2.36	**50%**
1.18	**40%**
0.600	**37%**
0.425	**35%**
0.300	**34%**
0.150	**29%**
0.075	**25%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Clayey Sandy Gravel, Red-Brown

Test Method(s): AS1289.3.6.1 - 2009

Sampling Method(s): Sampled By Client

Method of Dispersion:

Remarks:

NATA Accredited Laboratory Number: 828

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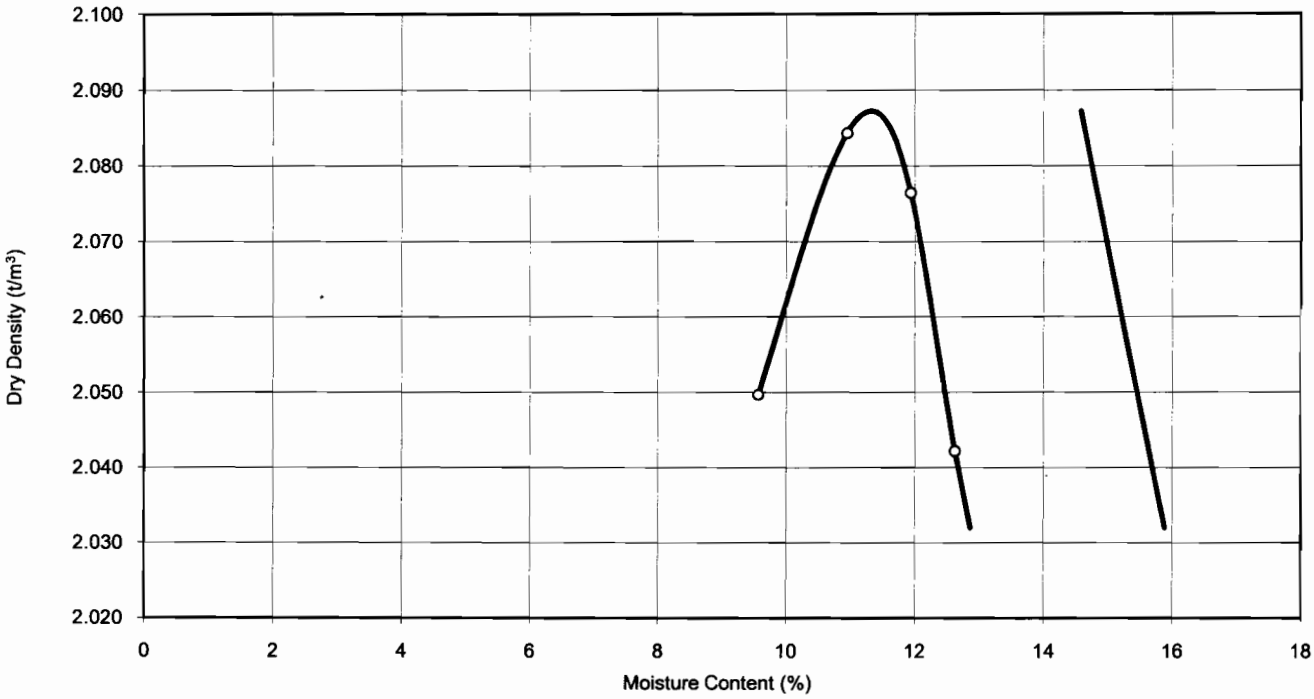
Accredited for compliance with ISO/IEC 17025

Approved Signatory:

Tested: AB
Checked: JH

J. Hollebone
Laboratory Manager

Project :	Proposed Residential Subdivision	**Report Date :**	6/07/2009
Location :	Durack, NT	**Date of Test:**	18/06/2009
		Page:	1 of 1



Sample Details **Location:** 24 **Particles > 19mm:** 0%

Depth: 0.5 - 0.8 m

Description: Clayey Sandy Gravel, Red-Brown

Maximum Dry Density:	**2.09 t/m^3**
Optimum Moisture Content:	**11.5 %**

Remarks:

Test Methods: AS 1289.5.2.1-2003 (MOD), AS 1289.2.1.1-1998

Sampling Methods: Sampled By Client

NATA Accredited Laboratory Number: 828

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Approved Signatory:

Tested:	ABB
Checked:	JH

J. Hollebone
Laboratory Manager

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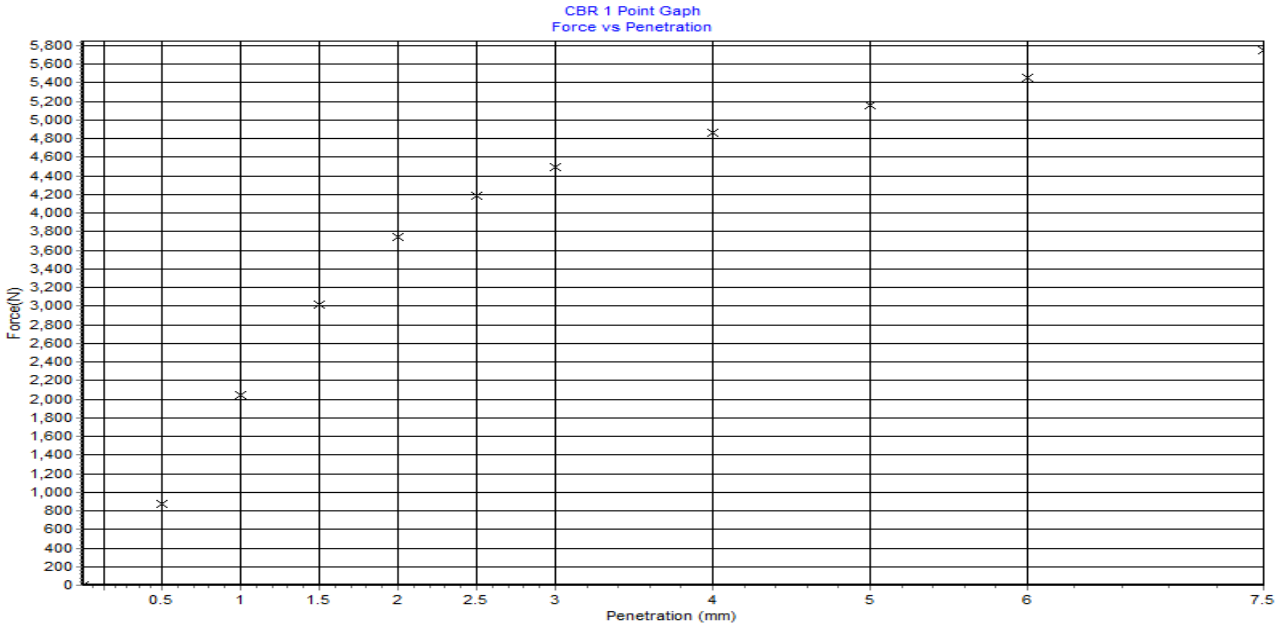
California Bearing Ratio Report (1 Point)

Client:	**Douglas Partners**	Report Number:	**JN630 - 3**
Client address:	**3/59 Winnellie Road Winnellie NT 820**		
Job Number:	**JN630**	Report Date:	**10/07/2009**
Project:	**Quality Control**	Order Number:	**83275**
Location	**Darwin Area , Darwin**		**Page 1 of 1**
Lab No:	**TN 58497**	Sample Location	
Date Sampled:	**02/07/2009**	**CDU Proposed**	
Date Tested:	**07/07/2009**	**Residential S/Division**	
Sampled By:	**Client**	**TP24**	
Sample Method:	**As Received**	**0.5-0.8**	
Material Source:	**Natural**	Test Method :	AS1289.6.1.1
For Use As:	**Insitu**	Lot Number:	**-**
Remarks:	**-**	Item Number :	**-**



Maximum Dry Density - MDD (t/m³) :	**2.087**	Dry Density after Soak (t/m³) :	**1.927**
Optimum Moisture Content - OMC (%) :	**11.3**	Moisture Content after Soak (%) :	**15.9**
Compactive Effort :	**modified**	Density Ratio after Soak (%) :	**92**
Nominated % Maximum Dry Density Compaction :	**95**	Field Moisture Content (%) :	**-**
Nominated % Optimum Moisture Content Compaction :	**100**	Moisture Content (Top) after Penetration (%) :	**16.4**
Achieved Dry Density before Soak (t/m³) :	**1.984**	Moisture Content (Total) after Penetration (%) :	**14.8**
Achieved Percentage of Maximum Dry Density (%) :	**95**	CBR 2.5mm (%) :	**30**
Achieved Moisture Content (%) :	**11.2**	CBR 5.0mm (%) :	**25**
Achieved Percentage of Optimum Moisture Content (%) :	**99**	Minimum Specified CBR Value (%) :	**-**
Test Condition (Soaked/Unsoaked) / Soaking Period (Days) :	**Soaked / 4 days**	Oversize (%) :	N/A
Swell (%) / Surcharge (kg):	**3.0 / 4.5 kg**	**CBR Value (%) :**	**30.0**

Soil Description :

NATA

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Approved Signatory

Darryl Tinning
NATA Accred No:11869

Form Number

CBR_1_3-1-34