

APPENDIX D

Geotechnical Investigation Along Proposed Alignment





REPORT ON GEOTECHNICAL INVESTIGATION

PROPOSED RISING SEWER MAIN, EAST POINT, NT

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REPORT ON GEOTECHNICAL INVESTIGATION PROPOSED RISING SEWER MAIN, EAST POINT, NT

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APPENDICES

APPENDIX A	Site Plans, Site Photos, Borehole Logs, DCP Results
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Our Ref U32527

Contact Ben Parry / Andrew Williams



20 December 2010

1. LETTER OF TRANSMITTAL

Power Water Corporation
GPO Box 4150
Darwin
NT 0800

Attention: Skefos Tsoukalis

REPORT ON GEOTECHNICAL INVESTIGATION PROPOSED RISING SEWER MAIN, EAST POINT, NT

Dear Sir,

We are pleased to present our report for the geotechnical investigation undertaken for the proposed rising main at the above site.

The report details the scope of investigation works and provides discussion and recommendations on the geological conditions, geotechnical design parameters and site characteristics. The findings and recommendations are based on a drilling program undertaken in October 2010.

The principal findings on the investigations are as follows:

- Three natural soil units were identified along the proposed alignment, being alluvial deposits, laterite and residual soil/extremely weathered rock.
- High weathered, porcellanite bedrock is underlying the site at depths ranging from 1.0 to beyond 4.0m.
- Provided foundations are 1.5m deep or greater, the allowable bearing capacity of subsoils exceeds 100 kPa in all locations except for BH28, BH29, BH31 and BH34.
- The proposed rising mains can be laid below ground with trench excavation likely to consist of material with easy to hard ripping characteristics. Some areas which require excavation into medium strength bedrock may encounter very hard ripping conditions.
- The composition of the excavated trench material is generally suitable for trench backfill but may require screening to remove a percentage of the finer grained soils, and/or oversized particles (>25mm) in some areas.
- Some areas are susceptible to tidal and storm surge inundation.
- Type 4 bedding is generally recommended for the length of the alignment however some areas may be suitable for Type 1 bedding.

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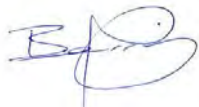
United Arab Emirates



- The general sidewall stability was assessed as good to moderate with 1V:1H batters appropriate. Some areas were identified as having poor stability and should allow for shallower batters.
- No contaminated soils were identified in the investigation
- Corrositivity of the soils tested range from non aggressive to mildly aggressive.
- Acid sulfate soils were identified in the investigation. An acid sulfate management plan will be required prior to earthworks at the site. A further investigation is also recommended to accurately quantify the extent of the acid sulfate soils.

We trust this report meets your requirements and that you will direct any queries to the undersigned.

Yours faithfully,



Ben Parry
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BSc. (Tech)
for **Cardno Ullman & Nolan (NT)**



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2. PROJECT BACKGROUND

As part of broader Darwin Region Sewage Strategy, Power and Water propose to undertake the third stage of the Larrakeyah outfall closure plan. This stage involves the duplication of the East Point effluent rising main and extension of the East Point Outfall.

The planned closure of the Larrakeyah outfall will eliminate the discharge of untreated sewage into Darwin Harbor and meets the requirements of the Water Services' wastewater discharge licence. The duplication of the sewer rising mains will assist in the discharge performance of the LWWTP and the East Point outfall, and increase the disposal capacity for the LWWTP Catchment.

3. SCOPE OF INVESTIGATION

Cardno Ullman & Nolan Geotechnic Pty Ltd (Cardno UNG) has undertaken a geotechnical investigation along the line of the proposed rising sewer main alignment.

The scope of investigation followed the Power Water Corporation Request For Quotation, Quotation No. CTD00709-232, which required a geotechnical investigation at the subject site. A proposal from CUNG was submitted on 21st June 2010 and was accepted on 24th September 2010.

The purpose of the investigation was to provide discussion on the soil conditions and site characteristics and provide recommendations on a number of geotechnical parameters. No specific structural or concept details were provided.

The investigation undertaken included field investigations and laboratory testing in general accordance with the following documentation:

- Australian Standard AS1726 – *Geotechnical Site Investigations*
- Australian Standards AS1289 – *Methods of Testing Soil for Engineering Purposes*
- Australian Standards AS3798 – *Guidelines on earthworks for commercial and residential developments*
- Australian Standards AS4482.1-2005 “*Guide to the investigation and sampling of sites with potentially contaminated soil*”

4. GEOTECHNICAL INVESTIGATION

4.1 Fieldwork

Fieldwork was carried out from the 4th - 8th of October 2010 and comprised the drilling of thirty four (34) boreholes (nominated BH1 – BH35). BH24 was not undertaken due to a construction works in this area. Boreholes were drilled to a target depth of 3 – 4m or earlier refusal. Boreholes were drilled using our IH3100 trailer mounted drill rig. Due to adverse site conditions, BH35 was drilled using a hand auger.

Standard Penetration Tests (SPTs) were conducted at 1.5m intervals in each borehole where appropriate. Dynamic Cone Penetrometer (DCP) tests were undertaken adjacent to each borehole and borehole to a target depth of 2.0m or earlier refusal.

Boreholes were sampled and logged on site by experienced Engineering Geologist and Geoscientist in accordance with AS1726. The test locations were numbered by Cardno UNG and are shown on Figure No's. 2 – 6, presented at the end of this report. Borehole logs including SPT results and DCP test results are presented in Appendix A.

All samples were transported to the Cardno UNG Darwin laboratory upon completion of the fieldwork. During excavation of boreholes, thirty (30) samples were recovered as part of the contamination, corrositivity and acid sulphate soils investigation. Disposable gloves and sealable soil bags were utilised during sampling. Bags were filled to minimize headspace on-site, placed in eskies on ice and transported to our Darwin laboratory to be subsequently sent to an external laboratory for environmental testing.

4.2 Laboratory Testing

Laboratory testing was conducted in accordance with AS1289 at our NATA accredited Darwin Laboratory. The testing comprised of fifteen (15) Atterberg limits and ten (10) particle size distributions in order to assist in classification of soil. Full laboratory results are attached in Appendix B.

A total of thirty (30) samples were collected during the field investigation and sent to Australian Laboratory Services Pty Ltd (ALS) in Brisbane for analytical testing for contaminants, corrositivity and chromium suite (ASS). ALS Laboratory test results are presented in Appendix C.

5. LOCAL GEOLOGY

The solid geology of the subject area is described in the Northern Territory Geological Survey (NTGS) 1:100,000 Geological Map Series titled DARWIN and associated map, Sheet 5073.

The predominant rock member in the immediate area is the horizontally bedded, Darwin Member of the Bathurst Island Formation. This member underlies most of Darwin City and extensively areas to the north, due the very gradual dipping strata (0.1 degrees) to the north. The formation consists of radiolarian claystone, sandy claystone, glauconitic sandstone and a basal conglomerate deposited in the Cretaceous under a shallow marine or paralic, low energy environment.

During the Late Cretaceous and Early Tertiary, alteration of the original smectitic clays to kaolinite, has occurred along with redistribution of silica and iron oxides. This has resulted in the formation of a duracrust, common in the upper few meters, known locally as porcellanite. Porcellanite can be best seen in exposures outcropping along the sea-cliff edges around the northern tip of East Point.

Rocky outcrops are generally scarce in the inland areas, often covered by a thin layer of Quaternary alluvium or colluvium or capped by laterite and saprolite soils, formed from the weathering of the bedrock.

6. SITE DESCRIPTION

Surface Conditions

The proposed rising main alignment runs from the existing Ludmilla Sewage Treatment Plant the northern edge of East Point approximately 3.0km to the northwest. The majority of the alignment traverses near level terrain of clear grassland and relatively open pockets of bush and scrub.

Testing revealed several locations with a surface layer of alluvium which suggests these areas have received flowing surface waters (sheet flows) that have deposit varying amounts of silt, sand and gravel. The majority of testing however, revealed residual soils from the surface indicating a denuded or eroding landscape.

An approximate 350m section of the alignment closest to the Ludmilla sewage treatment plant runs through relatively dense and mature bush. This area is also on the margins of mangrove environment extending back from Ludmilla Creek. This area is particularly low relief and sections are likely to become tidal inundation on king tides and storm surge events. A section of the alignment north of the intersection with Covlias Road is also subject to these conditions.

7. SUBSURFACE CONDITIONS

Due to the distance covered by the investigation and changing geomorphology, the boreholes encountered soil and rock varying in composition and strength. Four distinct subsurface materials were however identified along the length of the alignment. Although not all boreholes revealed the units, the general stratigraphic sequence is as follows.

A surface layer of alluvium was revealed in a number of boreholes, particularly the East Point end of the alignment. The alluvium comprises loose to dense, gravels, silts and sands with thickness ranging from 0.2 – 0.5. BH28 and BH32 at the Ludmilla Sewage Treatment Plant end of the alignment encountered a layer of soil deposited in a shallow marine or mangrove type environment. This material comprised loose, clayey sand and soft clay.

The underlying material was predominately a layer of laterite comprising medium dense to very dense, silty or clayey, sandy gravel. The thickness of the laterite varies from around 0.20 – 0.9m.

The lowest soil unit was residual soil/extremely weathered rock, varying in composition from soft–hard clay to loose–very dense sand and gravel.

The deepest unit revealed in the investigation was very low to moderate strength, highly weathered porcellanite rock. The bedrock generally indicates the borehole refused depth where the porcellanite rock became too difficult to penetrate.

Some boreholes (BH20 and BH31 - BH34) encountered fill soils comprising loose to very dense, silty or clayey sandy gravel to depths ranging from 0.75 – 2.0m.

7.1 Groundwater

Groundwater was encountered within ten of the thirty four boreholes during the investigation. The two general areas where groundwater was encountered were the Ludmilla Sewage treatment Plant end of the alignment and the intersection of the alignment and Covlias Road.

It is likely however, that groundwater will fluctuate significantly under seasonal influences and also under tidal influences. Groundwater may occur as a perched water table particularly above the clay layers and at the soil/bedrock interface.

Table 1: Depth to groundwater when encountered in the boreholes.

Borehole	BH11	BH12	BH13	BH14	BH22	BH23	BH25	BH26	BH30	BH33
Depth (m)	1.0	0.7	0.4	0.8	1.8	1.8	1.2	1.4	1.2	2.5

8. ENGINEERING ASSESSMENT & RECOMMENDATIONS

8.1 Site Classification/Soil Reactivity

The proposed development may be outside the range of dimensions and uses for which the standard footing designs of AS2870-1996 "Residential Slabs & Footings" apply. Footing design for the water mains should be based on engineering principles, using the site classification in this section as a guide to the potential reactivity of the site soils.

Based on the field work and visual/textural examination of the subsurface materials across the site, we consider the classification of the site for design purposes to vary from **CLASS S – Slightly Reactive** to **CLASS M – Moderately Reactive** in accordance with AS2870-1996 "Residential Slabs and Footings"

Borehole locations assigned a **CLASS S**, are considered to have a characteristic ground surface movement as a result of moisture variation (y_s) in the order of 10 to 20mm.

CLASS M sites are considered to have a characteristic ground surface movement (y_s) in the order of 20 to 35mm.

Table 9 provides a classification for each borehole at a foundation depth of 2.0m below surface level.

It is likely the nature and depth to underlying materials will vary across the site. We recommend that inspections be carried out during footing excavations to confirm that conditions exposed are as anticipated.

8.2 Geotechnical Parameters for Foundation and Thrust Block Design

The allowable bearing capacity of the soils at borehole/borehole locations has been calculated using empirical methods, DCP and SPT results. The vertical allowable bearing capacity of the soil encountered across the site has been analysed and estimated to range from 50 – 200 kPa. The bedrock underlying the soil at various depths has an allowable bearing capacity in the order of 200 - 500 kPa.

The horizontal lateral load (lateral allowable bearing capacity) used for thrust block design will be approximately one third of this vertical load value.

Vertical and lateral allowable bearing capacities for various depths along the alignment are provided in Table 2 on the following page.

Table 2: Allowable bearing capacity for various depths at borehole locations.

Borehole No.	Allowable Bearing Capacity (kPa)							
	1.5m		2.0m		2.5m		3.0m	
	Vertical	Lateral	Vertical	Lateral	Vertical	Lateral	Vertical	Lateral
BH1	200	65	200	65	500*	170*	500*	170*
BH2	200	65	200	65	500*	170*	500*	170*
BH3	100	35	100	35	100	35	500	170
BH4	200	65	200	65	500*	170*	500*	170*
BH5	500*	170*	500*	170*	500*	170*	500*	170*
BH6	200	65	500*	170*	500*	170*	500*	170*
BH7	200	65	500*	170*	500*	170*	500*	170*
BH8	500*	170*	500*	170*	500*	170*	500*	170*
BH9	200	65	200	65	200	65	500	170
BH10	200	65	200	65	500	170	500*	170*
BH11	200	65	200	65	500*	170*	500*	170*
BH12	200	65	200	65	500*	170*	500*	170*
BH13	200	65	500*	170*	500*	170*	500*	170*
BH14	200	65	500	170	500*	170*	500*	170*
BH15	500*	170*	500*	170*	500*	170*	500*	170*
BH16	100	35	200	65	200	65	200	65
BH17	200	65	500	170	500*	170*	500*	170*
BH18	200	65	500	170	500*	170*	500*	170*
BH19	100	35	200	65	200	65	500*	170*
BH20	100	35	100	35	200	65	200	65
BH21	200	65	500*	170*	500*	170*	500*	170*
BH22	100	35	200	65	200	65	200	65
BH23	100	35	200	65	500*	170*	500*	170*
BH24 (No Test)	-	-	-	-	-	-	-	-
BH25	200	65	200	65	500*	170*	500*	170*
BH26	100	35	100	35	200	65	500*	170*
BH27	200	65	500*	170*	500*	170*	500*	170*
BH28	50	15	50	15	500	170	500*	170*
BH29	50	15	100	35	100	35	200	65
BH30	100	35	100	35	500	170	500*	170*
BH31	50	15	100	35	100	35	100	35
BH32	500*	500*	500*	170*	500*	170*	500*	170*
BH33	#	#	#	#	100	35	500*	170*
BH34	#	#	50	15	100	35	500	170
BH35	100*	35*	100*	35*	100*	35*	100*	35*

* Assumed information (depth is below borehole refusal/ termination depth)

No recommendation (fill)

8.3 Bedding requirements

Due to the soil and rock encountered within the boreholes, it is likely the proposed new rising main can be embedded in a trench utilizing the insitu soil strength and bedding sand as foundations. As the invert level for the pipe is not yet known, we have provided recommendations based on a trench excavation of 2.0m.

The Summary of Results Table (Table 9) provides an indication of the bedding requirement at each borehole location. The recommendation is based on the underlying material and potential groundwater conditions. If sand, gravel or rock is present at foundation depth, Type 1 bedding is suitable. If silt and clay soils are present or the area is subject to high ground water, Type 4 bedding should be used. Table 3 presents the requirement for Type 1 bedding. Type 4 bedding is Type 1 embedment material encapsulated in geotextile fabric.

Table 3: Type 1 embedment material: Sand, free of clay, dust, salt or organic matter.

<u>SIEVE SIZE</u>	<u>PERCENTAGE PASSING BY DRY WEIGHT</u>	
	TYPE 1A	TYPE 1B
4.75 mm		90 – 100
2.36 mm	100	75 – 100
1.18 mm	95-100	45 – 95
600 um	80-100	20 – 80
300 um	40-80	5 – 40
150 um	0-6	0 – 6
75 um	0-6	0 – 6

Linear shrinkage of materials passing a 425 um sieve shall be less than 2.5%.

Ideally local sand would be sourced for bedding construction, however the investigation did not reveal any suitable source of sand that would comply with Type 1. Bedding material of the above quality should therefore be imported to the site.

8.4 Excavatability

The excavatability of the subsoil materials can range from Class 1 to 6 in the Kirsten's Classification System (Table 4 on the following page).

A summary of the excavatability class assigned for each borehole and borehole location is presented in Table 9.

It should be made clear that the excavation characteristics are estimations only, based on information from borehole drilling and local knowledge.

Table 4: Definition of Eight Point Excavation Classification System for Soil, Detritus, Rock and Boulders

Material Type	Material Excavation Classification ⁽¹⁾		Description of Excavatability
	Class	Class index boundaries	
Soil/Detritus	1	$N < 0.01$	Hand spade
	2	$0.01 < N < 0.1$	Hand pick and spade
	3	$0.1 < N < 1.0$	Power tools
Rock	4	$1.0 < N < 10$	Easy ripping
	5	$10 < N < 100$	Hard ripping
	6	$100 < N < 1,000$	Very hard ripping
	7	$1,000 < N < 10,000$	Extremely hard ripping/blasting
	8	$N > 10,000$	Blasting

Note: ⁽¹⁾ Kirsten Classification System

8.5 Batter Slope Stability

During the drilling of the boreholes, the condition of the hole and the excavated material was examined to give an estimate of the side wall stability of a trench in the area. Table 9 provides an indication at each borehole location in terms of good, moderate and poor side wall stability.

As a guide, the trenches can be battered to 1:1 if the classification is good or moderate and 1V : 1.5H if poor. We stress that if the trench is deeper than 1.5 metres, temporary shoeing will be required for any trench with side wall stability worse than good. Regular inspections of the excavation should be undertaken by a geotechnical professional to provide further recommendations on the sidewall stability.

8.6 Fill Reuse

The composition of the soil in the upper 2.0m varies greatly across the length of the site. The majority of soils, particularly from 1.0 – 2.0m, contain silt and/or clay levels higher than the maximum specification as detailed in Table 5 on the following page. For use as trench backfill these soils will require screening to remove a percentage of finer grained material. Alternately or in conjunction with screening, the trench excavations may be mixed with a more coarse grained material to produce suitable backfill.

Generally low levels of oversized particles were encountered in the soil profile however it is likely that the trench will require excavation through the soil into the shallow bedrock. This excavated material is likely to have a concentration of large particles above the maximum specification and therefore require screening or crushing if intended for use as backfill. This is likely to be the case for all excavations extending into bedrock.

Table 9 provides a recommendation for fill reuse at each borehole location.

Table 5: Required specification of soil suitable for trench backfill

SIEVE SIZE (mm)	PERCENTAGE PASSING BY DRY WEIGHT
25.0	100
9.50	30 – 100
2.36	15 – 65
0.075	5 – 25

8.7 Acid Sulfate Soils

Ten (10) samples were selected for chromium suite testing from boreholes with the highest potential to produce acid sulfate soils. Sample selection was based on the soil colour, consistency and site geomorphology. No acid sulfate or potential acid sulfate soils were identified from BH1 to BH27. This area of the alignment is therefore considered to have a very low risk of producing acid sulfate soils.

Chromium suite results from BH28 and BH34 indicate potential acid sulfate and actual acid sulfate soils are present in this area. Consequently, management of soils will be required if disturbance occurs. The most likely form of disturbance is via excavation of the subsoils at the time of the trench excavation for rising main. Heavy machinery used in the construction process may cause gouging and turning of the subsoils and may therefore contribute further to the production of acid sulfates. If these disturbances during construction works are envisaged, treatment of subsoils with lime will be required.

Table 6 on the following page provides a summary of the chromium suite results and an estimation of required liming rates. Chromium Suite laboratory results are presented in Appendix C.

Acid sulfate soils have been identified and therefore an Acid Sulfate Management Plan will be required prior to earthworks or soil disturbances at this site.

The chromium suite testing was undertaken to identify the presence or absence of acid sulfate soils and is preliminary in nature. We strongly recommend a further investigation is undertaken to accurately quantify the vertical and lateral extent of the acid sulfate producing soils.

Cardno Ullman and Nolan can provide a service to undertake further testing and produce a detailed acid sulfate management plan.

Table 6: Summary of Chromium Suite test results

Borehole	Depth (m)	pH KCl	TAA m/t	s-TAA %S	S Cr %S	s-NAS %S	ANC BT %S	ABA (1) Net Acid %S	Presence of Acid Sulfate Soils (ASS)	Liming Rates (kg/m ³)
BH12	0.1 - 0.5	6.40	<2	<0.01	<0.005	<0.01	-	<0.01	Non-acidic	-
BH13	0.2 - 0.4	6.60	<2	<0.01	<0.005	<0.01	0.76	0.00	Non-acidic	-
BH14	1.5 - 1.8	7.80	<2	<0.01	<0.005	<0.01	<0.01	<0.01	Non-acidic	-
BH16	0.2 - 0.5	6.20	<2	<0.01	0.01	<0.01	-	<0.02	Non-acidic	-
BH27	1.5 - 1.8	5.10	8	0.01	<0.005	<0.01	-	<0.02	Non-acidic	-
BH28	0.3 - 0.4	5.00	26	0.04	0.011	<0.01	-	0.05	Potential/Actual ASS	5.00
BH31	1.5 - 1.8	4.90	11	0.02	<0.005	<0.01	-	<0.03	Non-acidic	-
BH31	3.0 - 4.0	5.60	4	0.01	<0.005	<0.01	-	<0.02	Non-acidic	-
BH34	1.75 - 2.25	6.70	<2	<0.01	0.141	<0.01	<0.01	0.14	Potential ASS	12.00
BH35	0.5 - 0.7	5.60	7	0.01	<0.005	<0.01	-	<0.02	Non-acidic	-

CHROMIUM SUITE

ABA (1)

pH_{KCl}<4.5 Net Acidity = Scr+s-TAA+s-Snas

4.5≤pH_{KCl}<6.5 Net Acidity = Scr+s-TAA

pH_{KCl}>6.5 Net Acidity = Scr - (sANC_{bt}/1.5)

8.8 Corrosistivity

Soil samples taken from ten (10) boreholes were analysed for pH, chloride and sulphate content. Results showed low levels chloride and sulphate with pH levels ranging from 4.5 – 7.9.

The following table provides a classification according to AS 2159 1995 – Piling – Design and Installation, exposure classification for concrete and steel piles.

Table 7: Summary of corrosistivity classification at each test location.

Borehole No.	Concrete	Steel
BH8	Non Aggressive	Non Aggressive
BH11	Mildly Aggressive	Non Aggressive
BH12	Mildly Aggressive	Non Aggressive
BH13	Mildly Aggressive	Non Aggressive
BH16	Non Aggressive	Non Aggressive
BH18	Mildly Aggressive	Non Aggressive
BH20	Non Aggressive	Non Aggressive
BH28	Mildly Aggressive	Non Aggressive
BH31	Mildly Aggressive	Non Aggressive
BH35	Non Aggressive	Non Aggressive

Laboratory results are presented in Appendix C.

8.9 Contamination Issues

A summary of laboratory test results is provided in Table 8 on the next page. Samples were tested for benzene, toluene, exhylbenzene xylene (BTEX), Total Petroleum Hydrocarbons and As, Cd, Cr, Cu, Pb, Ni, Zn and Hg (Metals). Department of Environment and Resource Management (DERM) Environmental and Health-based Investigation Levels (EIL and HIL) are also shown.

All potential contaminants assessed were below EIL and HIL levels, with the exception of BH12 which encountered arsenic levels slightly higher than EIL but lower than HIL. The result is considered very low and the cause may be attributed to naturally high background levels in the soils at this site.

Laboratory results are presented in Appendix C.

It is important to note that the investigation including the sampling program undertaken by Cardno UNG is preliminary in nature and may not reflect the extreme conditions of the site. Materials not investigated by Cardno UNG may contain contaminants exceeding DERM environmental or health based investigation levels.

8.9.1 Laboratory Test Results

Table 8: Environmental Laboratory Test Results

Borehole / Borehole No.	Analysis results in mg/kg															
	8 metals								TPH				BTEX			
	As	Cd	Cr	Cu	Pb	Ni	Zn	Hg	C ₆ -C ₉	C ₁₀ - C ₁₄	C ₁₅ - C ₂₈	C ₂₉ - C ₃₆	B	T	E	X
BH8	10	LDL	178	LDL	7	9	7	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
BH11	17	LDL	229	6	11	8	10	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
BH12	21	LDL	132	10	9	8	10	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
BH13	11	LDL	98	12	LDL	4	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
BH16	14	LDL	219	7	9	9	12	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
BH18	12	LDL	134	9	8	10	15	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
BH20	12	LDL	93	12	7	26	63	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
BH28	20	LDL	37	42	134	11	111	0.1	LDL	LDL	LDL	120	LDL	LDL	LDL	LDL
BH31	12	LDL	88	6	9	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
BH35	6	LDL	16	10	15	2	92	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL	LDL
Environmental Investigation Levels	20	3	400	100	600	60	200	1	-	-	-	-	-	-	-	-
Health Investigation Levels	200	40	200¹	2,000	600	600	14,000	30	-	-	180	180	-	-	-	-

LDL = Lower than Detection Limit ¹ 200 mg/kg is for parks. 24% is for chromium3

Table 9: Summary of results and recommendations from Geotechnical Investigation.

Borehole No.	Excavatability Class			Site Classification / Soil Reactivity ¹	Bedding Type Required ¹	Depth to Highly Weathered Rock (m)	Sidewall Stability	Risk of Tidal/Storm Surge Inundation	Fill Reuse	
	0.0 - 1.0m	1.0– 2.0m	2.0 – 3.0m						Large Particle Screening ²	Fine Particle Screening
BH1	3-4	4-5	5-6	Class S	1	2.20	Poor	No	Minimal	No
BH2	2-4	4	5-6	Class S	1	2.25	Poor	No	No	No
BH3	4-5	4	5	Class M	4	2.90	Poor	No	No	Yes
BH4	4-5	4	5-6	Class M	4	2.25	Moderate	No	No	Yes
BH5	4	5-6	5-6	Class S	1	1.70	Moderate	No	No	Yes
BH6	2-4	4-6	5-6	Class S	1	1.50	Moderate	No	No	Yes
BH7	2-4	4-5	5-6	Class S	1	1.20	Moderate	No	Yes	No
BH8	2-4	4-6	5-6	Class S	1	1.40	Moderate	No	No	Minimal
BH9	2-5	3-4	3-4	Class M	4	3.10	Moderate	No	No	Yes
BH10	5-5	3-4	5-6	Class S	1	2.00	Moderate	No	No	Yes
BH11	3-4	3-4	5-6	Class M	4	2.25	Moderate	Yes	No	Yes
BH12	3-4	3-4	5-6	Class M	4	2.25	Good	Yes	No	Minimal
BH13	3-4	4-6	5-6	Class S	4	1.40	Good	Yes	Yes	Minimal
BH14	3-4	4-5	5-6	Class S	4	2.00	Good	Yes	No	Yes
BH15	4	5-6	5-6	Class S	4	1.30	Moderate	Yes	No	Yes
BH16	2-4	3-4	4-5	Class M	4	2.00	Moderate	No	No	Yes
BH17	2-4	4	5-6	Class S	1	2.00	Moderate	No	No	Yes
BH18	2-4	4	5-6	Class S	1	2.00	Moderate	No	No	Yes
BH19	3-4	4	5-6	Class S	1	1.90	Good	No	No	Minimal
BH20	3-4	4-5	4-5	Class M	4	2.10	Moderate	No	Minimal	Minimal
BH21	3-4	5	5-6	Class M	1	1.00	Moderate	No	No	No
BH22	3-4	3-4	3-4	Class M	4	NA	Moderate	Yes	No	Yes
BH23	3-4	3-4	5-6	Class M	4	2.20	Moderate	No	No	Yes
BH24	3-4	3-4	5-6	Class S	1	2.00	Moderate	No	No	Yes
BH25	-	-	-	-	-	-	-	-	-	-
BH26	3-4	3-4	5	Class M	4	2.60	Moderate	No	Yes	Yes
BH27	5	5	5-6	Class S	1	1.80	Good	No	No	No

¹ Assuming a foundation depth of 2.0m

² Large particle screening of the soil component **excludes** excavation into bedrock.

NE Not Encountered

Table 9: Continued

Borehole No.	Excavatability Class			Site Classification / Soil Reactivity ¹	Bedding Type Required ¹	Depth to Highly Weathered Rock (m)	Sidewall Stability	Risk of Tidal/Storm Surge Inundation	Fill Reuse	
	0.0 - 1.0m	1.0– 2.0m	2.0 – 3.0m						Large Particle Screening ²	Fine Particle Screening
BH28	1-3	3-4	5-6	Class M	4	2.50	Poor	Yes	Minimal	Yes
BH29	1-3	3-4	4-5	Class M	4	NE	Poor	Yes	No	Yes
BH30	2-4	3-4	3-6	Class M	4	2.40	Moderate	Yes	No	Yes
BH31	2-4	3-4	3-4	Class M	4	NE	Poor	Yes	No	Yes
BH32	4	5-6	5-6	Class S	1	NE	Poor	Yes	No	Yes
BH33	4	3-4	4-6	Class M	4	2.65	Poor	Yes	No	Yes
BH34	3-4	3-4	4-5	Class M	4	2.90	Poor	Yes	No	Yes
BH35	1-3	3-6	3-6	Class M	4	NE	Poor	Yes	No	Yes

¹ Assuming a foundation depth of 2.0m

² Large particle screening of the soil component **excludes** excavation into bedrock.

NE Not Encountered

9. LIMITATIONS

The findings presented in this report have been based on a combination of:

- The investigation described herein,
- Professional opinion based on local experience,
- Site visits by an experienced geologist.

Geotechnical services are provided by Cardno Ullman & Nolan Geotechnic Pty Ltd (Cardno UNG) in accordance with generally accepted professional engineering and geologic practice in the area where these services are rendered. The client acknowledges that the present standard in the engineering and geologic and environmental profession does not include a guarantee of perfection, and no other warranty, expressed or implied, is extended by Cardno UNG.

It is the reader's responsibility to verify the correct interpretation and intention of the recommendations presented herein. Cardno UNG assumes no responsibility for misunderstandings or improper interpretations that result in unsatisfactory or unsafe work products. It is the reader's further responsibility to acquire copies of any supplemental reports, addenda or responses to public agency reviews that may supersede recommendations in this report.

The findings presented in this report have been based on the investigation described herein undertaken by Cardno UNG. There are always some variations in subsurface conditions across the site, which cannot be fully defined by investigation. It is unlikely that the measurements and values obtained from sampling and testing during the investigation will represent the extremes of conditions that may exist within the site. Hence it is recommended that if any ground conditions significantly different to those described in this report are encountered during construction, further advice should be immediately sought from Cardno UNG.

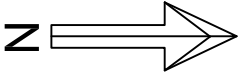
It is recommended that Cardno UNG be commissioned to provide a review of design and documentation to confirm that the intents of the geotechnical report are properly reflected in the designs. Similarly, inspection of the footing excavations is considered a prudent means of ensuring that ground conditions meet design expectations.

This report has been prepared specifically for PowerWater Corporation. Information contained in this report should not be construed as appropriate for any other purposes or for other users.

We appreciate this opportunity to be of service. Please contact Cardno UNG if you have any enquires regarding the findings of this report or if you require further assistance.

APPENDIX A

Site Plans, Site Photos, Borehole Logs, DCP Results



LEGEND



Borehole locations

Proposed alignment

Drawn by

B. PARRY

Checked by

A. WILLIAMS

NOTES

[illegible]

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76 Benson Road, Winnellie, NT
P.O. Box 38623 Winnellie NT 0821
Email: doumihobbs@cardno.com.au
Phone (08) 8984 4953 Fax (08) 8984 4659

CLIENT: POWER WATER CORPORATION

JOB NO: U32527

PROJECT: Proposed East Point Sewer Rising Main

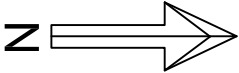
LOCATION: Ludmilla STP - East Point

SCALE at A3

NOT TO SCALE

DRAWING NO.

Fig. 2

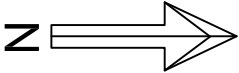


LEGEND

 Borehole locations

 Proposed alignment

Drawn by B.PARRY		Checked by A.WILLIAMS	
Date 21.10.10		Date 23.10.10	
		32527-1A	
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CLIENT: POWER WATER CORPORATION			
JOB NO: U32527			
PROJECT: Proposed East Point Sewer Rising Main			
LOCATION: Ludmilla STP - East Point			
SCALE at A3			
NOT TO SCALE			
DRAWING No.			
Fig. 3			

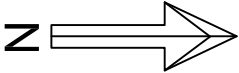


LEGEND

Borehole locations

Proposed alignment

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32527-1A		
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CLIENT: POWER WATER CORPORATION		SCALE at A3 NOT TO SCALE DRAWING No. Fig: 4
JOB NO: U32527		
PROJECT: Proposed East Point Sewer Rising Main LOCATION: Ludmilla STP - East Point		



Borehole locations

Proposed alignment

LEGEND

Drawn by B. PARRY	Checked by A. WILLIAMS
Date 21.10.10	Date 23.10.10

32527-1A

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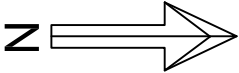


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Email: cardno@cardno.com.au

CLIENT: POWER WATER CORPORATION	SCALE at A3 NOT TO SCALE
JOB NO: U32527	DRAWING No.
PROJECT: Proposed East Point Sewer Rising Main	Fig: 5
LOCATION: Ludmilla STP - East Point	



Borehole locations

Proposed alignment

LEGEND

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Date 21.10.10	Date 23.10.10				

Site Photos



Photo 1: Looking northwest from BH6 down the length of the proposed alignment.



Photo 2: BH12 located in long grass and scrub.



Photo 3: Looking from BH12 southeast towards BH13 over a semi-tidal area.



Photo 4: BH13 located in the semi-tidal area. Note exposed laterite in this in this area.



Photo 5: Looking northwest from BH19 back along the alignment towards BH18.



Photo 6: Very dense laterite exposed in a drain cutting adjacent to BH27.



Photo 7: Low relief, semi-tidal area at BH28 and a stormwater drainage easement.



Photo 8: Low relief, semi-tidal area at BH35, adjacent to the Leanyer Sewage Treatment Plant.

CLIENT: Power & Water Corporation
 PROJECT: East Point Rising Sewer Main
 LOCATION: East Point, Darwin, NT
 UN JOB NO: U32527
 LOGGED BY: BP DATE: 04/10/10 – 09/10/10
 REPORT ON: Descriptive Borehole Logs
 MACHINERY: IH3100 Drill Rig

BOREHOLE NO	DEPTH (m)	MATERIAL DESCRIPTION			
BH 1	0.00-0.30	Sandy Silty Gravel ; pale brown, fine to coarse grained, angular to sub angular, sand is fine to coarse grained, very dense, dry. FILL			
		MPS 50	LL 20	P75 30	(GM)
	0.30-0.80	Silty Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, dry to moist. NATURAL			
		MPS 15	LL 20	P75 20	(GM)
	0.80-1.50	Clayey Sandy Gravel ; red brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, dry to moist. LATERITE			
		MPS 15	LL 35	P75 25	(GC)
SPT 1.5m N=12	1.50-2.20	Sandy Clayey Gravel ; dark brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, dry to moist.			
		MPS 15	LL 45	P75 35	(GC)
	2.20-2.30 Borehole Refusal 2.3m	Highly Weathered Rock : pale grey, low to medium strength.			

BH 2	0.00-0.20	Gravelly Silty Sand ; dark brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, dense, moist. TOPSOIL			
		MPS 10	LL 25	P75 35	(SM)
	0.20-0.50	Silty Sandy Gravel ; pale brown, fine to coarse grained, sub angular to sub rounded, sand is fine to coarse grained, very dense, moist. NATURAL			
		MPS 25	LL 20	P75 20	(GM)
	0.50-1.40	Silty Sandy Gravel ; red brown, fine to coarse grained, sub angular to sub rounded, sand is fine to medium grained, dense, moist. LATERITE			
		MPS 10	LL 25	P75 25	(GM)
SPT 1.5m N=14	1.40-2.10	Sandy Gravel Clay ; brown red, mottled grey, gravel is fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, moist.			
		MPS 10	LL 46	P75 50	(CI)
	2.10-2.25 Borehole Refusal 2.25m	Highly Weathered Rock ; pale yellow, low medium strength.			

BH 3	0.00-0.30	Gravelly Silty Sand ; dark brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, dense, moist. TOPSOIL			
		MPS 10	LL 25	P75 35	(SM)
	0.30-0.50	Silty Sandy Gravel ; dark brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, moist. NATURAL ALLUVIUM			
		MPS 10	LL 15	P75 10	(GM)
	0.50-0.80	Silty Gravelly Sand ; red brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, dense, moist. LATERITE			
		MPS 15	LL 25	P75 30	(SM)
SPT 1.5m N=6	0.80-1.60	Silty Clay ; red brown, mottled grey, with sand, stiff, moist.			
		MPS 10	LL 40	P75 80	(CI)
	1.60-2.90	Silty Clay ; very pale grey, mottled red, stiff, moist			
		MPS 5	LL 45	P75 90	(CI)
SPT 3.0m N=Ref	2.90-3.00 Borehole Refusal 3.0m	Highly Weathered Rock ; pale yellow, low medium strength.			

BH 4	0.00-0.30	Silty Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense, dry to moist. NATURAL ALLUVIUM			
		MPS 10	LL 15	P75 10	(GM)
	0.30-0.75	Sandy Clayey Gravel ; red brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense moist to dry. LATERITE			
		MPS 15	LL 30	P75 30	(GC)
	0.75-1.50	Gravelly Sandy Clay ; brown red, mottled grey, sand is fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, very stiff, moist.			
		MPS 12	LL 54	P75 50	(CH)
SPT 1.5m N=15	1.50-2.10	Silty Clay ; with sand and gravel, very pale red, mottled pale grey, very stiff, moist.			
		MPS 10	LL 45	P75 85	(CI)
	2.10-2.25 Borehole Refusal 2.25m	Highly Weathered Rock ; pale yellow, low medium strength.			

BH 5	0.00-0.10	Silty Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense, moist. TOPSOIL			
		MPS 10	LL 15	P75 10	(GM)
	0.10-0.60	Silty Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, moist. NATURAL ALLUVIUM			
		MPS 10	LL 15	P75 15	(GM)
	0.60-1.10	Sandy Clayey Gravel ; red brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense to very dense, moist.			
		MPS 15	LL 35	P75 35	(GC)
	1.10- 1.25 Borehole Refusal 1.25m	Highly Weathered Rock ; pale brown, low medium strength.			

BH 6	0.00-0.10	Silty Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense, moist. TOPSOIL			
		MPS 10	LL 15	P75 10	(GM)
	0.10-0.50	Silty Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, moist. NATURAL ALLUVIAL			
		MPS 8	LL 25	P75 20	(GM)
	0.50-0.80	Sandy Clayey Gravel ; orange brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense.			
		MPS 15	LL 35	P75 30	(GC)
	0.80-1.50	Silty Clay ; pale grey, mottled red, hard, moist.			
		MPS 3	LL 45	P75 85	(CI)
SPT 1.5m N=Ref	1.50-1.70 Borehole Refusal 1.7m	Highly Weathered Rock ; pale yellow, low medium strength.			

BH 7	0.00-0.25	Silty Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, medium dense, moist. TOPSOIL			
		MPS 10	LL 15	P75 10	(GM)
	0.25-0.90	Clayey Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, moist. NATURAL			
		MPS 10	LL 30	P75 20	(GC)
SPT 1.5m N=16	0.90-1.80	Silty Clay ; pale grey, mottled red, hard, moist.			
		MPS 3	LL 45	P75 85	(CI)
	1.80-1.90 Borehole Refusal 1.9m	Highly Weathered Rock ; pale yellow, low medium strength.			

BH 8	0.00-0.10	Silty Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, medium dense, moist. TOPSOIL			
		MPS 10	LL 15	P75 10	(GM)
	0.10-0.50	Silty Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, moist. NATURAL ALLUVIUM			
		MPS 10	LL 10	P75 15	(GM)
	0.50-1.20	Sandy Clayey Gravel ; brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very dense, moist.			
		MPS 15	LL 40	P75 35	(GC)
	1.20-1.40 Borehole Refusal 1.4m	Highly Weathered Rock ; pale orange, low medium strength.			

BH 9	0.00-0.25	Silty Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, dense, moist. TOPSOIL			
		MPS 10	LL 15	P75 10	(SM)
	0.25-0.50	Silty Sandy Gravel ; pale brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very dense, moist. NATURAL ALLUVIUM			
		MPS 10	LL 10	P75 15	(GM)
	0.50-0.80	Clayey Sandy Gravel ; dark brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very dense, moist. LATERITE			
		MPS 15	LL 35	P75 90	(GC)
SPT 1.5m N=14	0.80-2.00	Silty Clay ; pale yellow grey, very stiff, moist.			
		MPS 2	LL 45	P75 90	(CI)
	2.00-2.50	Silty Clay ; pale yellow brown, trace sand and gravel, very stiff, moist.			
		MPS 2	LL 35	P75 80	(CI)
SPT 3.0m N=Ref	2.50-3.10	Clay ; purple, very stiff to hard, moist.			
		MPS 1	LL 50	P75 95	(CI)
	3.10-4.00 Borehole Refusal 4.0m	Highly Weathered Rock ; pale yellow, low medium strength.			

BH 10	0.00-0.10	Silty Gravelly Sand ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, moist. TOPSOIL			
		MPS 10	LL 15	P75 10	(GM)
	0.10-0.40	Silty Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, moist. NATURAL ALLUVIUM			
		MPS 10	LL 10	P75 15	(GM)
	0.40-1.10	Clayey Sandy Gravel ; dark brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very dense, moist. LATERITE			
		MPS 15	LL 35	P75 20	(GC)
	1.10-1.50	Silty Clay ; with sand, pale grey, mottled yellow, very stiff, moist.			
		MPS 2	LL 40	P75 80	(CI)
SPT 1.5m N=Ref	1.50-2.00	Sandy Clay ; pale grey brown, fine to coarse grained, hard, moist.			
		MPS 10	LL 47	P75 60	(CI)
	2.00-2.50 Borehole Refusal 2.5m	Highly Weathered Rock ; pale yellow, low medium strength.			

BH 11	0.00-0.10	Silty Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, medium dense, moist to dry. TOPSOIL			
		MPS 10	LL 15	P75 10	(GM)
	0.10-1.00	Sandy Gravelly Clay ; pale red brown, gravel is fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, moist to wet. NATURAL WATER TABLE AT 1.0m			
		MPS 15	LL 65	P75 45	(CH)
SPT 1.5m N=18	1.00-1.80	Sandy Silty Clay ; red brown, mottled grey, sand is fine to coarse grained, stiff to very stiff, moist to wet.			
		MPS 5	LL 41	P75 65	(CI)
	1.80-2.15	Silty Clay ; pale grey, mottled yellow, with sand, stiff, moist.			
		MPS 2	LL 45	P75 80	(CI)
	2.15-2.25 Borehole Refusal 2.25m	Highly Weathered Rock ; pale grey, low medium strength.			

BH 12	0.00-0.10	Silty Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, loose, moist to dry. TOPSOIL			
		MPS 10	LL 15	P75 10	(SM)
SPT 1.5m N=Ref	0.10-1.90	Gravelly Sandy Clay ; pale brown, sand is fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, firm to hard, moist to wet. Becoming mottled with pale grey and red at 1.0m. NATURAL WATER TABLE AT 0.7m			
		MPS 10	LL 45	P75 55	(CI)
	1.90-2.15	Silty Clay ; pale yellow brown, stiff to hard, moist.			
		MPS 1	LL 40	P75 85	(CI)
	2.15-2.25 Borehole Refusal 2.25m	Highly Weathered Rock ; orange brown, low medium strength.			

BH 13	0.00-0.50	Clayey Sandy Gravel; brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very loose to dense, moist. LATERITE WATER TABLE AT 0.4m			
		MPS 15	LL 30	P75 15	(GC)
	0.50-1.40	Sandy Clayey Gravel; brown red, fine to coarse grained, sub angular to sub rounded, sand is fine to coarse grained, loose to medium dense, wet.			
		MPS 25	LL 38	P75 35	(GC)
SPT 1.5m N=Ref	1.40-1.60 Borehole Refusal 1.60m	Highly Weathered Rock; yellow brown, low medium strength.			

BH 14	0.00-0.20	Sandy Silty Gravel; pale brown, fine to medium grained, angular to sub angular, sand is fine to coarse grained, loose, dry. FILL			
		MPS 10	LL 20	P75 20	(GM)
	0.20-0.50	Sandy Clayey Gravel; brown red, fine to coarse grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, wet. LATERITE			
		MPS 25	LL 38	P75 35	(GC)
SPT 1.5m N=Ref	0.50-2.00	Silty Gravely Clay; pale grey, mottled yellow and orange, fine to medium grained, sub angular to sub rounded, firm to hard, wet. Becoming pale yellow brown at 1.5m. WATER TABLE AT 0.8m			
		MPS 10	LL 40	P75 65	(CI)
	2.00-2.10 Borehole Refusal 2.10m	Highly Weathered Rock; yellow brown, low medium strength.			

BH 15	0.00-0.10	Sandy Silty Gravel ; pale brown, fine to medium grained, angular to sub angular, sand is fine to coarse grained, very loose, dry. FILL			
		MPS 10	LL 20	P75 20	(GM)
	0.10-0.60	Clayey Sandy Gravel ; brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, moist to wet. LATERITE			
		MPS 15	LL 30	P75 15	(GC)
	0.60-0.80	Sandy Clayey Gravel ; grey brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, moist to wet.			
		MPS 15	LL 38	P75 35	(GC)
	0.80-1.10	Clay ; pale grey, mottled brown, with sand and gravel, very stiff, moist.			
		MPS 10	LL 40	P75 80	(CI))
	1.10-1.30	Gravelly Sandy Clay ; very pale grey, sand is fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, very stiff to hard, moist.			
		MPS 10	LL 35	P75 65	(CI)
	1.30-1.35 Borehole Refusal 1.35m	Highly Weathered Rock ; pale yellow grey, low medium strength.			

BH 16	0.00-0.10	Sandy Silty Gravel ; pale brown, fine to medium grained, angular to sub angular, sand is fine to coarse grained, very loose, moist. TOPSOIL			
		MPS 10	LL 20	P75 20	(GM)
	0.10-0.90	Clayey Sandy Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense, moist. Becoming brown red at 0.6m. NATURAL			
		MPS 15	LL 35	P75 15	(GC)
	0.90-1.50	Silty Clay ; very pale grey, mottled red, stiff, moist.			
		MPS 20	LL 45	P75 85	(CI)
SPT 1.5m N=6	1.50-2.00	Silty Clay ; with sand and gravel, very pale grey to white, stiff to hard.			
		MPS 20	LL 40	P75 80	(CI)
SPT 3.0m N= Ref	2.00 – 3.00 Borehole Terminated at 3.0m	Highly Weathered Rock ; pale purple, very low to low strength			

BH 17	0.00-0.40	Silty Sandy Gravel ; very dark brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense, moist. TOPSOIL			
		MPS 10	LL 20	P75 10	(GM)
	0.40-0.70	Clayey Sandy Gravel ; brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense, moist. NATURAL			
		MPS 8	LL 30	P75 25	(GC)
	0.70-1.10	Sandy Clayey Gravel ; brown red, mottled yellow, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense to very dense.			
		MPS 15	LL 40	P75 40	(GC)
SPT 1.5m N=Ref	1.10-1.70	Gravelly Clay ; very pale grey, gravel is fine to coarse grained, sub angular to sub rounded, hard, moist.			
		MPS 25	LL 40	P75 70	(CI)
	1.70-2.00	Gravelly Sandy Clay ; pale yellow brown, sand is fine to coarse grained, gravel is fine to medium grained, angular to sub angular, hard moist.			
		MPS 15	LL 40	P75 60	(CI)
	2.00-2.05 Borehole Refusal 2.05m	Highly Weathered Rock ; pale yellow brown, low to medium strength			

BH 18	0.00-0.10	Sandy Silty Gravel ; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very loose, moist. TOPSOIL			
		MPS 10	LL 20	P75 20	(GM)
	0.10-0.50	Silty Sandy Gravel ; pale brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense, moist. NATURAL ALLUVIUM			
		MPS 15	LL 25	P75 15	(GM)
	0.50-1.00	Gravelly Clayey Sand ; pale brown red, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, dense to very dense, moist.			
		MPS 15	LL 42	P 75 38	(GC)
	1.00-1.30	Sandy Gravelly Clay ; brown red, mottled grey, gravel is fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, stiff to vert stiff, moist.			
		MPS 10	LL 40	P75 55	(CI)
SPT 1.5m N=10	1.30-1.60	Silty Clay ; very pale grey to white, very stiff, moist.			
		MPS 2	LL 45	P75 90	(CI)
	1.60-2.00	Gravelly Sandy Clay ; pale yellow brown, fine to coarse grained, gravel is fine to medium grained, angular to sub angular, very stiff, moist.			
		MPS 15	LL 40	P75 60	(CI)
	2.00-2.05 Borehole Refusal 2.05m	Highly Weathered Rock ; pale yellow brown, low to medium strength.			

BH 19	0.00-0.40	Silty Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, dense, moist. TOPSOIL			
		MPS 10	LL 15	P75 10	(SM)
	0.40-0.80	Clayey Sandy Gravel ; dark orange brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, moist. LATERITE			
		MPS 15	LL 30	P75 15	(GC)
SPT 1.5m N=6	0.80-1.90	Sandy Clayey Gravel ; dark brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, moist.			
		MPS 15	LL 52	P75 35	(GC)
	1.90-2.60 Borehole Refusal 2.6m	Highly Weathered Rock ; pale grey brown to red yellow, low strength.			

BH 20	0.00-0.80	Silty Sandy Gravel ; very dark brown, fine to coarse grained, angular to sub rounded, sand is fine to coarse grained, medium dense, dry to moist. FILL			
		MPS 100	LL 25	P75 15	(GM)
	0.80-1.20	Clayey Sandy Gravel ; dark orange brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense to medium dense, moist. LATERITE			
		MPS 15	LL 30	P75 15	(GC)
	1.20-1.50	Sandy Clayey Gravel ; dark brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to dense, moist.			
		MPS 15	LL 40	P75 35	(GC)
SPT 1.5m N=4	1.50-2.10	Silty Clay ; pale grey, mottled brown, stiff, moist.			
		MPS 2	LL 40	P75 90	(GI)
SPT 3.0m N=Ref	2.10-4.00 Borehole Terminated at 4.0m	Highly Weathered Rock ; pale grey, low strength, becoming low to medium strength from 2.10 - 3.20m WATER TABLE AT 2.8m			

BH 21	0.00-0.10	Gravelly Sandy Silt; very dark brown, sand is fine to coarse grained, gravel is fine grained, sub angular to sub rounded, very soft, moist. TOPSOIL			
		MPS 5	LL 20	P75 55	(ML)
	0.10-0.60	Gravelly Clayey Sand; brown, fine to coarse grained, gravel is fine grained, sub angular to sub rounded, loose to medium dense, moist. NATURAL ALLUVIUM			
		MPS 6	LL 30	P75 35	(SC)
	0.60-1.00	Clayey Sandy Gravel; orange brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, dense to very dense, moist.			
		MPS 15	LL 30	P75 15	(GC)
SPT 1.5m N=Ref	1.00-1.70 Borehole Refusal 1.7m	Highly Weathered Rock; very pale grey, low to medium strength			

BH 22	0.00-0.20	Silty Gravelly Sand; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, loose, dry to moist. TOPSOIL			
		MPS 10	LL 15	P75 15	(SM)
	0.20-0.40	Gravelly Clayey Sand; grey brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, medium dense, moist. NATURAL ALLUVIUM			
		MPS 8	LL 38	P75 35	(SC)
	0.40-1.20	Sandy Gravelly Clay; pale grey, mottled red, gravel is fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, stiff to very stiff, moist.			
		MPS 10	LL 40	P75 55	(CI)
SPT 1.5m N=8	1.20-2.00	Silty Clay; pale grey, mottled red, firm to very stiff, moist to wet. WATER TABLE AT 1.8m			
		MPS 10	LL 37	P75 90	(CI)
SPT 3.0m N=Ref	2.00-4.00	Sandy Gravelly Clay; pale grey, mottled yellow and orange, gravel is fine to medium grained, angular to sub angular, sand is fine to coarse grained, very stiff to hard, moist.			
	Borehole Terminated 4.0m	MPS 10	LL 35	P75 50	(CI)

BH 23	0.00-0.40	Sandy Gravelly Clay ; brown, gravel is fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, stiff, moist. NATURAL			
		MPS 15	LL 38	P75 60	(CI)
	0.40-1.00	Sandy Clayey Gravel ; brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, loose to medium dense, moist.			
		MPS 15	LL 41	P75 35	(GC)
SPT 1.5m N=4	1.00-2.20	Clay ; pale grey, mottled pale red, firm to hard, wet. WATER TABLE AT 1.8m			
		MPS 10	LL 45	P75 95	
	2.20-2.30 Borehole Refusal 2.3m	Highly Weathered Rock ; pale grey brown, low to medium strength			

BH 24		No test due to construction works across site			
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BH 25	0.00-0.10	Silty Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, medium dense, dry to moist moist. TOPSOIL			
		MPS 10	LL 15	P75 15	(SM)
	0.10-0.40	Sandy Gravelly Clay ; grey brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, stiff, moist. NATURAL ALLUVIUM			
		MPS 15	LL 30	P75 55	(CI)
SPT 1.5m N=11	0.40-1.60	Clayey Sandy Gravel ; dark brown red, fine to coarse grained, angular to sub rounded, sand is fine to coarse grained, loose to very dense, moist to wet. WATER TABLE AT 1.2m			
		MPS 25	LL 35	P75 20	(GC)
	1.60-2.00	Sandy Gravelly Clay ; pale grey, mottled red, gravel is fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very stiff, wet.			
		MPS 15	LL 40	P75 65	(CI)
	2.00-2.10 Borehole Refusal 2.10m	Highly Weathered Rock ; yellow red, low to medium strength			

BH 26	0.00-0.10	Silty Gravelly Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, loose, moist. TOPSOIL			
		MPS 10	LL 15	P75 15	(SM)
	0.10-1.10	Sandy Clayey Gravel ; dark orange brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, loose to medium dense, moist. NATURAL			
		MPS 15	LL 38	P75 35	(GC)
SPT 1.5m N=4	1.10-1.60	Gravelly Clay ; pale grey, mottled red, gravel is fine to medium grained, sub angular to sub rounded, firm, moist to wet. WATER TABLE AT 1.4m			
		MPS 15	LL 42	P75 70	(CI)
	1.60-2.60	Silty Clay ; pale grey, mottled orange and yellow, with gravel, soft to stiff, wet.			
		MPS 10	LL 40	P75 72	(CI)
	2.60-2.75 Borehole Refusal 2.75m	Highly Weathered Rock ; pale grey brown, low to medium strength			

BH 27	0.00-0.80	Sandy Gravel ; brown red, fine to medium grained, angular to sub angular, sand is fine to coarse grained, very dense, dry. CEMENTED LATERITE			
		MPS 10	LL NA	P75 10	(GP)
SPT 1.5m N=Ref	0.80-1.80	Sandy Clayey Gravel ; brown red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very dense, moist.			
		MPS 15	LL 30	P75 15	(GC)
	1.80-1.90 Borehole Refusal 1.9m	Highly Weathered Rock ; pale red brown, medium strength			

BH 28	0.00-0.25	Sandy Silty Gravel; dark yellow brown, fine to coarse grained, sub angular to sub rounded, sand is fine to coarse grained, very loose to loose, moist. FILL			
		MPS 30	LL 25	P75 20	(GM)
	0.25-0.55	Clayey Sand; very dark brown, fine to coarse grained, loose, moist. NATURAL ALLUVIAL/MARINE			
		MPS 1	LL 50	P75 40	(SC)
	0.55-0.90	Sandy Clayey Gravel; yellow brown, mottled red, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, loose, moist to wet. WATER TABLE AT 0.8m			
		MPS 20	LL 40	P75 35	(GC)
SPT 1.5m N=2	0.90-2.15	Sandy Gravelly Clay; brown, gravel is fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, soft, wet.			
		MPS 15	LL 48	P75 45	(CI)
	2.15-2.50	Sandy Clay; pale blue, mottled red, firm to hard, wet.			
		MPS 1	LL 38	P75 70	(CI)
	2.50-2.55 Borehole Refusal 2.55m	Highly Weathered Rock; pale grey, low to medium strength			

BH 29	0.00-0.50	Clayey Sandy Gravel; dark brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, loose, dry to moist. TOPSOIL/FILL			
		MPS 10	LL 35	P75 20	(GC)
	0.50-1.00	Clay; brown orange, soft to firm, dry to moist. NATURAL			
		MPS	LL 35	P75 85	(CI)
SPT 1.5m N=3	1.00-2.00	Clay; brown, mottled red grey, soft to stiff, dry to moist. WATER TABLE AT 1.0m			
		MPS 3	LL 35	P75 90	(CI)
	2.00-2.25	Clay; red, mottled grey, stiff to very stiff, moist.			
		MPS 4	LL 40	P75 80	(CI)
SPT 3.0m N=Ref	2.25-3.25	Clay; grey red, stiff to very stiff, dry.			
		MPS 1	LL 45	P75 95	(CI)
	3.25-4.00 Borehole Terminated at 4.0m	Gravelly Sandy Clay; grey orange, sand is fine to coarse grained gravel is fine to medium grained, sub angular to sub rounded, very stiff to hard, dry to moist.			

BH 30	0.00-0.50	Clayey Sandy Gravel; dark brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, loose to medium dense, dry to moist. TOPSOIL/FILL			
		MPS 10	LL 35	P75 20	(GC)
	0.50-1.25	Sandy Clay; brown, mottled grey and red, sand is fine to coarse grained, with gravel, stiff to very stiff, dry to moist. WATER TABLE AT 1.25m			
		MPS 4	LL 45	P75 60	(CI)
SPT 1.5m N=7	1.25-1.75	Clay; red, mottled orange, with sand and gravel, stiff to very stiff, dry to moist.			
		MPS 6	LL 53	P75 75	(CH)
	1.75-2.40	Gravelly Sandy Clay; red orange, sand is fine to coarse grained, gravel is fine grained, sub angular to sub rounded, very stiff, moist.			
		MPS 10	LL 55	P75 55	(CH)
	2.40-2.50 Borehole Refusal 2.5m	Highly Weathered Rock; red grey, low to medium strength			

BH 31	0.00-1.25	Sandy Clayey Gravel; orange brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, loose, dry to moist. FILL			
		MPS 10	LL 35	P75 40	(GC)
SPT 1.5m N=2	1.25-1.75	Sandy Clay; grey, fine to coarse grained, firm to very stiff, moist to wet. NATURAL			
		MPS 2	LL 55	P75	(CH)
	1.75-3.00	Sandy Clayey Gravel; red brown, mottled grey, fine grained, sub angular to sub rounded, sand is fine to coarse grained, dense, dry to moist.			
		MPS 10	LL 35	P75 40	(GC)
	3.00-4.00 Borehole Terminated at 4.0m	Clay; grey, mottled orange, very stiff, dry to moist.			
		MPS 1	LL 55	P95	(CH)

BH 32	0.00-0.70	Clayey Sandy Gravel; brown, fine to medium grained, sub angular to sub rounded, sand is fine to coarse grained, very dense, dry. FILL			
		MPS 15	LL 30	P75 20	(GC)
	0.70 – 0.75	Clayey Sand; red, fine to coarse grained, very dense dry. CEMENTED LATERITE			
	Borehole refused at 0.75m	MPS 2	LL 30	P75 20	(SC)

BH 33	0.00-0.50	Clayey Sandy Gravel ; dark brown, fine to coarse grained, sub angular to sub rounded, sand is fine to coarse grained, loose, dry. FILL			
		MPS 25	LL 25	P75 20	(GC)
	0.50-2.00	Sandy Clayey Gravel ; pale brown, fine to coarse grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense to very dense, dry. FILL			
		MPS 25	LL 45	P75 40	(GC)
	2.00-2.40	Gravelly Clayey Sand ; red brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, very dense moist. NATURAL			
		MPS 15	LL 35	P75 35	(SC)
	2.40-2.65	Gravelly Sandy Clay ; brown, sand is fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, very stiff to hard, moist to wet. WATER TABLE AT 2.5m			
		MPS 10	LL 35	P75 50	(CI)
	2.65-2.75 Borehole Refusal 2.75m	Highly Weathered Rock ; pale yellow, low to medium strength			

BH 34	0.00-0.75	Clayey Sandy Gravel ; brown orange, fine to coarse grained, sub angular to sub rounded, sand is fine to coarse grained, very loose to dense, dry. FILL			
		MPS 25	LL 35	P75 20	(SC)
	0.75-1.75	Clayey Sandy Gravel ; brown, fine to coarse grained, sub angular to sub rounded, sand is fine to coarse grained, medium dense, dry to moist. FILL			
		MPS 20	LL 30	P75 20	(GC)
	1.75-2.25	Clay ; blue grey, mottled orange, soft, moist. NATURAL ALLUVIUM/MARINE			
		MPS 1	LL 60	P75 95	(CH)
	2.25-2.90	Clayey Sandy Gravel ; orange brown, fine grained, sub angular to sub rounded, fine to coarse grained, dense to very dense, dry.			
		MPS 6	LL 30	P75 20	(GC)
SPT 3.0m N=Ref	2.90-3.00 Borehole Refusal 3.0m	Highly Weathered Rock ; pale yellow brown, low to medium strength			

BH 35	0.00-0.50	Gravelly Silty Sand ; brown, fine to coarse grained, gravel is fine to medium grained, sub angular to sub rounded, loose, wet.			
		MPS 15	LL 25	P75 20	(SM)
	0.50-0.70 Borehole Refusal 0.7m	Clay ; blue brown, mottled brown, stiff to hard, wet. NATURAL ALLUVIUM/MARINE			
		MPS 8	LL 59	P75 90	(CH)

Checked By:



Date: 18/10/10

By visual assessment

MPS Maximum Particle Size

LL Liquid Limit

P75 Percentage of material passing 0.075mm sieve



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(-/12/05)

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Darwin Laboratory

CLIENT: PowerWater Corporation

JOB NO: U32527

LAB REF NO: -

PROJECT: East Point Rising Sewer Main

TESTED BY: MEL

DATE: 8/10/2010

LOCATION: East Point, Darwin, NT

CHECKED BY: MD

DATE: 18/10/2010

TEST PROCEDURES : AS 1289 6.3.2

CLIENT REF: -

Test No.: 1
Test Location/Chainage : BH 1
Ground Surface R.L. (m) : Unknown
Depth Below Ground
Surface at start of Test (mm): 0
Soil Description: Refer attached logs

Soil Moisture Condition: Dry - moist
Depth to Groundwater (m) : Not Encountred

Test No.: 2
Test Location/Chainage : BH 2
Ground Surface R.L. (m) : Unknown
Depth Below Ground
Surface at start of Test (mm): 0
Soil Description: Refer attached logs

Soil Moisture Condition: Moist
Depth to Groundwater (m) : Not Encountred

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
25	100	4
Refusal	200	

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
15	100	7
31	200	6
46	300	7
67	400	5
89	500	5
114	600	4
Refusal	700	



Accredited No. 1855
Certificate No. U32527
Date of Issue 18/10/10

This document is issued in accordance with NATA's accreditation requirements.

Authorised Signatory

Matthew Dunkley



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DYNAMIC CONE PENETROMETER

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(-12/05)

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Darwin Laboratory

CLIENT: PowerWater Corporation

JOB NO: U32527

LAB REF NO: -

PROJECT: East Point Rising Sewer Main

TESTED BY: MEL

DATE: 8/10/2010

LOCATION: East Point, Darwin, NT

CHECKED BY: MD

DATE: 18/10/2010

TEST PROCEDURES : AS 1289 6.3.2

CLIENT REF: -

Test No.:	3
Test Location/Chainage :	BH 3
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Test No.:	4
Test Location/Chainage :	BH 4
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Dry - moist
Depth to Groundwater (m) :	Not Encountred

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
8	100	13
18	200	10
27	300	11
38	400	9
53	500	7
72	600	5
88	700	6
102	800	7
127	900	4
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
5	100	20
11	200	17
17	300	17
26	400	11
45	500	5
62	600	6
87	700	4
Refusal		



Accredited No. 1855
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Date of Issue 18/10/10

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Authorised Signatory

Matthew Dunkley



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UNGR 92N

(-12/05)

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Darwin Laboratory

CLIENT: PowerWater Corporation

JOB NO: U32527

LAB REF NO: -

PROJECT: East Point Rising Sewer Main

TESTED BY: MEL

DATE: 8/10/2010

LOCATION: East Point, Darwin, NT

CHECKED BY: MD

DATE: 18/10/2010

TEST PROCEDURES : AS 1289 6.3.2

CLIENT REF: -

Test No.:	5
Test Location/Chainage :	BH 5
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Test No.:	6
Test Location/Chainage :	BH 6
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
5	100	20
15	200	10
22	300	14
28	400	17
41	500	8
58	600	6
73	700	7
95	800	5
117	900	5
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
7	100	14
11	200	25
15	300	25
21	400	17
31	500	10
38	600	14
50	700	8
75	800	4
Refusal		



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DATE: 18/10/2010

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CLIENT REF: -

Test No.:	7
Test Location/Chainage :	BH 7
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Test No.:	8
Test Location/Chainage :	BH 8
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
4	100	25
9	200	20
13	300	25
16	400	33
20	500	25
29	600	11
41	700	8
48	800	14
54	900	17
64	1000	10
69	1100	20
74	1200	20
80	1300	17
86	1400	17
96	1500	10
109	1600	8
119	1700	10
124	1800	20
128	1900	25
133	2000	20

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
7	100	14
18	200	9
28	300	10
47	400	5
72	500	4
Refusal		



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TEST PROCEDURES : AS 1289 6.3.2

CLIENT REF: -

Test No.:	9
Test Location/Chainage :	BH 9
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Test No.:	10
Test Location/Chainage :	BH 10
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
10	100	10
22	200	8
39	300	6
64	400	4
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
2	100	50
9	200	14
24	300	7
49	400	4
Refusal		



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CLIENT REF: -

Test No.:	11
Test Location/Chainage :	BH 11
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Dry - wet
Depth to Groundwater (m) :	1

Test No.:	12
Test Location/Chainage :	BH 12
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist - wet
Depth to Groundwater (m) :	0.7

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
4	100	25
10	200	17
20	300	10
28	400	13
39	500	9
52	600	8
55	700	33
60	800	20
64	900	25
67	1000	33
70	1100	33
73	1200	33
77	1300	25
82	1400	20
86	1500	25
90	1600	25
95	1700	20
100	1800	20
125	1900	4
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
2	100	50
5	200	33
7	300	50
9	400	50
13	500	25
16	600	33
21	700	20
30	800	11
39	900	11
45	1000	17
52	1100	14
58	1200	17
66	1300	13
82	1400	6
107	1500	4
Refusal		



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CLIENT REF: -

Test No.:	13
Test Location/Chainage :	BH 13
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist - wet
Depth to Groundwater (m) :	0.4

Test No.:	14
Test Location/Chainage :	BH 14
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist - wet
Depth to Groundwater (m) :	0.8

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
1	100	100
3	200	50
4	300	100
8	400	25
18	500	10
24	600	17
27	700	33
30	800	33
32	900	50
34	1000	50
37	1100	33
62	1200	4
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
1	100	100
3	200	50
11	300	13
23	400	8
28	500	20
30	600	50
33	700	33
35	800	50
37	900	50
39	1000	50
41	1100	50
43	1200	50
48	1300	20
55	1400	14
61	1500	17
72	1600	9
79	1700	14
83	1800	25
88	1900	20
92	2000	25
96	2100	25



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CLIENT REF: -

Test No.:	15
Test Location/Chainage :	BH 15
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist - wet
Depth to Groundwater (m) :	Not Encountred

Test No.:	16
Test Location/Chainage :	BH 16
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
4	100	25
11	200	14
19	300	13
29	400	10
36	500	14
39	600	33
47	700	13
57	800	10
70	900	8
77	1000	14
95	1100	6
120	1200	4
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
5	100	20
9	200	25
13	300	25
17	400	25
21	500	25
24	600	33
29	700	20
35	800	17
39	900	25
44	1000	20
46	1100	50
50	1200	25
54	1300	25
58	1400	25
62	1500	25
67	1600	20
76	1700	11
101	1800	4
Refusal		



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CLIENT REF: -

Test No.:	17
Test Location/Chainage :	BH 17
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Test No.:	18
Test Location/Chainage :	BH 18
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
5	100	20
11	200	17
15	300	25
20	400	20
32	500	8
47	600	7
62	700	7
72	800	10
82	900	10
91	1000	11
102	1100	9
114	1200	8
131	1300	6
156	1400	4
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
3	100	33
6	200	33
11	300	20
15	400	25
31	500	6
56	600	4
Refusal		



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CLIENT REF: -

Test No.:	19
Test Location/Chainage :	BH 19
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountred

Test No.:	20
Test Location/Chainage :	BH 20
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Dry - wet
Depth to Groundwater (m) :	2.8

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
6	100	17
14	200	13
21	300	14
28	400	14
41	500	8
66	600	4
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
3	100	33
9	200	17
15	300	17
19	400	25
23	500	25
26	600	33
31	700	20
36	800	20
43	900	14
68	1000	4
Refusal		



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TEST PROCEDURES : AS 1289 6.3.2

CLIENT REF: -

Test No.:	21
Test Location/Chainage :	BH 21
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist
Depth to Groundwater (m) :	Not Encountered

Test No.:	22
Test Location/Chainage :	BH 22
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist - wet
Depth to Groundwater (m) :	1.8

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
1	100	100
5	200	25
8	300	33
12	400	25
16	500	25
29	600	8
42	700	8
59	800	6
79	900	5
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
3	100	33
6	200	33
11	300	20
23	400	8
31	500	13
35	600	25
41	700	17
46	800	20
49	900	33
55	1000	17
60	1100	20
63	1200	33
65	1300	50
67	1400	50
69	1500	50
72	1600	33
75	1700	33
78	1800	33
81	1900	33



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TEST PROCEDURES: AS 1289 6.3.2 **CLIENT REF:** -

Test No.: 23			Test No.: 24		
Test Location/Chainage : BH 23			Test Location/Chainage : NO TEST		
Ground Surface R.L. (m) : Unknown			Ground Surface R.L. (m) :		
Depth Below Ground			Depth Below Ground		
Surface at start of Test (mm): 0			Surface at start of Test (mm):		
Soil Description: Refer attached logs			Soil Description:		
Soil Moisture Condition: Moist - wet			Soil Moisture Condition:		
Depth to Groundwater (m) : 1.8			Depth to Groundwater (m) :		
Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)	Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-			-
5	100	20			
11	200	17			
15	300	25			
18	400	33			
20	500	50			
22	600	50			
26	700	25			
32	800	17			
36	900	25			
41	1000	20			
44	1100	33			
46	1200	50			
48	1300	50			
51	1400	33			
53	1500	50			
56	1600	33			
61	1700	20			
67	1800	17			
83	1900	6			
108	2000	4			
Refusal					



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CLIENT REF: -

Test No.: 25			Test No.: 26		
Test Location/Chainage : BH 25			Test Location/Chainage : BH 26		
Ground Surface R.L. (m) : Unknown			Ground Surface R.L. (m) : Unknown		
Depth Below Ground			Depth Below Ground		
Surface at start of Test (mm): 0			Surface at start of Test (mm): 0		
Soil Description: Refer attached logs			Soil Description: Refer attached logs		
Soil Moisture Condition: Moist - wet			Soil Moisture Condition: Moist - wet		
Depth to Groundwater (m) : 1.2			Depth to Groundwater (m) : 1.4		
Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)	Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-	0	0	-
6	100	17	1	100	100
10	200	25	8	200	14
17	300	14	15	300	14
23	400	17	22	400	14
32	500	11	27	500	20
39	600	14	31	600	25
42	700	33	33	700	50
44	800	50	35	800	50
46	900	50	36	900	100
48	1000	50	37	1000	100
50	1100	50	39	1100	50
61	1200	9	41	1200	50
74	1300	8	44	1300	33
99	1400	4	46	1400	50
Refusal			48	1500	50
			50	1600	50
			51	1700	100
			52	1800	100
			55	1900	33



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CLIENT REF: -

Test No.: 27			Test No.: 28		
Test Location/Chainage : BH 27			Test Location/Chainage : BH 28		
Ground Surface R.L. (m) : Unknown			Ground Surface R.L. (m) : Unknown		
Depth Below Ground			Depth Below Ground		
Surface at start of Test (mm): 0			Surface at start of Test (mm): 0		
Soil Description: Refer attached logs			Soil Description: Refer attached logs		
Soil Moisture Condition: Dry - moist			Soil Moisture Condition: Moist - wet		
Depth to Groundwater (m) : Not Encountred			Depth to Groundwater (m) : 0.8		
Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)	Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-	0	0	-
6	100	17	1	100	100
31	200	4	3	200	50
Refusal			4	300	100
			7	400	33
			9	500	50
			11	600	50
			13	700	50
			15	800	50
			16	900	100
			17	1000	100
			18	1100	100
			36	1200	6
			37	1300	100
			38	1400	100
			39	1500	100
			40	1600	100
			41	1700	100
			42	1800	100
			43	1900	100
			44	2000	100
			46	2100	50
			48	2200	50
			54	2300	17
			68	2400	7
			93	2500	4
			Refusal		



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CLIENT REF: -

Test No.: 29			Test No.: 29 Con't		
Test Location/Chainage : BH 29			Test Location/Chainage :		
Ground Surface R.L. (m) : Unknown			Ground Surface R.L. (m) :		
Depth Below Ground			Depth Below Ground		
Surface at start of Test (mm): 0			Surface at start of Test (mm):		
Soil Description: Refer attached logs			Soil Description:		
Soil Moisture Condition: Dry - wet			Soil Moisture Condition:		
Depth to Groundwater (m) : 1			Depth to Groundwater (m) :		
Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)	Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-	96	2700	25
1	100	100	105	2800	11
3	200	50	113	2900	13
4	300	100			
8	400	25			
9	500	100			
10	600	100			
13	700	33			
16	800	33			
19	900	33			
38	1000	5			
43	1100	20			
48	1200	20			
50	1300	50			
51	1400	100			
52	1500	100			
55	1600	33			
61	1700	17			
67	1800	17			
71	1900	25			
73	2000	50			
75	2100	50			
78	2200	33			
82	2300	25			
85	2400	33			
89	2500	25			
92	2600	33			



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DYNAMIC CONE PENETROMETER

UNGR 92N

(-/12/05)

Page 17 of 19

Darwin Laboratory

CLIENT: PowerWater Corporation

JOB NO: U32527

LAB REF NO: -

PROJECT: East Point Rising Sewer Main

TESTED BY: MEL

DATE: 8/10/2010

LOCATION: East Point, Darwin, NT

CHECKED BY: MD

DATE: 18/10/2010

TEST PROCEDURES : AS 1289 6.3.2

CLIENT REF: -

Test No.:	30
Test Location/Chainage :	BH 30
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist - wet
Depth to Groundwater (m) :	1.25

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
1	100	100
2	200	100
3	300	100
4	400	50
6	500	50
7	600	100
8	700	100
10	800	50
12	900	100
13	1000	100
14	1100	100
18	1200	25
21	1300	33
24	1400	14
31	1500	14
56	1600	4
Refusal		

Test No.:	31
Test Location/Chainage :	BH 31
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Moist - wet
Depth to Groundwater (m) :	Not Encountered

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
1	100	100
3	200	50
6	300	33
15	400	11
27	500	8
31	600	25
36	700	20
45	800	11
55	900	10
58	1000	33
61	1100	33
63	1200	50
73	1300	10
82	1400	11
88	1500	17
91	1600	33
93	1700	50
96	1800	33
100	1900	25
105	2000	20
125	2100	5
Refusal		



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Page 18 of 19

Darwin Laboratory

CLIENT: PowerWater Corporation

JOB NO: U32527

LAB REF NO: -

PROJECT: East Point Rising Sewer Main

TESTED BY: MEL

DATE: 8/10/2010

LOCATION: East Point, Darwin, NT

CHECKED BY: MD

DATE: 18/10/2010

TEST PROCEDURES : AS 1289 6.3.2

CLIENT REF: -

Test No.:	32
Test Location/Chainage :	BH 32
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Dry - moist
Depth to Groundwater (m) :	Not Encountred

Test No.:	33
Test Location/Chainage :	BH 33
Ground Surface R.L. (m) :	Unknown
Depth Below Ground	
Surface at start of Test (mm):	0
Soil Description:	Refer attached logs
Soil Moisture Condition:	Dry - wet
Depth to Groundwater (m) :	2.75

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
4	100	25
14	200	10
39	300	4
Refusal		

Cumulative No. of Blows	Depth Below Starting Level (mm)	Penetration Rate (mm/blow)
0	0	-
1	100	100
2	200	100
3	300	100
5	400	50
7	500	50
17	600	10
19	700	50
25	800	17
41	900	6
53	1000	8
66	1100	8
79	1200	8
93	1300	7
111	1400	6
131	1500	5
Refusal		



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APPENDIX B

Laboratory Testing

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76 Benison Road Winnellie NT
REPORT ON SOIL CLASSIFICATION

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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation

JOB NO: U32527

LAB REF NO: 104398

PROJECT: Proposed Rising Sewer Main

SAMPLED BY: BP

DATE: 4-7/10/10

LOCATION: East Point, NT BH2, 0.3 - 0.4m

TESTED BY: GC

DATE: 26/10/10

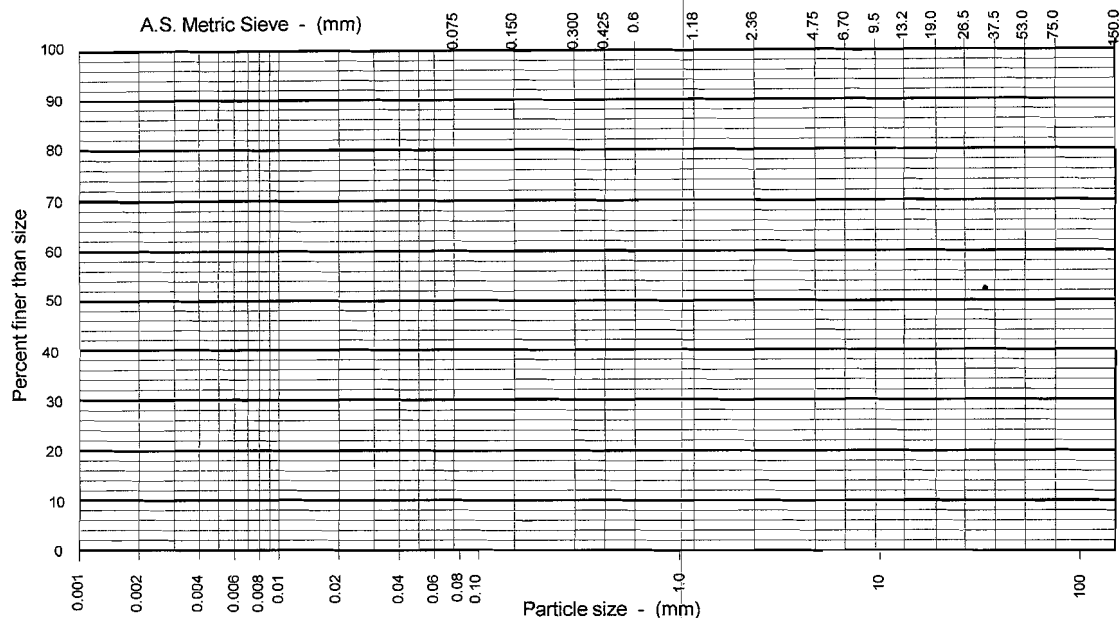
MATERIAL: Refer Logs

CHECKED BY: MD

DATE: 16/11/10

TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1

CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				43	27	16	-	
75.0				Classification:				
37.5								
26.5								
19.0				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5								
4.75				Preparation History of Atterberg Limits				
2.36				Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425				Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075				Curled/Crumbled: N				



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REPORT ON SOIL CLASSIFICATION

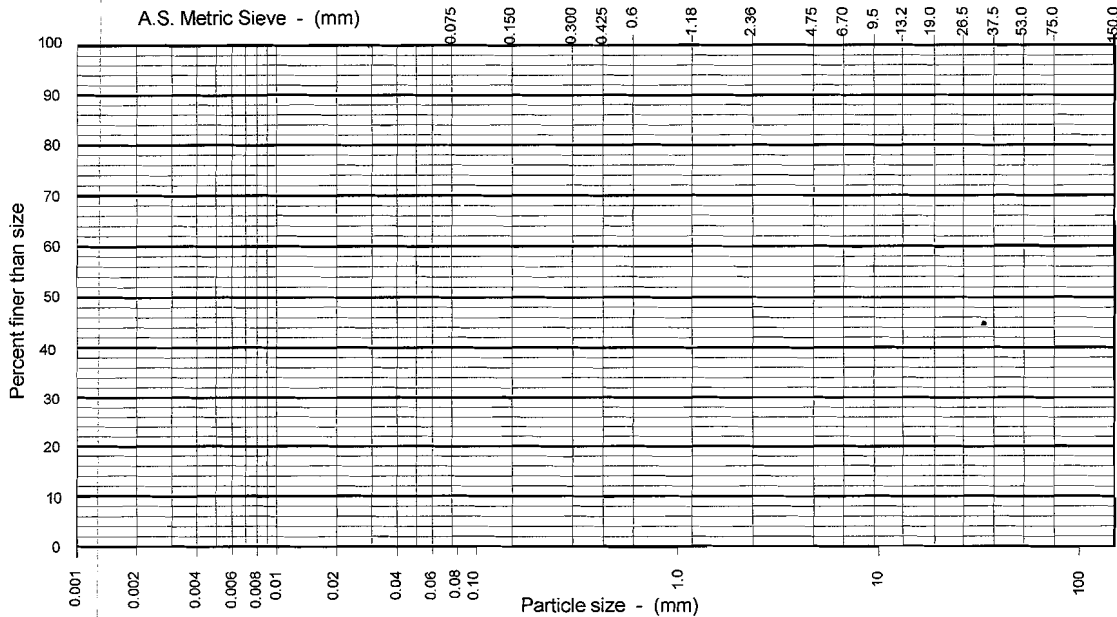
UNGR 1 N

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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104397
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT BH2; 1.5-1.8m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				54	21	33	-	
75.0				Classification:				
37.5								
26.5								
19.0				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5								
4.75				Preparation History of Atterberg Limits				
2.36				Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425				Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075				Curled/Crumbled: N				



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REPORT ON SOIL CLASSIFICATION

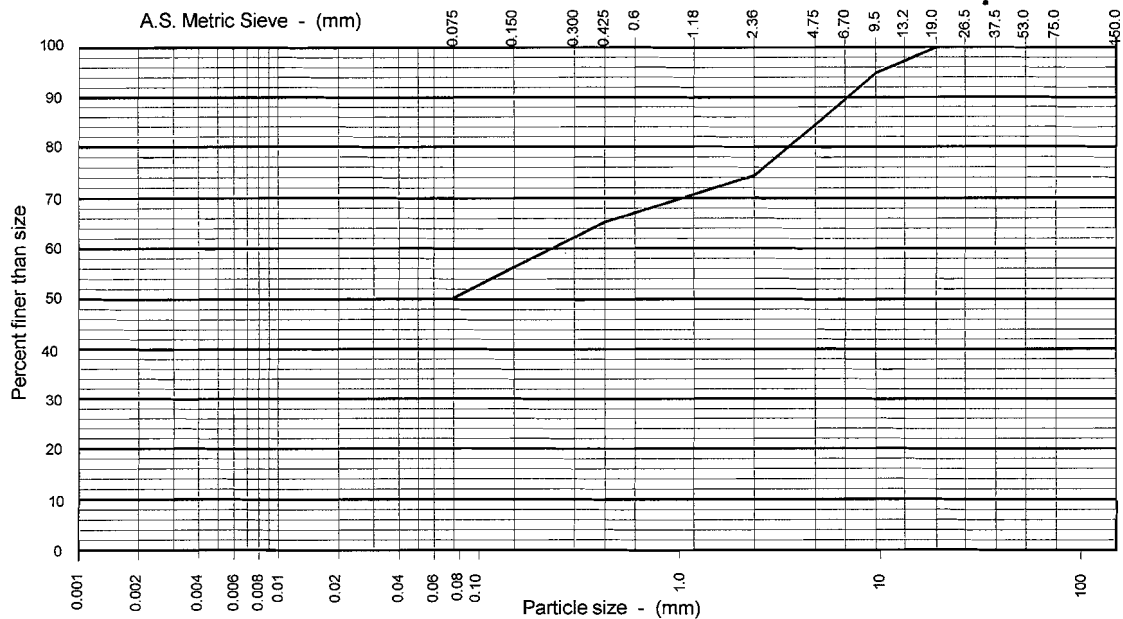
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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104392
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH2; 1.4 - 2.1m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1,3.6.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	
	50			8	8	7	14	12	0	0

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				46	20	26	-	
75.0				Classification:				
37.5								
26.5								
19.0	100			Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5	95							
4.75	85			Preparation History of Atterberg Limits				
2.36	74			Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425	65			Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075	50			Curled/Crumbled: N				



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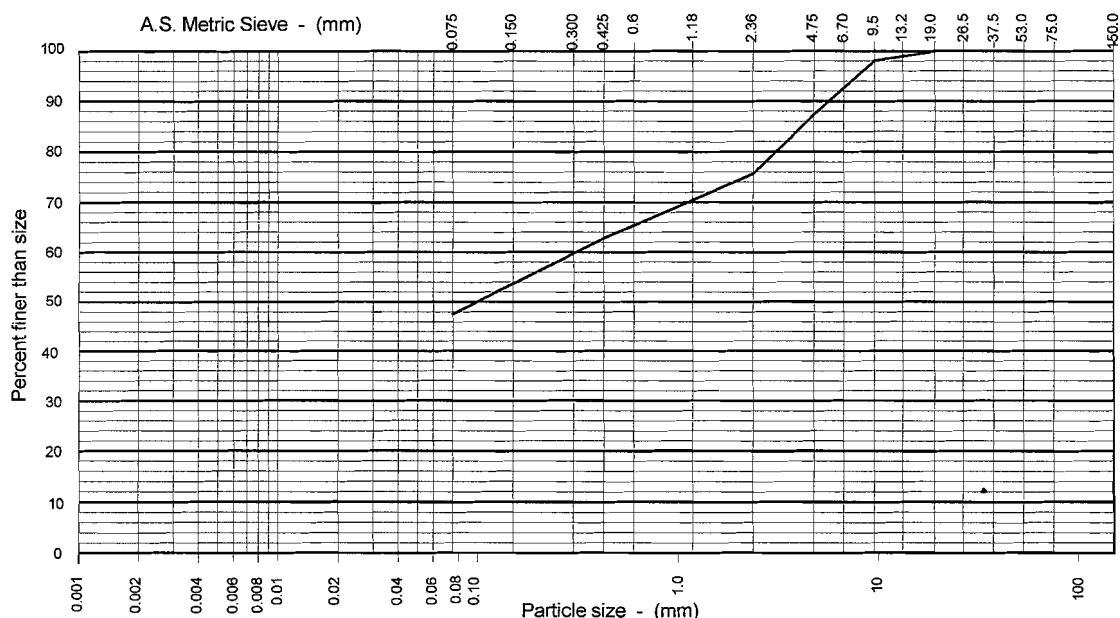
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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104391
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT BH4; 0.75-1.0m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1,3.6.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	
	48			9	9	10	15	9	0	0

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				54	23	31	-	
75.0				Classification:				
37.5								
26.5								
19.0	100			Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5	98							
4.75	87			Preparation History of Atterberg Limits				
2.36	76							
1.18				Sample : Air-Dried				
0.600								
0.425	63			Sieved: Wet				
0.300								
0.150				Linear Shrinkage Data				
0.075	48							
				Length of Mould (mm) : -				
				Sample				
				Curled/Crumbled: N				



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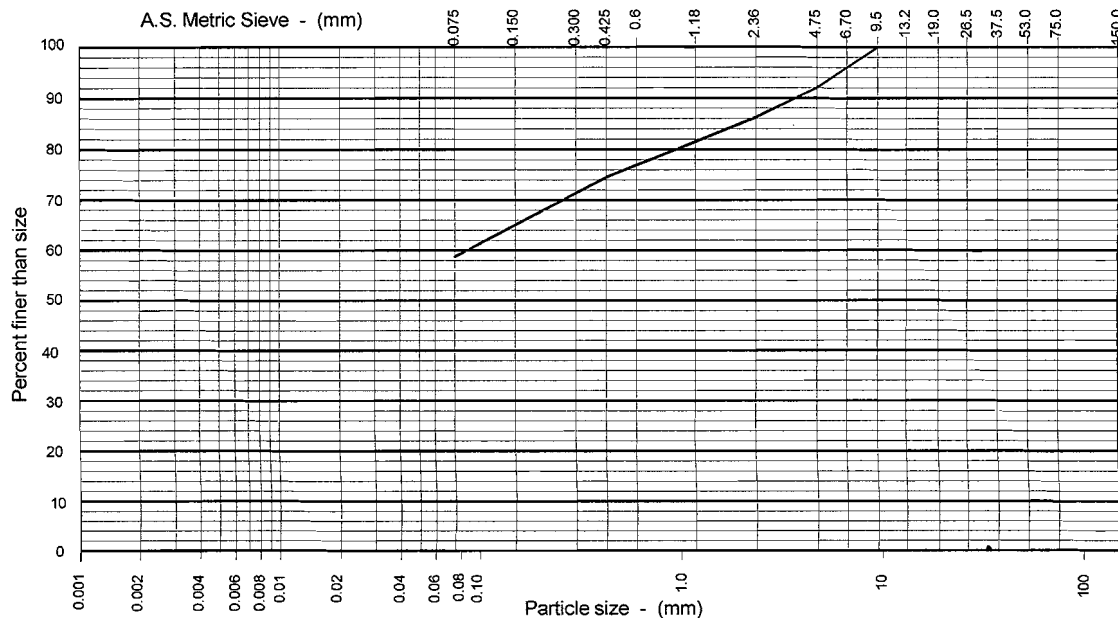
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REPORT ON SOIL CLASSIFICATION

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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104390
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH10, 1.5 - 1.8m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1,3.6.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	
	59			9	9	9	8	5	0	0

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				47	40	7	-	
75.0				Classification:				
37.5								
26.5								
19.0				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5	100							
4.75	92			Preparation History of Atterberg Limits				
2.36	86			Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425	75			Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075	59			Curled/Crumbled: N				



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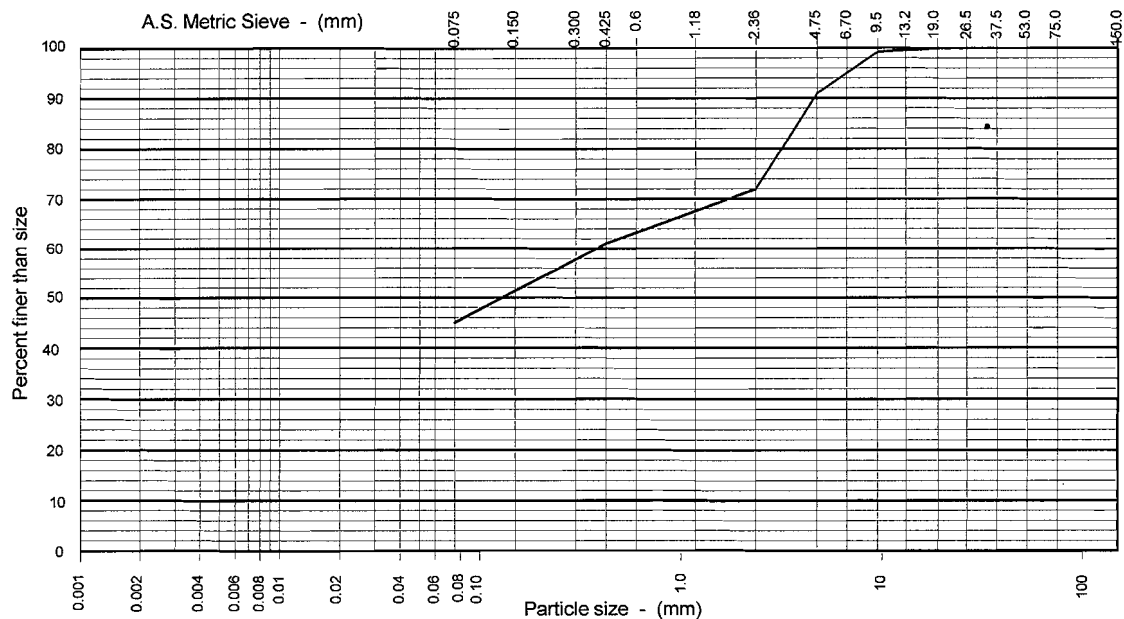
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REPORT ON SOIL CLASSIFICATION

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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation **JOB NO:** U32527 **LAB REF NO:** 104394
PROJECT: Proposed Rising Sewer Main **SAMPLED BY:** BP **DATE:** 4-7/10/10
LOCATION: East Point, NT, BH11; 0.5 - 1.0m **TESTED BY:** GC **DATE:** 26/10/10
MATERIAL: Refer Logs **CHECKED BY:** MD **DATE:** 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1,3.6.1 **CLIENT REF:** -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	
	45			9	9	9	22	6	0	0

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				65	24	41	-	
75.0				Classification:				
37.5								
26.5								
19.0	100			Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5	99							
4.75	91			Preparation History of Atterberg Limits				
2.36	72			Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425	61			Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075	45			Curled/Crumbled: N				



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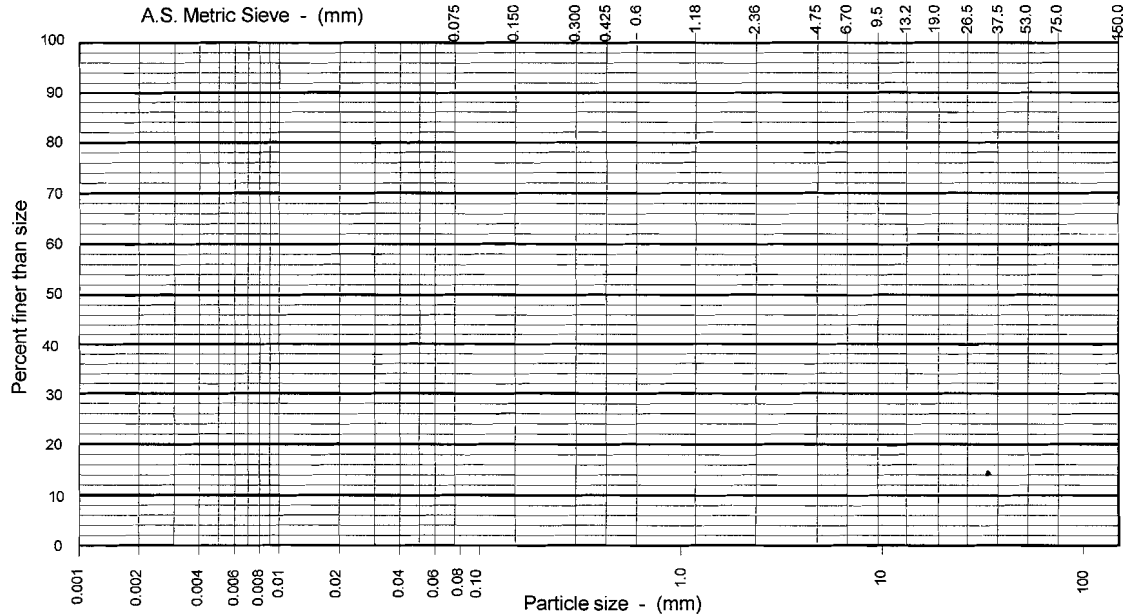
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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104399
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH 12, 1.5 - 1.8m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)	
150.0				45	33	12	-		
75.0				Classification:					
37.5									
26.5									
19.0				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3					
9.5									
4.75				Preparation History of Atterberg Limits					
2.36				Sample : Air-Dried					
1.18				Sieved: Wet					
0.600									
0.425				Linear Shrinkage Data					
0.300				Length of Mould (mm) : -					
0.150				Sample					
0.075				Curled/Crumbled: N					



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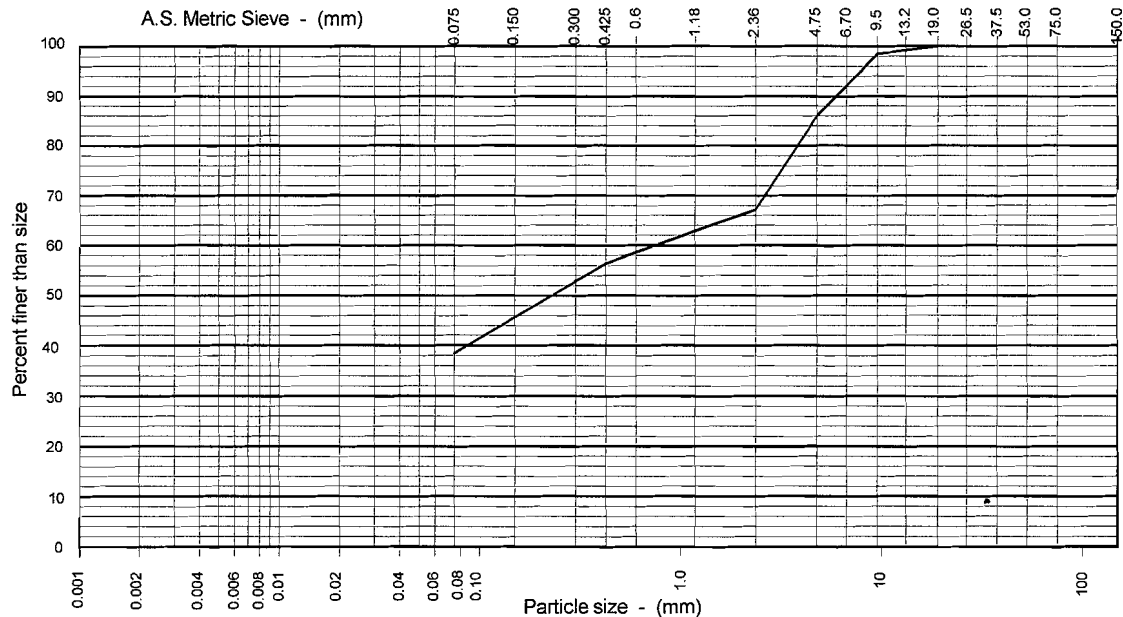
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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104389
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT BH18; 0.5-1.0m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1,3.6.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	
	38			10	10	9	23	10	0	0

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				42	19	23		
75.0				Classification:				
37.5								
26.5								
19.0	100			Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5	98							
4.75	86			Preparation History of Atterberg Limits				
2.36	67			Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425	56			Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075	38			Curled/Crumbled: N				



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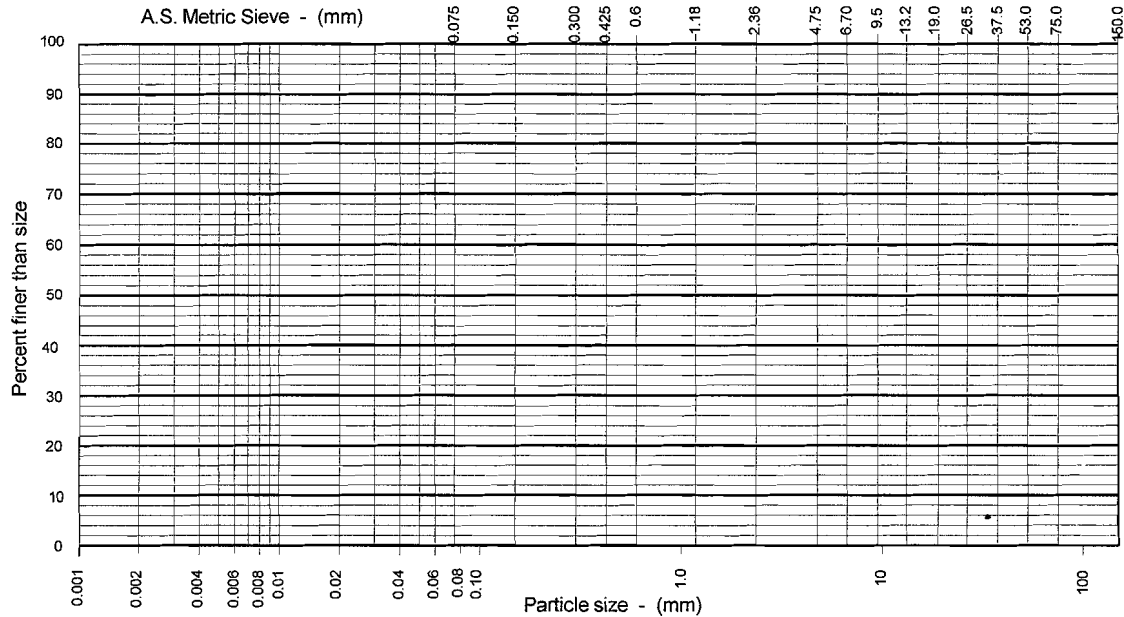
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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104396
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH19; 1.5 - 1.8m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				52	20	32	-	
75.0				Classification:				
37.5								
26.5								
19.0				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5								
4.75				Preparation History of Atterberg Limits				
2.36				Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425				Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075				Curled/Crumbled: N				



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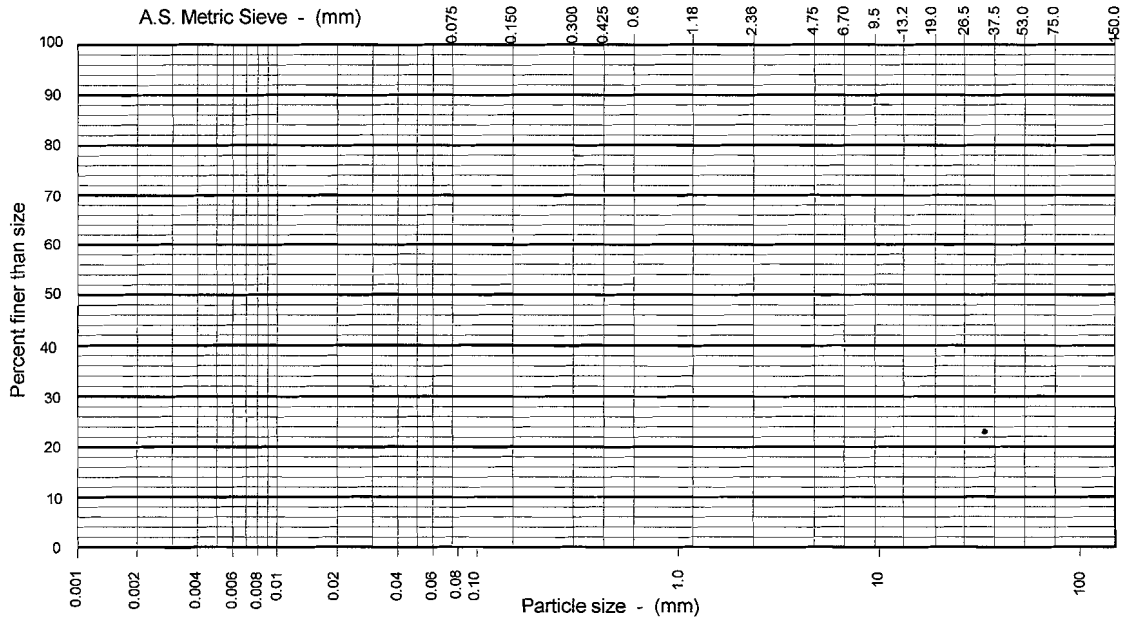
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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104387
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH22; 1.5 - 1.8m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				37	18	19	-	
75.0				Classification:				
37.5								
26.5								
19.0				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
9.5								
4.75				Preparation History of Atterberg Limits				
2.36				Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425				Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075				Curled/Crumbled: N				



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Date of Issue 16/11/10

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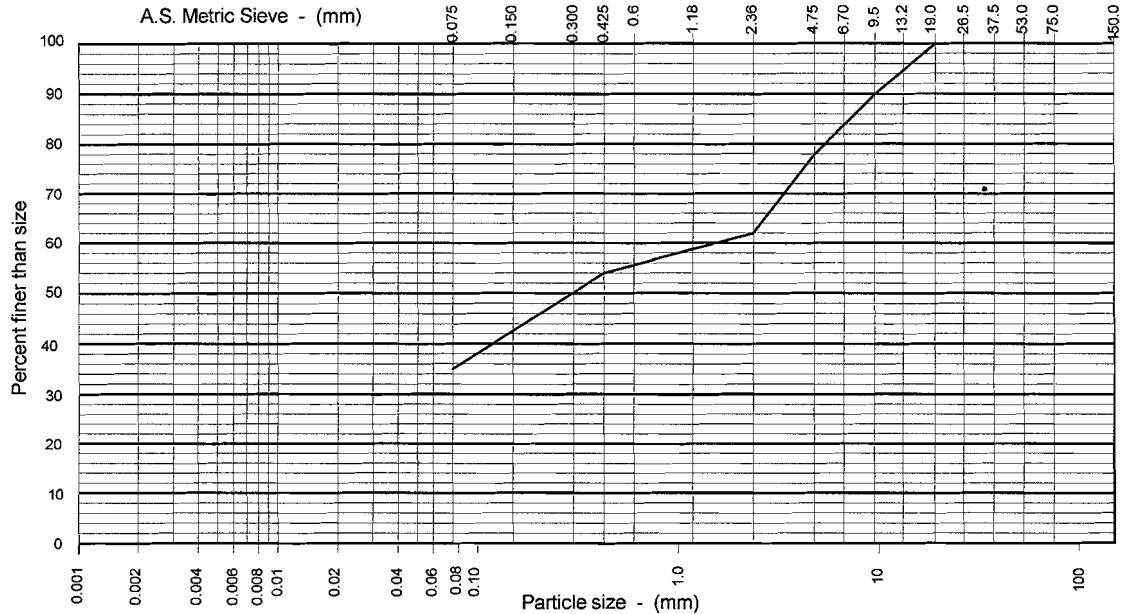
UNGR 1 N

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Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104386
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH23, 0.4 - 1.0m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1,3.6.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	
	35			11	10	6	20	18	0	0

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				41	14	27	-	
75.0				Classification:				
37.5								
26.5				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
19.0	100							
9.5	90							
4.75	78			Preparation History of Atterberg Limits				
2.36	62			Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425	54			Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075	35			Curled/Crumbled: N				



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Date of Issue 16/11/10

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Authorised Signatory

Matthew Dunkley

CARDNO ULLMAN & NOLAN GEOTECHNIC (NT) PTY LTD

76 Benison Road Winnellie NT
REPORT ON SOIL CLASSIFICATION

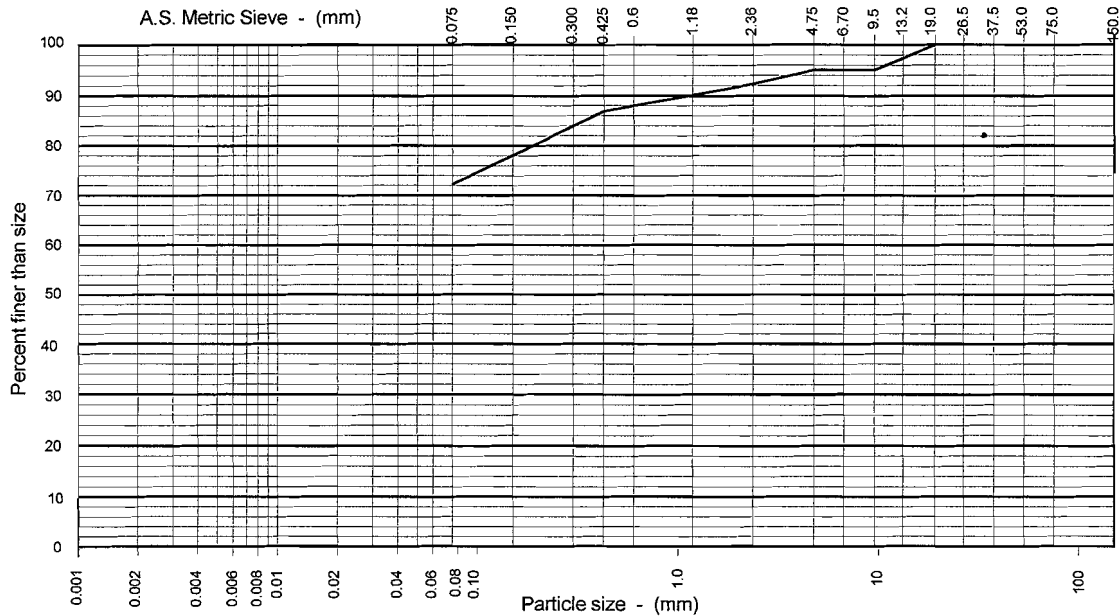
UNGR 1 N

(-/10/05)

Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104393
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT BH 26; 2.2-2.6m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1,3.6.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	
	72			8	7	4	3	5	0	0

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)
150.0				40	24	16	-	
75.0				Classification:				
37.5								
26.5				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3				
19.0	100							
9.5	95							
4.75	95			Preparation History of Atterberg Limits				
2.36	92			Sample : Air-Dried				
1.18				Sieved: Wet				
0.600								
0.425	87			Linear Shrinkage Data				
0.300				Length of Mould (mm) : -				
0.150				Sample				
0.075	72			Curled/Crumbled: N				



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Certificate No. 104393

Date of Issue 16/11/10

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Authorised Signatory

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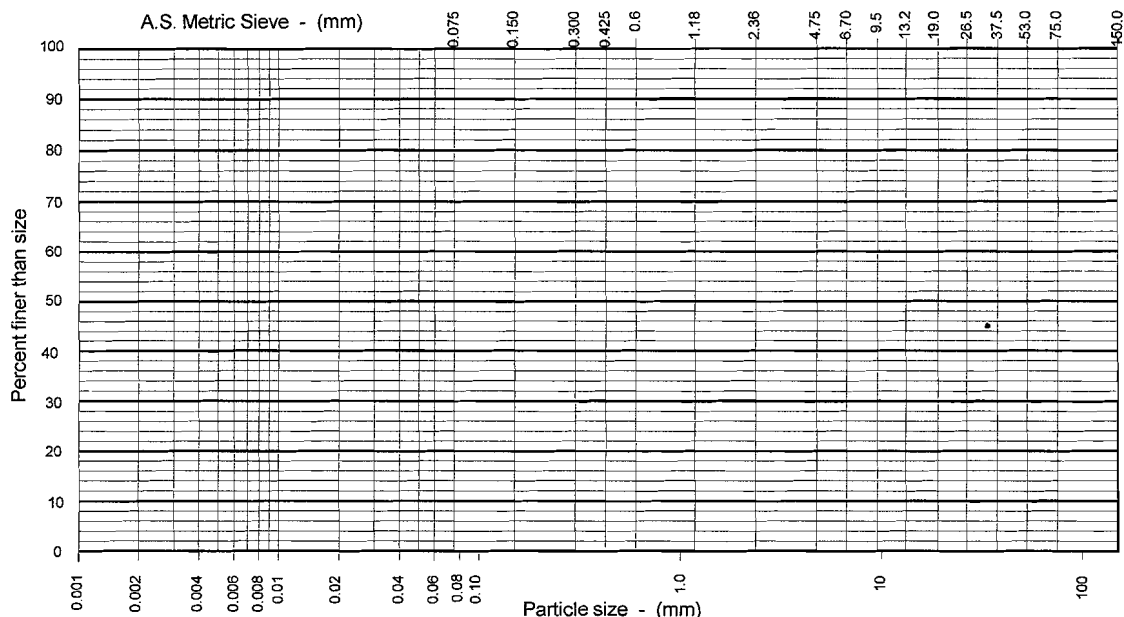
76 Benison Road Winnellie NT
REPORT ON SOIL CLASSIFICATION

UNGR 1 N
(-/10/05)

Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104395
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH28; 1.5 - 1.8m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)	
150.0				48	19	29	-		
75.0				Classification:					
37.5									
26.5									
19.0				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3					
9.5									
4.75				Preparation History of Atterberg Limits					
2.36				Sample : Air-Dried					
1.18				Sieved: Wet					
0.600									
0.425				Linear Shrinkage Data					
0.300				Length of Mould (mm) : -					
0.150				Sample					
0.075				Curled/Crumbled: N					



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REPORT ON SOIL CLASSIFICATION

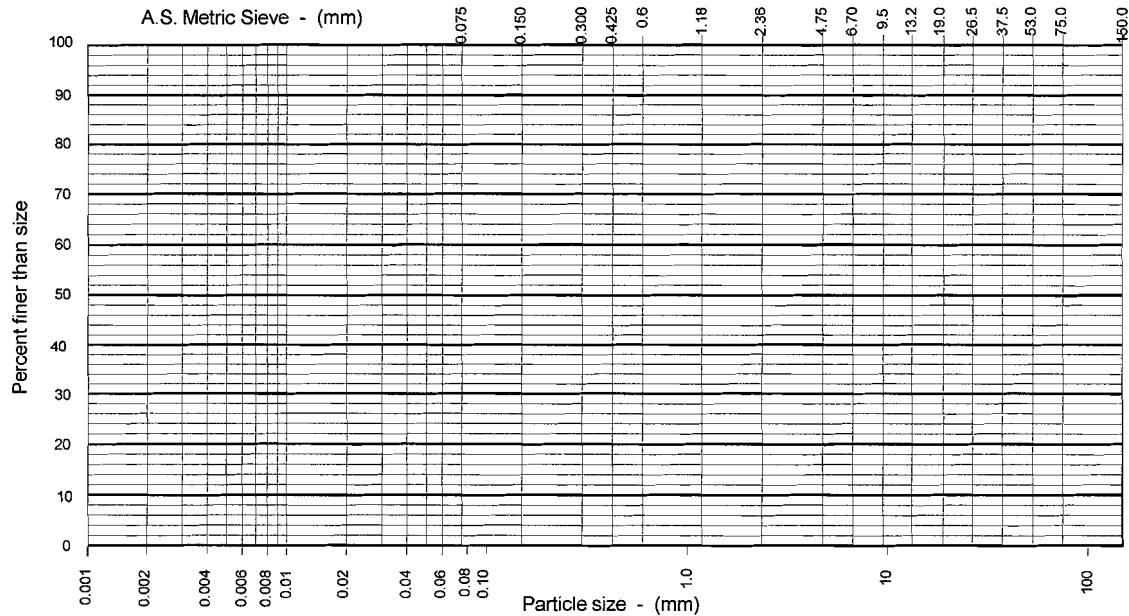
UNGR 1 N

(-/10/05)

Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104388
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH30; 1.5 - 1.8m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1,3.6.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)	
150.0				53	19	34	-		
75.0				Classification:					
37.5									
26.5				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3					
19.0									
9.5									
4.75				Preparation History of Atterberg Limits					
2.36				Sample : Air-Dried					
1.18				Sieved: Wet					
0.600									
0.425				Linear Shrinkage Data					
0.300				Length of Mould (mm) : -					
0.150				Sample					
0.075				Curled/Crumbled: N					



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76 Benison Road Winnellie NT
REPORT ON SOIL CLASSIFICATION

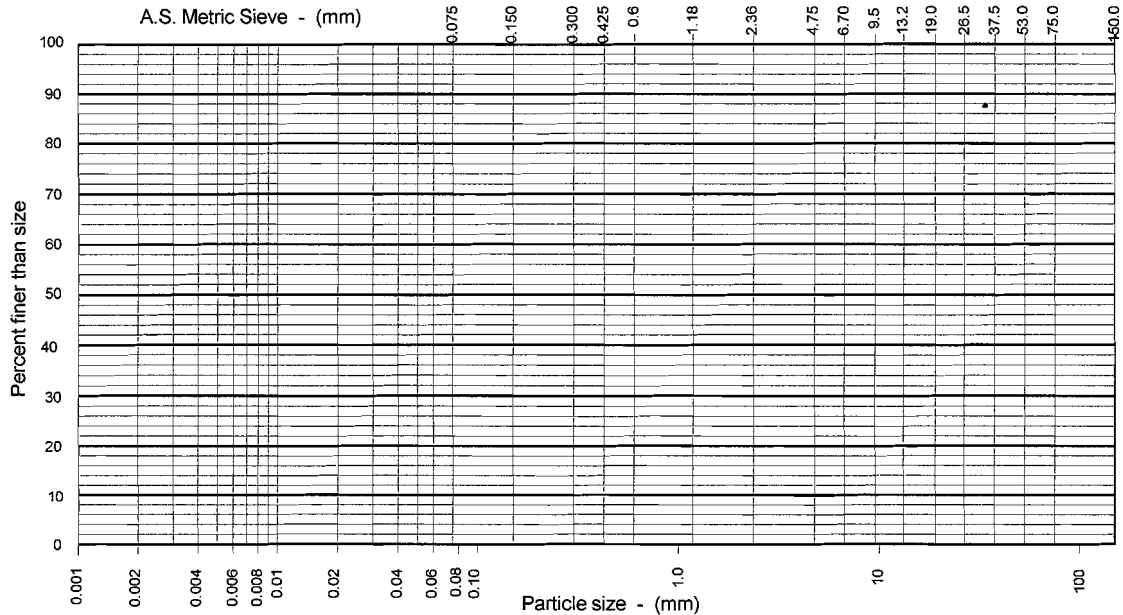
UNGR 1 N

(-/10/05)

Sheet 1 of 1

Darwin Laboratory

CLIENT: Power and Water Corporation JOB NO: U32527 LAB REF NO: 104385
PROJECT: Proposed Rising Sewer Main SAMPLED BY: BP DATE: 4-7/10/10
LOCATION: East Point, NT, BH35; 0.5 - 0.7m TESTED BY: GC DATE: 26/10/10
MATERIAL: Refer Logs CHECKED BY: MD DATE: 16/11/10
TEST PROCEDURES: AS1289 3.1.1,3.2.1,3.3.1 CLIENT REF: -



clay	silt			sand			gravel			cobbles
	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	

Particle Size (mm)	Percent Passing (%)	Particle Size (mm)	Percent Passing (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (g/cm ³)	
150.0				59	21	38	-		
75.0				Classification:					
37.5									
26.5									
19.0				Sampled in accordance to AS1289.1.2.1 Clause 6.5.3					
9.5									
4.75				Preparation History of Atterberg Limits					
2.36				Sample : Air-Dried					
1.18				Sieved: Wet					
0.600									
0.425				Linear Shrinkage Data					
0.300				Length of Mould (mm) : -					
0.150				Sample					
0.075				Curled/Crumbled: N					



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Certificate No. 104385

Date of Issue 16/11/10

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Authorised Signatory

Matthew Dunkley

APPENDIX C

ALS Laboratory Results



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EB1018277	Page	: 1 of 9
Client	: CARDNO ULLMAN & NOLAN GEOTECHNIC PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MR BEN PARRY	Contact	: Carsten Emrich
Address	: PO BOX 39623 WINNELLI NT, AUSTRALIA 0821	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: ben.parry@cardno.com.au	E-mail	: carsten.emrich@alsenviro.com
Telephone	: +61 08 89844983	Telephone	: +61 7 3243 7123
Facsimile	: +61 08 89844659	Facsimile	: +61 7 3243 7218
Project	: U32527	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: UN 1335	Date Samples Received	: 13-OCT-2010
C-O-C number	: ----	Issue Date	: 25-OCT-2010
Sampler	: Ben Parry	No. of samples received	: 30
Site	: ----	No. of samples analysed	: 30
Quote number	: EN/024/09		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Bne Acid Sulphate Soils
Kim McCabe	Senior Inorganic Chemist	Inorganics
Matt Frost	Senior Organic Chemist	Organics

Environmental Division Brisbane

Part of the **ALS Laboratory Group**

32 Shand Street Stafford QLD Australia 4053

Tel. +61-7-3243 7222 Fax. +61-7-3243 7218 www.alsglobal.com

A Campbell Brothers Limited Company



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- **EG005T (Total Metals) - Sample EB1018208 - 002 shows poor matrix spike recovery due to sample heterogeneity. Confirmed by visual inspection.**
- **Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m³ in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m³'.**
- **Retained Acidity not required because pH KCl greater than or equal to 4.5**



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				BH12 0.1-0.5m	BH28 0.3-0.4m	BH20 0.1-0.8m	BH13 0.5-1.0m	BH31 0.0-1.25m
				06-OCT-2010 11:00	07-OCT-2010 11:00	07-OCT-2010 11:00	06-OCT-2010 11:00	08-OCT-2010 11:00
Compound	CAS Number	LOR	Unit	EB1018277-001	EB1018277-002	EB1018277-003	EB1018277-004	EB1018277-005
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	12.6	22.4	9.6	13.6	12.5
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	21	20	12	11	12
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	132	37	93	98	88
Copper	7440-50-8	5	mg/kg	10	42	12	12	6
Lead	7439-92-1	5	mg/kg	9	134	7	<5	9
Nickel	7440-02-0	2	mg/kg	8	11	26	4	<2
Zinc	7440-66-6	5	mg/kg	10	111	63	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	120	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	120	<50	<50	<50
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	102	93.4	114	104	103
Toluene-D8	2037-26-5	0.1	%	121	84.6	101	127	96.4
4-Bromofluorobenzene	460-00-4	0.1	%	109	80.4	92.1	114	88.6



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				BH35 0.0-0.5m	BH8 0.1-0.5m	BH11 0.5-1.0m	BH18 0.5-1.0m	BH16 0.2-0.5m
				08-OCT-2010 11:00	05-OCT-2010 11:00	06-OCT-2010 11:00	06-OCT-2010 11:00	06-OCT-2010 11:00
Compound	CAS Number	LOR	Unit	EB1018277-006	EB1018277-007	EB1018277-008	EB1018277-009	EB1018277-010
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	15.9	5.8	14.5	9.1	8.2
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	6	10	17	12	14
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	16	178	229	134	219
Copper	7440-50-8	5	mg/kg	10	<5	6	9	7
Lead	7439-92-1	5	mg/kg	15	7	11	8	9
Nickel	7440-02-0	2	mg/kg	2	9	8	10	9
Zinc	7440-66-6	5	mg/kg	92	7	10	15	12
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	84.0	113	106	110	109
Toluene-D8	2037-26-5	0.1	%	83.2	127	120	124	126
4-Bromofluorobenzene	460-00-4	0.1	%	78.4	112	113	108	110



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				BH11 1.5-1.8m	BH22 3.0-3.3m	BH17 1.5-1.8m	BH19 1.5-1.8m	BH35 0.5-0.7m
				06-OCT-2010 11:00	07-OCT-2010 11:00	06-OCT-2010 11:00	07-OCT-2010 11:00	08-OCT-2010 11:00
Compound	CAS Number	LOR	Unit	EB1018277-011	EB1018277-012	EB1018277-013	EB1018277-014	EB1018277-015
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.9	5.4	5.4	4.8	6.2
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	24.2	25.2	19.6	11.5	23.9
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	440	80	50	60	420
ED045: Chloride								
Chloride	16887-00-6	10	mg/kg	2760	340	60	30	3250



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				BH31 1.5-1.8m	BH28 1.5-1.8m	BH2 1.4-2.1m	BH6 0.9-1.2m	BH26 2.2-2.6m
				08-OCT-2010 11:00	08-OCT-2010 11:00	05-OCT-2010 11:00	05-OCT-2010 11:00	07-OCT-2010 11:00
Compound	CAS Number	LOR	Unit	EB1018277-016	EB1018277-017	EB1018277-018	EB1018277-019	EB1018277-020
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.2	5.6	4.8	4.5	5.8
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	17.4	30.8	10.7	13.7	25.1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	120	60	50	40
ED045: Chloride								
Chloride	16887-00-6	10	mg/kg	30	700	40	30	110



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				BH31 3.0-4.0m	BH34 1.75-2.25m	BH35 0.5-0.7m	BH28 0.3-0.4m	BH27 1.5-1.8m
				08-OCT-2010 11:00	08-OCT-2010 11:00	08-OCT-2010 11:00	08-OCT-2010 11:00	07-OCT-2010 11:00
Compound	CAS Number	LOR	Unit	EB1018277-021	EB1018277-022	EB1018277-023	EB1018277-024	EB1018277-025
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	5.6	6.7	5.6	5.0	5.1
Titratable Actual Acidity (23F)	----	2	mole H+ / t	4	<2	7	26	8
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	0.04	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.141	<0.005	0.011	<0.005
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	88	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	<0.01	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	<10	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	<0.01	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	0.14	<0.02	0.05	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	88	<10	32	<10
Liming Rate	----	1	kg CaCO3/t	<1	7	<1	2	<1



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				BH31 1.5-1.8m	BH12 0.1-0.5m	BH13 0.2-0.4m	BH14 1.5-1.8m	BH16 0.2-0.5m
				08-OCT-2010 11:00	06-OCT-2010 11:00	06-OCT-2010 11:00	06-OCT-2010 11:00	06-OCT-2010 11:00
Compound	CAS Number	LOR	Unit	EB1018277-026	EB1018277-027	EB1018277-028	EB1018277-029	EB1018277-030
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	4.9	6.4	6.6	7.8	6.2
Titratable Actual Acidity (23F)	----	2	mole H+ / t	11	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	<0.005	<0.005	0.010
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	2.36	<0.01	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	472	<10	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	0.76	<0.01	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	11	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1



Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	52.7	133.7
Toluene-D8	2037-26-5	60.3	131.1
4-Bromofluorobenzene	460-00-4	59.2	126.6