Appendix M

Report:
"Hydrogeological Investigation Report"

71 Ash Street
PO Box 191
BARCALDINE QLD 4725

BARCALDINE REGIONAL COUNCIL
WASTE MANAGEMENT FACILITY

HYDROGEOLOGICAL INVESTIGATION REPORT

MARCH 2016

GBA CONSULTING ENGINEERS

Version History

Date	Name	Position	**Action required** *(Review/Endorse/Approve)*
02/03/2017	W. Green	Environmental Engineer	Review
03/03/2017	S. Bourne	Senior Engineer	Approved

Prepared by William Green
Title Environmental Engineer, George Bourne & Associates, Barcaldine QLD
Location 67 Elm Street, Barcaldine, QLD 4725
Version date 02/03/2017
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Contact for enquiries and proposed changes

If you have any questions regarding this document or if you have a suggestion for improvements, please contact:

Project Manager Simon Bourne **RPEQ:** 1513
Phone 07 4651 2177

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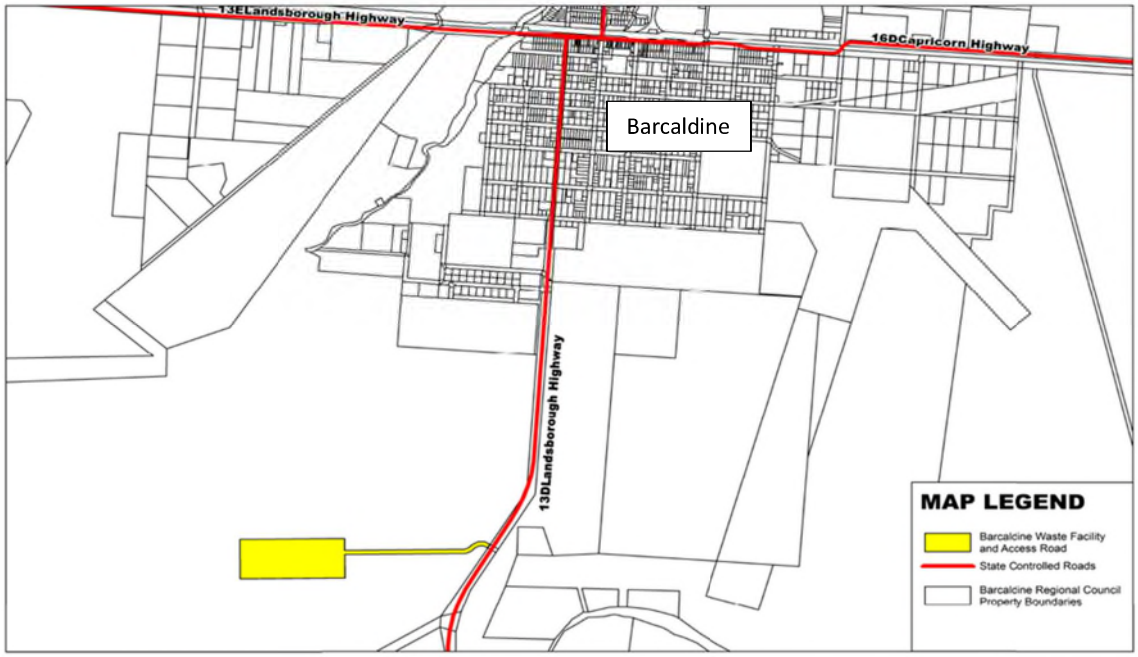
1. Scope

This report has been developed to present the findings of a hydrogeological investigation undertaken to identify the suitability of the underlying geology and ground water for the proposed development of the Barcaldine Waste Management Facility. Located on Yellowjack Drive approximately 4km south west of the township of Barcaldine.

Figure 1 Location Map - Barcaldine Waste Management Facility



2. Introduction

An investigation has been conducted to determine the geotechnical properties of the underlying geology and groundwater levels at the site. The investigation was done in two stages:

i) Test Hole Drilling and Sampling: The first stage of the investigation included the drilling of test holes to determine if a shallow water table was present and whether a considerable level of separation could be achieved between the proposed landfill cell base (proposed depth 7m) and the water table. Another aspect of this initial investigation was to determine the characteristics of the underlying geology of the site and take core samples for analysis below the proposed landfill cell.

ii) Landfill Cell Base Sampling: A second round of material testing investigations were undertaken to analyse the characteristics of the insitu material immediately below the base of the landfill cell. These tests were conducted primarily to determine if the insitu material at the base of the landfill cell possessed hydraulic conductivity values capable of restricting the leaching of contaminants to the groundwater system to avoid contamination. These samples taken immediately below the landfill cell were also tested for Atterberg Limits and Moisture Density Relationships.

3. Investigation Methodologies

3.1 Test Hole Drilling and Sampling

Four test holes were drilled at 2 locations; a southern and a northern location. The southern location is mid-way along the southern boundary of the facility and the northern location is adjacent to the southern test hole location on the northern boundary. Table 1 below provides a summary of the test hole locations and depths.

Table 1 Test Hole Locations and Depths

Test Hole ID		Location - Lat	Location - Lon	Depth (m)
001	Southern Site	-23.587602	145.265333	04.0
002		-23.587584	145.265333	18.0
003	Northern Site	-23.585134	145.265131	11.2
004		-23.585116	145.265131	04.0

Soil samples were taken at the lower depths of Test Hole 002 to determine the soil properties of the material underlying the proposed landfill cell. The core samples were taken at 8-12m, 14-15m and 16-17m depths, these samples were tested for Particle Size Distribution and Atterberg Limits.

3.2 Landfill Cell Base Sampling

Following the initial test hole sampling, materials tests were conducted immediately below the landfill cell base in 4 locations at depths of 0.5m and 1.5m, approximately 7.5 and 9 m below ground level. For each sampling point Atterberg Limits, Moisture Density Relationships and Permeability Testing was conducted. A summary of testing points and locations are provided in table 2 below.

Table 2 Landfill Cell Base Sampling Locations and Depths

Sample ID	Location - Lat	Location - Lon	Depth (m)
WS17-8	-23.585538	145.266160	0.5
WS17-9	-23.585538	145.266160	1.5
WS17-10	-23.585576	145.266286	0.5
WS17-11	-23.585576	145.266286	1.5
WS17-12	-23.585315	145.266169	0.5
WS17-13	-23.585315	145.266169	1.5
WS17-14	-23.585330	145.266359	0.5
WS17-15	-23.585330	145.266359	1.5

4. Results

4.1 Test Hole Drilling and Sampling

Groundwater

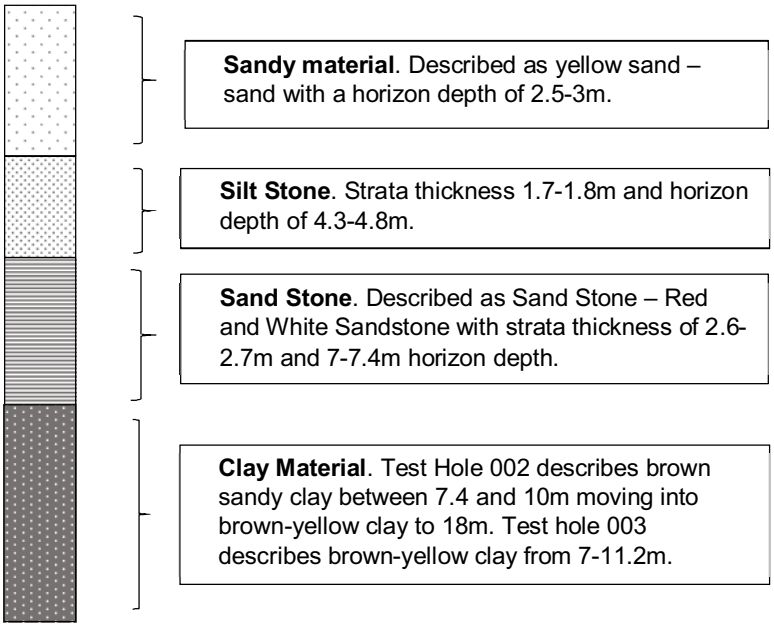
As detailed in table 1 four test holes were drilled in two locations, with a shallow and a deeper test hole drilled at either location. On the southern drilling site Test Hole 002 was drilled to a maximum depth of 18m and at the northern site a maximum depth of 11.2m was reached at Test Hole 003. The drilling logs identified that ground water was not reached at these depths. Regular inspections since the

time of drilling have taken place to determine if fluctuations in water table depths occur and can be detected at these depths.

Underlying Strata

As the test hole sites were drilled a description was made for the different strata types encountered during drilling in the Drilling Log Forms. The underlying strata found at the drilling locations showed a high level of consistency between drilling locations in the strata type and horizon depths. A summary of the underlying strata based on the Drilling Log Forms is provided below in figure 2. Drill Log Forms are attached in Appendix 1a.

Figure 2 Summary of Drill Log Strata Descriptions



Materials Testing Core Samples

Core samples were taken from Test Hole 002 at 8-12m, 14-15m and 16-17m depths. These samples were taken to determine the properties of the materials underlying the proposed landfill cell. The samples were tested for Particle Size Distribution and Atterberg Limits. A complete set of core sample Quality of Materials Reports are attached in appendix 1b. A summary of test results are provided below in table 3.

Table 3 Materials Testing Core Sample Summary

Sample	Liquid Limit %	Plastic Index %	Linear Shrinkage %
Location 1 8-12m Depth	59	39	17
Location 2 14-15m Depth	71	24	19
Location 3 16-17m Depth	71	48	19.5

4.2 Landfill Cell Base Sampling

Following the initial test hole investigation, further testing was conducted on the materials directly underlying the landfill cell. Analysis of the hydraulic conductivity and physical characteristics of the material was conducted, to determine the capacity of the material to restrict the leaching of contaminants beyond the vicinity of the landfill cell base. In order to determine the suitability of the insitu material underlying the landfill cell a range of tests were conducted, including; Moisture Density Relationship testing, Atterberg Limits and Permeability testing. A summary of these results are provided in table 4 on the following page.

Table 4 Summary of Soil Testing Results - Material Underlying Landfill Cell

Location	Sample Number	Depth (m)	Liquid Limit (%)	Plasticity index (%)	Linear shrinkage (%)	maximum dry density (t/m3)	Optimum Moisture Content (%)	Coefficient of Permeability m/s	Coefficient of Permeability mm/yr
1	WS17-8	0.5	24.6	19.4	2.4	1.8664	12.4	3E-009	94.67
1	WS17-9	1.5	27	19.2	3.6	1.92	11.9	9E-010	28.40
2	WS17-10	0.5	25.8	21.2	3.4	1.866	12.3	9E-010	28.40
2	WS17-11	1.5	27.2	21.8	3.2	1.904	11.7	6E-009	189.35
3	WS17-12	0.5	22	19.2	2.8	1.915	11.3	2E-009	63.11
3	WS17-13	1.5	25.4	19	2.6	1.882	12.8	8E-010	25.25
4	WS17-14	0.5	20.4	7.4	3.8	1.891	11.7	8E-010	25.25
4	WS17-15	1.5	21.6	9.2	3.2	1.88	12	2E-009	63.11

5. Discussion

5.1 Test Hole Drilling and Sampling

One objective for the drilling of test holes was to determine if a suitable distance of separation could be achieved between the proposed landfill cell base and the uppermost groundwater aquifer. The drilling of test holes at varied depths from 4m to 18m did not locate a water aquifer. Since the test holes were drilled they have been inspected regularly, particularly after large rainfall events to determine if water persists at these depths, water has not been identified at these locations.

The strata descriptions from the 4 test hole locations indicate a uniform strata formation across the site. As depicted in Section 4.1 figure 2 the upper strata layer is a sandy layer associated with the naturally occurring sandy loam plains encountered in the district. This sandy material then transitions into what is described as a silty material; then into a more solidified material described in the drilling logs as a sandstone type material. Underlying this sandstone material at approximately 7m depth the material has been described as a clay material.

The Quality of Material Reports for the core samples tested from test hole 002 provide information relating to the type of material underlying the landfill cells. The Quality of Materials Reports are provided in appendix 1b. These reports indicate that the material found between 8 and 16 metres is fine grained material with more than 75% of materials passing through a .075mm sieve and 90% or greater for the samples taken at lower depths from locations 2 and 3. Plasticity index results greater than 30 are considered to be highly plastic and have a high clay content. The materials test results therefore identify all of the core samples from Test Hole 002 as highly plastic. The linear shrinkage results from the material quality reports also indicate that a high clay content is present with linear shrinkage values ranging from 17 to 19.5%. The Quality of Materials Reports from core samples taken from Test Hole 002 identify a relatively deep layer of fine grained clay material is present below the proposed landfill cell, ranging from approximately 8m to 17m or greater depths. These materials may not be ideal for lining materials due to the shrink swell characteristics identified, however when occurring at significant depths such as these, large fluctuations in moisture conditioning and subsequent desiccation cracking is unlikely. The underlying clay strata below the landfill cell provides a favourable medium in preference to courser permeable material or solidified material prone to fracture.

5.2 Landfill Cell Base Sampling

Following the initial test hole studies another round of material suitability investigations were undertaken. These samples were taken from within the perimeter of the proposed landfill cell at depths of 0.5 and 1.5m below the proposed landfill cell base (approximately 7.5 and 9m below ground level), materials were tested for Atterberg Limits, Moisture Density and Permeability.

The characteristics of the insitu materials underlying the base of the cell have been characterised as clayey sand material for all of the samples taken. The Atterberg Limit results for these samples demonstrate slight to medium plasticity characteristics, with plasticity index scores ranging from 7.4-21.8% and liquid limits ranging from 20.4-27.2%. In correlation with plasticity values linear

shrinkage values were relatively low with scores ranging from 2.4-3.8%. Relatively low plasticity values and shrink swell characteristics for materials utilised as landfill cell liners are favourable characteristics as materials with a low plasticity index are less susceptible to desiccation cracking compared to clays with a high plasticity and shrink swell characteristics.

Permeability values for the soils tested from the base of the landfill cell at depths of 0.5 and 1.5m indicate that these materials possess low hydraulic conductivity values with permeability values ranging from 25.25-189.5mm/yr. These results indicate the insitu materials forming the underlying strata of the landfill cell would have the capacity to greatly restrict the flow of leachate material from the landfill cell avoiding the contamination of underlying groundwater systems.

6. Conclusions

Results obtained from both the initial test hole study and the soil testing from the landfill cell location indicate that the geological strata of the site has the capacity to restrict the leaching of potential contaminants from causing pollution to the groundwater system. This investigation has also identified the absence of a shallow water table at this site.

The drilling of test holes at two locations with maximum drilling depths of 18 and 11m at the Southern and Northern sites respectfully was conducted without the detection of groundwater. Indicating a significant separation distance between the landfill cell base and the uppermost groundwater aquifer. Inspections following the drilling of the bores has failed to identify any water at theses depths even following substantial rainfall events.

The test hole strata descriptions identify a uniform strata formation across the site. Materials testing from the deepest of the test holes (Test Hole 002) provides Atterberg limits and Particle Size Distributions for core samples between the depths of 8-17m. The materials testing values for the core samples demonstrates fine grained material is present at these depths; plasticity and linear shrinkage values indicate a high level of plasticity consistent with clay material. These clay materials prevailing to significant depths below the landfill cell identify the absence of porous or fractured material.

Material testing below the landfill cell sampled at 0.5 and 1.5 depth provided values for Atterberg Limits, Moisture Density and Permeability. This material was characterised as a Sandy Clay. The Atterberg Limit values identify these soils to be slightly – medium plastic, in correlation with the plasticity values linear shrinkage values were low and ranged from 2.4-3.8%. These plasticity values identify a low susceptibility to desiccation cracking, a desirable characteristic for landfill cell base material. Permeability results indicate low permeability values for these soils ranging from $6x10^{-9}$ – $8x10^{-10}$, although these results show some variation they indicate the capacity to greatly restrict the leaching of contaminants from the landfill cell.

This investigation has identified the insitu materials at this site are conducive to the implementation of a landfill site. It has been determined there is a significant distance of separation between the landfill cell base and the uppermost groundwater aquifer; the material immediately below the base of the landfill cell has low permeability and plasticity values providing a natural leachate barrier with a low susceptibility to desiccation cracking; and the material underlying the cell base is a fine grained clay material persisting to a significant depth below the landfill cell.

Appendix 1a
Test Hole Drill Log Forms

Drill log form

Queensland Government

1037751

Authorisation details
Registered number _____ Development permit number _____ Works reference number 001

SECTION A—LOCATION DETAILS
Name of landholder Barcaldine Regional Council Phone No. 46515 600
Postal address PO Box 191 Barcaldine Postcode 4725
Real property address New Rubbish tip Barcaldine Postcode 4725
Real property description Lot 1 Plan SP223525 or Bore location GPS. Latitude 23° 35-256 S Longitude 145° 15-920 Datum _____
Easting _____ Northing _____ Zone _____

SECTION B—BORE COMPLETION DETAILS
Date commenced 22/8/2014
Date completed 22/8/2014

SECTION C—DRILLING METHOD
☐ Rotary mud ☐ Cable tool
☐ Auger ☑ Rotary air
☐ Other _____

SECTION D—HOLE SIZE

Diameter (mm)	Location (metres) From	To
171	0	1·5
120	1·5	4

SECTION E—CASING DETAILS

Type (PVC, steel etc)	Size O.D. (mm)	Wall thickness (mm)	Location (metres) From	To
PVC	60	5·1	0	4
steel	114	4	+ 0·6	1·5

SECTION F—CENTRALISERS TYPE

Type	Location (metres) From	To

SECTION G—PERFORATIONS/ SLOTS/ SCREENS

Type	Size O.D. (mm)	Aperture (mm)	Location (metres) From	To
slots	60	0·4	2·5	4

SECTION H—CEMENTING/ GRAVEL PACK/ ANNULAR FILL DETAILS

Type & material size	Hole diameter (mm)	Casing diameter (mm O.D.)	Location (metres) From	To
concreat	171	114	0	1
grout	120	60	1	2
Bentenite	120	60	2	2·3
gravel	120	60	2·3	4

SECTION I—BORE PURPOSE
☐ Domestic ☐ Stock ☐ Irrigation ☐ Commercial
☐ Urban ☑ Industrial Other (please specify) Monitoring

SECTION J—PARTICULARS OF STRATA

From (metres)	To (metres)	Strata description (use more than one line if required)	Water bed thus(*)
0	3·1	Yelow sand	
3·1	4	silt stone	

SECTION K—WATER BEARING BEDS

Depth struck (metres)	Water rose to (metres)	Supply (litres/second)	Quality (e.g. potable, brackish, salty)
			no water
			dry

Conductivity(EC) pH

SECTION L—SUB ARTESIAN BORE ON COMPLETION
Depth to standing water level from ground level (metres)
Depth to pump suction or bottom of drill stem (metres)
Type of test used ☐ Air ☐ Bail ☐ Pump

Est. supply (litres/second)	Duration of test (hours)	Drawdown level from surface (metres)

SECTION M—ARTESIAN BORE ON COMPLETION

Pressure (kPa)	Free flow (litres/second)	Temperature (°C)

SECTION N—REMARKS

SECTION O—CERTIFICATION
I hereby certify that the bore is drilled and constructed according to the conditions of my driller's licence and the information provided in sections A to E and section H above is true, accurate and complete to the best of my knowledge and belief.
Driller Brett Weld Driller's Licence No. 3079
Trainee Driller _____ Driller's Licence No. _____
Signature of Driller Brett Weld Date 24/8/2014
Contractor Brett Weld

#23874 03/09/2010

Department of Environment and Resource Management

White — foward to the Department of Environment and Resource Management. Pink — provide to landholder. Blue — Driller to retain.

Drill log form

Queensland Government

1037752

Authorisation details
Registered number _____ Development permit number _____ Works reference number 002

SECTION A—LOCATION DETAILS
Name of landholder Barcaldine Regional Council Phone No. 46575 600
Postal address PO Box 191 Barcaldine Postcode 4725
Real property address New Ribbish tips Barcaldine Postcode 4725
Real property description Lot 1 Plan SP223525 or Bore location GPS. Latitude 23°35-255 S Longitude 145°15-920 E Datum _____
Easting _____ Northing _____ Zone _____

SECTION B—BORE COMPLETION DETAILS
Date commenced 22/8/2014
Date completed 22/8/2014

SECTION C—DRILLING METHOD
☐ Rotary mud ☐ Cable tool
☐ Auger ☑ Rotary air
☐ Other _____

SECTION D—HOLE SIZE

Diameter (mm)	Location (metres) From	To
171	0	1.5
120	1.5	18

SECTION E—CASING DETAILS

Type (PVC, steel etc)	Size O.D. (mm)	Wall thickness (mm)	Location (metres) From	To
PVC	60	5-1	0	11-1
steel	114	4	+0.5	1-5

SECTION F—CENTRALISERS TYPE

Type	Location (metres) From	To

SECTION G—PERFORATIONS/ SLOTS/ SCREENS

Type	Size O.D. (mm)	Aperture (mm)	Location (metres) From	To
slots	60	0-4	5-1	11-1

SECTION H—CEMENTING/ GRAVEL PACK/ ANNULAR FILL DETAILS

Type & material size	Hole diameter (mm)	Casing diameter (mm O.D.)	Location (metres) From	To
Concreat	171	114	0	1.5
grout	180 120	60	1.5	4.5
Bentenite	120	60	4.5	5
gravel	120	60	5.	11-1

SECTION I—BORE PURPOSE
☐ Domestic ☐ Stock ☐ Irrigation ☐ Commercial
☐ Urban ☑ Industrial Other (please specify) Monitoring

SECTION J—PARTICULARS OF STRATA

From (metres)	To (metres)	Strata description (use more than one line if required)	Water bed thus(*)
0	3-1	yelow sand	
3-1	4-8	silt stone	
4-8	7-4	red and white sand stone	
7-4	10	Brown sandy clay	
10	18	Brown-yelow clay	
soil		samples taken for permeability testing	
		grout 120mm hole 11-1m - 18m	

SECTION K—WATER BEARING BEDS

Depth struck (metres)	Water rose to (metres)	Supply (litres/second)	Quality (e.g. potable, brackish, salty)
			clay

Conductivity(EC) pH

SECTION L—SUB ARTESIAN BORE ON COMPLETION
Depth to standing water level from ground level (metres)
Depth to pump suction or bottom of drill stem (metres)
Type of test used ☐ Air ☐ Bail ☐ Pump

Est. supply (litres/second)	Duration of test (hours)	Drawdown level from surface (metres)

SECTION M—ARTESIAN BORE ON COMPLETION

Pressure (kPa)	Free flow (litres/second)	Temperature (°C)

SECTION N—REMARKS

SECTION O—CERTIFICATION
I hereby certify that the bore is drilled and constructed according to the conditions of my driller's licence and the information provided in sections A to E and section H above is true, accurate and complete to the best of my knowledge and belief.
Driller Brett Wehl Driller's Licence No. 3079
Trainee Driller _____ Driller's Licence No. _____
Signature of Driller B Wehl Date 24/8/2014
Contractor Brett Wehl

03/09/2010 #28874

Department of Environment and Resource Management

White — foward to the Department of Environment and Resource Management. Pink — provide to landholder. Blue — Driller to retain.

Drill log form

Queensland Government

1037753

Authorisation details
Registered number _____ Development permit number _____ Works reference number 003

SECTION A—LOCATION DETAILS
Name of landholder Barcaldine Regional Council Phone No. 46515600
Postal address PO Box 191 Barcaldine Postcode 4725
Real property address New Rubbish Tip Barcaldine Postcode 4725
Real property description Lot 1 Plan SP223525 or Bore location GPS. Latitude 23°35-107S Longitude 145°15-908E Datum _____
Easting _____ Northing _____ Zone _____

SECTION B—BORE COMPLETION DETAILS
Date commenced 22/8/2014
Date completed 23/8/2014

SECTION C—DRILLING METHOD
☐ Rotary mud ☐ Cable tool
☐ Auger ☑ Rotary air
☐ Other _____

SECTION D—HOLE SIZE

Diameter (mm)	Location (metres) From	To
171	0	1.5
120	1.5	11.2

SECTION E—CASING DETAILS

Type (PVC, steel etc)	Size O.D. (mm)	Wall thickness (mm)	Location (metres) From	To
PVC	60	5.1	0	11.2
Steel	114	4	+0.6	1

SECTION F—CENTRALISERS TYPE

Type	Location (metres) From	To

SECTION G—PERFORATIONS/ SLOTS/ SCREENS

Type	Size O.D. (mm)	Aperture (mm)	Location (metres) From	To
slots	60	0.4	5.2	11.2

SECTION H—CEMENTING/ GRAVEL PACK/ ANNULAR FILL DETAILS

Type & material size	Hole diameter (mm)	Casing diameter (mm O.D.)	Location (metres) From	To
Concreat	171	114	0	1.5
grout	120	60	1.5	4.6
Bentermit	120	60	4.6	5.2
gravel	120	60	5.2	11.2

SECTION I—BORE PURPOSE
☐ Domestic ☐ Stock ☐ Irrigation ☐ Commercial
☐ Urban ☑ Industrial Other (please specify) Monitoring

SECTION J—PARTICULARS OF STRATA

From (metres)	To (metres)	Strata description (use more than one line if required)	Water bed thus(*)
0	2.5	Sand	
2.5	4.3	silt stone	
4.3	7	sand stone	
7	11.2	Brown yelow clay	

SECTION K—WATER BEARING BEDS

Depth struck (metres)	Water rose to (metres)	Supply (litres/second)	Quality (e.g. potable, brackish, salty)
			dry

Conductivity(EC) pH

SECTION L—SUB ARTESIAN BORE ON COMPLETION
Depth to standing water level from ground level (metres)
Depth to pump suction or bottom of drill stem (metres)
Type of test used ☐ Air ☐ Bail ☐ Pump

Est. supply (litres/second)	Duration of test (hours)	Drawdown level from surface (metres)

SECTION M—ARTESIAN BORE ON COMPLETION

Pressure (kPa)	Free flow (litres/second)	Temperature (°C)

SECTION N—REMARKS

SECTION O—CERTIFICATION
I hereby certify that the bore is drilled and constructed according to the conditions of my driller's licence and the information provided in sections A to E and section H above is true, accurate and complete to the best of my knowledge and belief.
Driller Brett Webb Driller's Licence No. 3079
Trainee Driller _____ Driller's Licence No. _____
Signature of Driller B A Webb Date 24/8/2014
Contractor B A Webb

#28874
03/09/2010

Department of Environment and Resource Management

White — foward to the Department of Environment and Resource Management. Pink — provide to landholder. Blue — Driller to retain.

Drill log form

Queensland Government

1037754

Authorisation details
Registered number _____ Development permit number _____ Works reference number 004

SECTION A—LOCATION DETAILS
Name of landholder Barcaldine Regional Council Phone No. 46515 600
Postal address PO Box 191 Barcaldine Postcode 4725
Real property address New rubbish tip Barcaldine Postcode 4725
Real property description Lot 1 Plan SP233525 or Bore location GPS. Latitude 23°35-108S Longitude 145°15-908E Datum _____
Easting _____ Northing _____ Zone _____

SECTION B—BORE COMPLETION DETAILS
Date commenced 23/8/2014
Date completed 23/8/2014

SECTION C—DRILLING METHOD
☐ Rotary mud ☐ Cable tool
☐ Auger ☑ Rotary air
☐ Other _____

SECTION D—HOLE SIZE

Diameter (mm)	Location (metres) From	To
171	0	1.5
120	1.5	4

SECTION E—CASING DETAILS

Type (PVC, steel etc)	Size O.D. (mm)	Wall thickness (mm)	Location (metres) From	To
PVC	60	5.1	0	3.55
steel	114	4	+0.5	1

SECTION F—CENTRALISERS TYPE

Type	Location (metres) From	To

SECTION G—PERFORATIONS/ SLOTS/ SCREENS

Type	Size O.D. (mm)	Aperture (mm)	Location (metres) From	To
slots	60	0.4	2.05	3.55

SECTION H—CEMENTING/ GRAVEL PACK/ ANNULAR FILL DETAILS

Type & material size	Hole diameter (mm)	Casing diameter (mm O.D.)	Location (metres) From	To
concrete	171	114	0	1.5
grout	120	60	1.5	2
gravel	120	60	2	3.55
Bentonite	120	60	3.55	4

SECTION I—BORE PURPOSE
☐ Domestic ☐ Stock ☐ Irrigation ☐ Commercial
☐ Urban ☑ Industrial Other (please specify) Monitoring

SECTION J—PARTICULARS OF STRATA

From (metres)	To (metres)	Strata description (use more than one line if required)	Water bed thus(*)
0	2.5	yllow sand	
2.5	4	silt stone	

SECTION K—WATER BEARING BEDS

Depth struck (metres)	Water rose to (metres)	Supply (litres/second)	Quality (e.g. potable, brackish, salty)
			dry

Conductivity(EC) _____ pH _____

SECTION L—SUB ARTESIAN BORE ON COMPLETION
Depth to standing water level from ground level (metres)
Depth to pump suction or bottom of drill stem (metres)
Type of test used ☐ Air ☐ Bail ☐ Pump

Est. supply (litres/second)	Duration of test (hours)	Drawdown level from surface (metres)

SECTION M—ARTESIAN BORE ON COMPLETION

Pressure (kPa)	Free flow (litres/second)	Temperature (°C)

SECTION N—REMARKS

SECTION O—CERTIFICATION
I hereby certify that the bore is drilled and constructed according to the conditions of my driller's licence and the information provided in sections A to E and section H above is true, accurate and complete to the best of my knowledge and belief.

Driller Brett Wehl Driller's Licence No. 3079
Trainee Driller _____ Driller's Licence No. _____
Signature of Driller B Wehl Date 24/8/2014
Contractor Brett Wehl

Department of Environment and Resource Management

White — foward to the Department of Environment and Resource Management. Pink — provide to landholder. Blue — Driller to retain.

Appendix 1b

Test Hole Core Samples Quality of Materials Report

Cardno Construction Sciences
ABN: 74 126 806 735
Address:
37 Carmel Street,
Garbutt QLD 4814

Laboratory: Townsville Laboratory
Phone: 0747288023 Fax: 0747288024
Email: michael.midgley@cardno.com.au

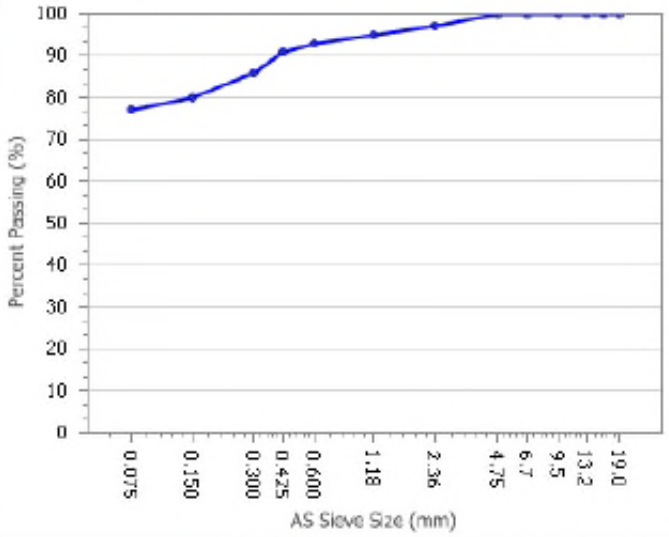
QUALITY OF MATERIALS REPORT

Client:	Barcaldine Regional Council	Report Number:	10599/R/8306-1
Client Address:	Regional Council, PO Box 191, Barcaldine	Project Number:	10599/P/337
Project:	General Testing	Lot Number:	New Refuse Tip- Development
Location:	Barcaldine	Internal Test Request:	10599/T/3454
Component:	Quality Compliance	Client Reference/s:	203627
Area Description:	Drilled Clay Samples	Report Date / Page:	11/09/2014 Page 1 of 3

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1
Sample Number	10599/S/19331
Sampling Method	Tested as Received
Date Sampled	8/09/2014
Sampled By	Client Sampled
Date Tested	8/09/2014
Att. Drying Method	Oven Dried
Atterberg Preparation	Dry Sieved
Location	8-12m
Material Source	CLIENT
Material Type	Clay Fill
Material Description	-

AS Sieve (mm)	Specification Minimum	Percent Passing (%)	Specification Maximum
19.0		100	
16.0		100	
13.2		100	
9.5		100	
6.7		100	
4.75		100	
2.36		97	
1.18		95	
0.600		93	
0.425		91	
0.300		86	
0.150		80	
0.075		77	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum	Result	Specification Maximum	Test Result	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)		59		0.075/0.425 Fines Ratio		0.85	
Plastic Limit (%)		20		PI x 0.425 Ratio (%)		3549.0	
Plastic Index (%)		39		LS x 0.425 Ratio (%)		1547.0	
Linear Shrinkage (%)		17.0		Linear Shrinkage Defects	curl		

Remarks

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

Accreditation Number: 1986
Corporate Site Number: 10599

Approved Signatory: Nathan Lyne
Form ID: W85Rep Rev 1

Cardno Construction Sciences
ABN: 74 128 806 735
Address:
37 Carmel Street,
Garbutt QLD 4814

Laboratory: Townsville Laboratory
Phone: 0747288023 Fax: 0747288024
Email: michael.midgley@cardno.com.au

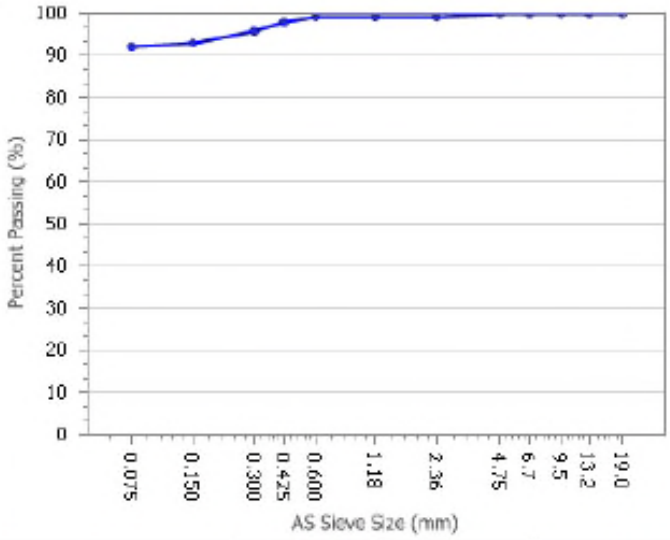
QUALITY OF MATERIALS REPORT

Client:	Barcaldine Regional Council	Report Number:	10599/R/8306-1
Client Address:	Regional Council, PO Box 191, Barcaldine	Project Number:	10599/P/337
Project:	General Testing	Lot Number:	New Refuse Tip- Development
Location:	Barcaldine	Internal Test Request:	10599/T/3454
Component:	Quality Compliance	Client Reference/s:	203627
Area Description:	Drilled Clay Samples	Report Date / Page:	11/09/2014 Page 2 of 3

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	10599/S/19332	Location	14-15m
Sampling Method	Tested as Received		
Date Sampled	8/09/2014		
Sampled By	Client Sampled		
Date Tested	8/09/2014	Material Source	CLIENT
Att. Drying Method	Oven Dried	Material Type	Clay Fill
Atterberg Preparation	Dry Sieved	Material Description	-

AS Sieve (mm)	Specification Minimum	Percent Passing (%)	Specification Maximum
19.0		100	
13.2		100	
9.5		100	
6.7		100	
4.75		100	
2.36		99	
1.18		99	
0.600		99	
0.425		98	
0.300		96	
0.150		93	
0.075		92	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum	Result	Specification Maximum	Test Result	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)		71		0.075/0.425 Fines Ratio		0.94	
Plastic Limit (%)		24		PI x 0.425 Ratio (%)		4606.0	
Plastic Index (%)		47		LS x 0.425 Ratio (%)		1862.0	
Linear Shrinkage (%)		19.0		Linear Shrinkage Defects	curl		

Remarks

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Cardno Construction Sciences
ABN: 74 128 806 735
Address:
37 Carmel Street,
Garbutt QLD 4814

Laboratory: Townsville Laboratory
Phone: 0747288023 Fax: 0747288024
Email: michael.midgley@cardno.com.au

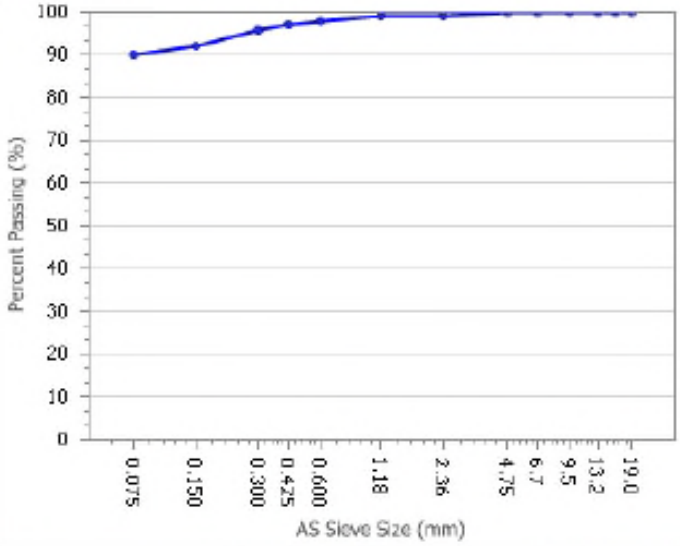
QUALITY OF MATERIALS REPORT

Client:	Barcaldine Regional Council	Report Number:	10599/R/8306-1
Client Address:	Regional Council, PO Box 191, Barcaldine	Project Number:	10599/P/337
Project:	General Testing	Lot Number:	New Refuse Tip- Development
Location:	Barcaldine	Internal Test Request:	10599/T/3454
Component:	Quality Compliance	Client Reference/s:	203627
Area Description:	Drilled Clay Samples	Report Date / Page:	11/09/2014 Page 3 of 3

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	10599/S/19333	Location	16-17m
Sampling Method	Tested as Received		
Date Sampled	8/09/2014		
Sampled By	Client Sampled		
Date Tested	8/09/2014	Material Source	CLIENT
Att. Drying Method	Oven Dried	Material Type	Clay Fill
Atterberg Preparation	Dry Sieved	Material Description	-

AS Sieve (mm)	Specification Minimum	Percent Passing (%)	Specification Maximum
19.0		100	
16.0		100	
13.2		100	
9.5		100	
6.7		100	
4.75		100	
2.36		99	
1.18		99	
0.600		98	
0.425		97	
0.300		96	
0.150		92	
0.075		90	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum	Result	Specification Maximum	Test Result	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)		71		0.075/0.425 Fines Ratio		0.93	
Plastic Limit (%)		23		PI x 0.425 Ratio (%)		4656.0	
Plastic Index (%)		48		LS x 0.425 Ratio (%)		1891.5	
Linear Shrinkage (%)		19.5		Linear Shrinkage Defects	curl		

Remarks

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Form ID: W85Rep Rev 1

Appendix 2a

Landfill Cell Base Moisture Density and Atterberg Limit Reports

Westest
Materials Testing Services

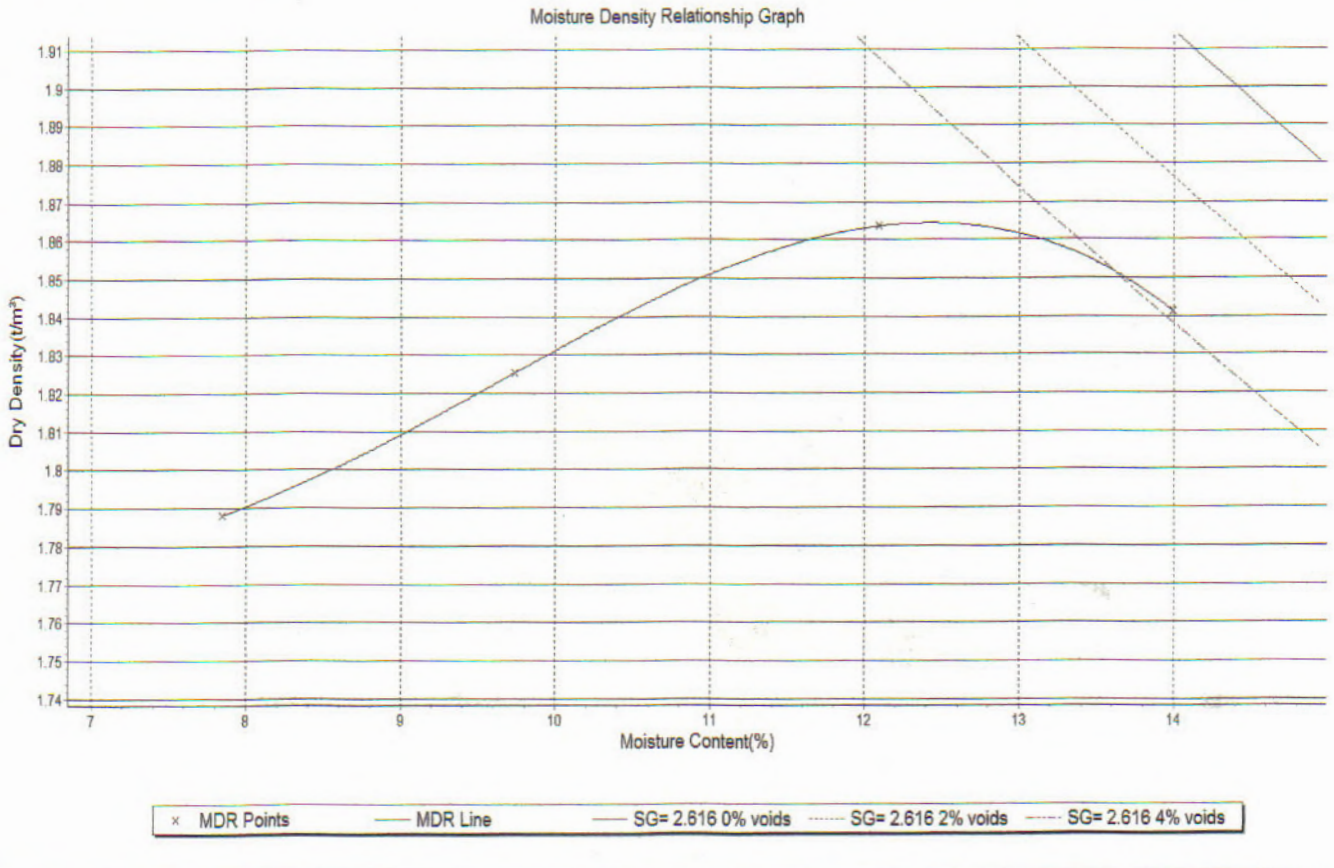
Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidvea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Moisture Density Relationship Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1208 - 1/1**
Address :	**Ash Street Barcaldine QLD 4725**	Report Date :	**30/01/2017**
Project Name :	**Barcaldine Land Fill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q142A**
Location:	**Barcaldine New Dump , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-8	SAMPLE LOCATION	
Sampling Method :	AS1289.1.2.1 CL 6.5.4	Location (1) 0.5 M Depth	
Sampled By :	Ernie Taylor		
Date Sampled :	24/01/2017		
Date Tested :	25/01/2017		
Material Type :	Clayey Sand	Test Number :	1
Material Source :	Existing	Lot Number :	N/A
Remarks :		Moisture Method :	Q102A

Maximum Size (mm) :	19.0	**Maximum Dry Density (t/m) :**	**1.864**
Oversize Dry (%) :	0.0	**Optimum Moisture Content (%) :**	**12.4**
Oversize Density (t/m³) :	0.0		



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Dean Maloney - Technical Manager
NATA Accreditation Number
19218

Document Code RF125-5

Westest
Materials Testing Services

Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Atterberg Limits Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1214 - 1/1**
Address :	**Ash Street Barcaldine QLD 4725, Barcaldine**	Report Date :	**13/02/2017**
Project Name :	**Barcaldine Landfill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q104D,Q105,Q106**
Location:	**New Landfill Site , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-8			
Test Number :	1			
Date Sampled :	24/01/2017			
Date Tested :	7/02/2017			
Sampled By :	Ernie Taylor			
Sampling Method :	AS1289.1.2.1 CL 6.5.4			
Material Source :	Existing			
Material Type :	Clayey Sand			
Sample Location :	Location (1) 0.5 M Depth			
Lot Number :	N/A			
Moisture Method :	Q102A			
Sample History :	Oven Dried			
Sample Preparation :	Dry			
Notes :	No Cracking or Crumbling			
Mould Length (mm) :	149.65			
Liquid Limit (%) :	24.6			
Plastic Limit (%) :	5.2			
Plasticity Index (%) :	19.4			
Linear Shrinkage (%) :	2.4			
SPECIFICATION DETAILS				
Specification Number :	Base WQ35 Alternative 2			
Liquid Limit - Max :	0			
Plasticity Index - Max :	0			
Linear Shrinkage - Max :	4.5			
Remarks :	-			

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Dean Maloney - Technical Manager
NATA Accreditation Number :
19218

Westest
Materials Testing Services

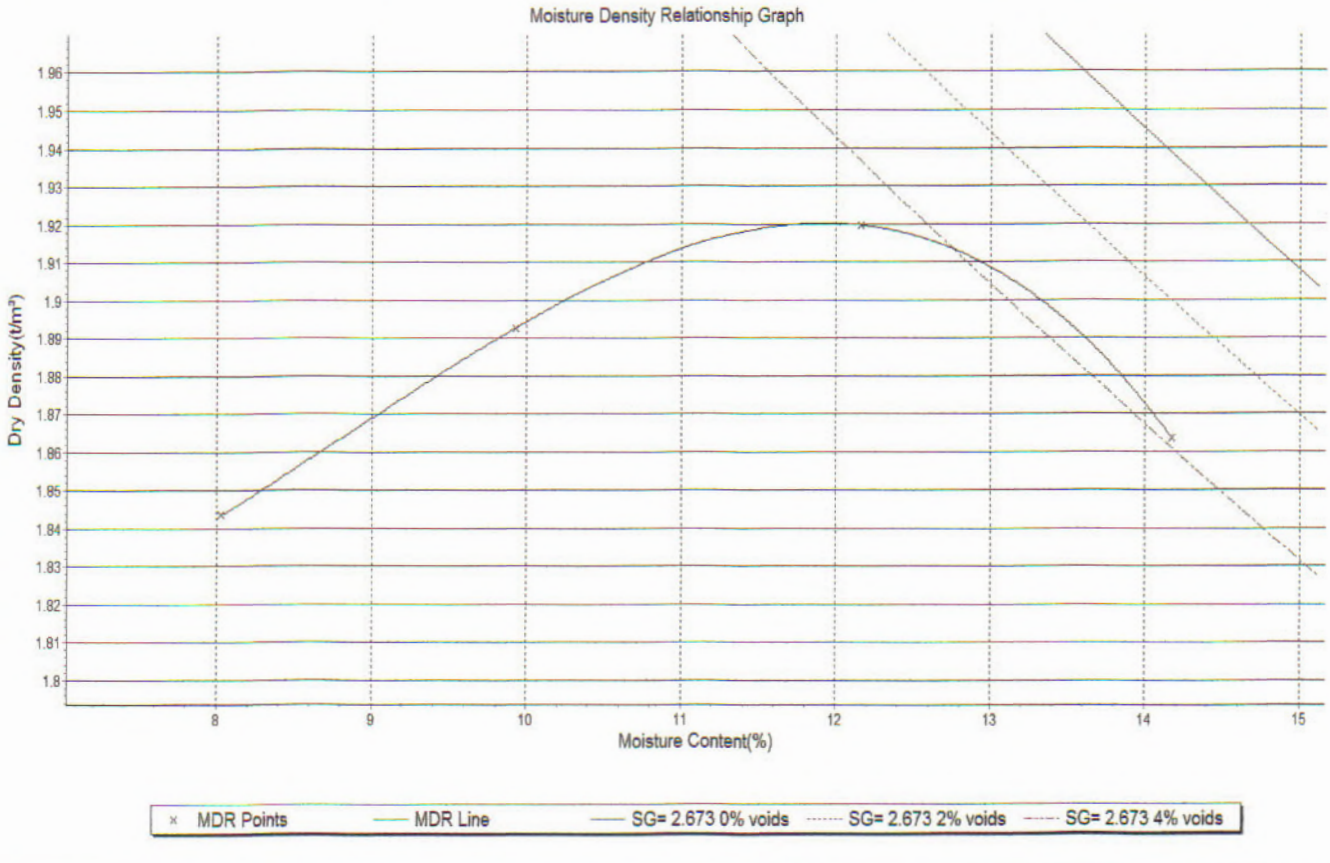
Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Moisture Density Relationship Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1208 - 2/1**
Address :	**Ash Street Barcaldine QLD 4725**	Report Date :	**30/01/2017**
Project Name :	**Barcaldine Land Fill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q142A**
Location:	**Barcaldine New Dump , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-9	SAMPLE LOCATION	
Sampling Method :	AS1289.1.2.1 CL 6.5.4	Location (1) 1.5 M Depth	
Sampled By :	Ernie Taylor		
Date Sampled :	24/01/2017		
Date Tested :	25/01/2017	Test Number :	2
Material Type :	Clayey Sand	Lot Number :	N/A
Material Source :	Existing	Moisture Method :	Q102A
Remarks :			

Maximum Size (mm) :	19.0	**Maximum Dry Density (t/m) :**	**1.92**
Oversize Dry (%) :	0.0	**Optimum Moisture Content (%) :**	**11.9**
Oversize Density (t/m³) :	0.0		



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Dean Maloney - Technical Manager
NATA Accreditation Number
19218

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Westest
Materials Testing Services

Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Atterberg Limits Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1214 - 2/1**
Address :	**Ash Street Barcaldine QLD 4725, Barcaldine**	Report Date :	**13/02/2017**
Project Name :	**Barcaldine Landfill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q104D,Q105,Q106**
Location:	**New Landfill Site , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-9			
Test Number :	2			
Date Sampled :	24/01/2017			
Date Tested :	8/02/2017			
Sampled By :	Ernie Taylor			
Sampling Method :	AS1289.1.2.1 CL 6.5.4			
Material Source :	Existing			
Material Type :	Clayey Sand			
Sample Location :	Location (1) 1.5 M Depth			
Lot Number :	N/A			
Moisture Method :	Q102A			
Sample History :	Oven Dried			
Sample Preparation :	Dry			
Notes :	No Cracking or Crumbling			
Mould Length (mm) :	149.86			
Liquid Limit (%) :	27.0			
Plastic Limit (%) :	7.8			
Plasticity Index (%) :	19.2			
Linear Shrinkage (%) :	3.6			
SPECIFICATION DETAILS				
Specification Number :	Base WQ35 Alternative 2			
Liquid Limit - Max :	0			
Plasticity Index - Max :	0			
Linear Shrinkage - Max :	4.5			
Remarks :	-			

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Dean Maloney - Technical Manager

NATA Accreditation Number : 19218

Westest
Materials Testing Services

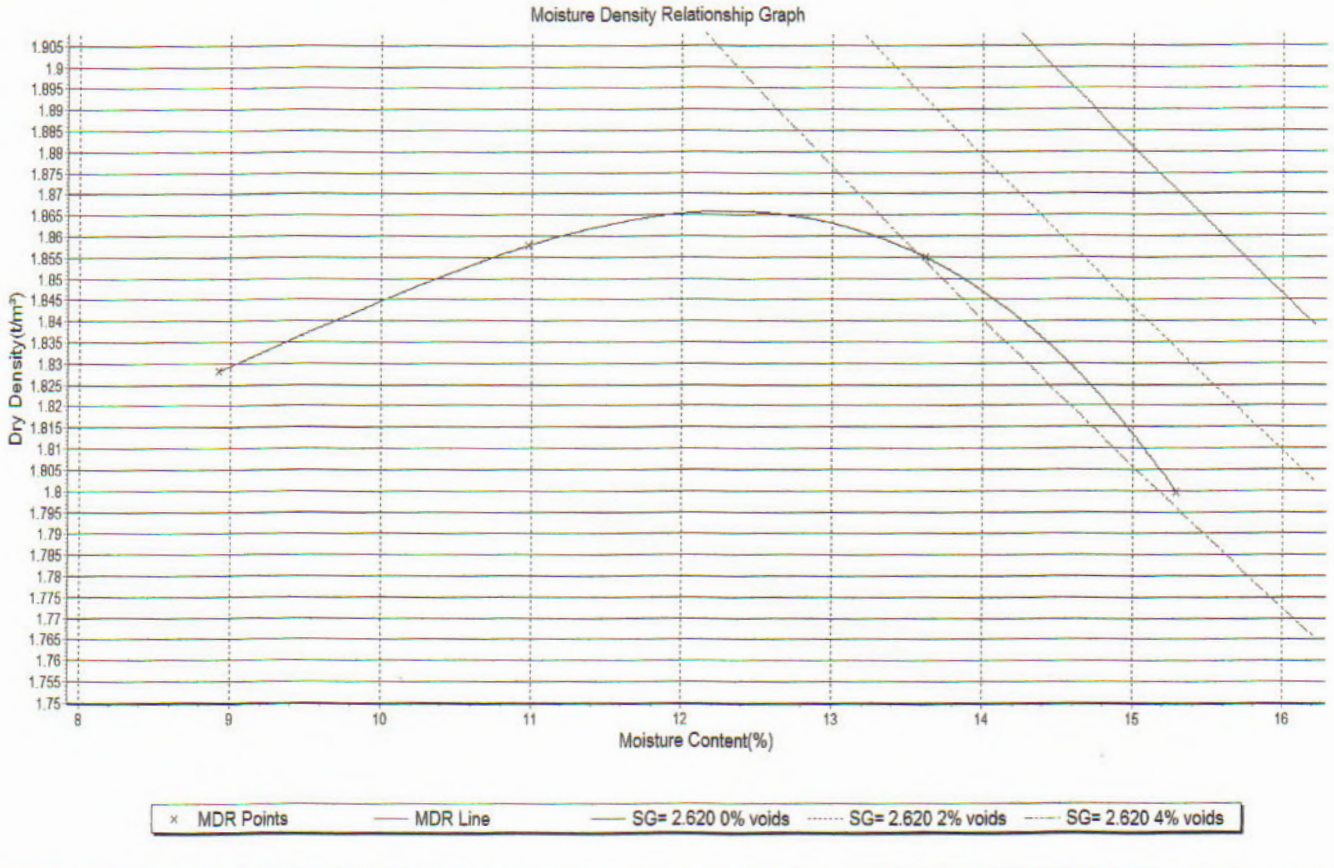
Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Moisture Density Relationship Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1208 - 3/1**
Address :	**Ash Street Barcaldine QLD 4725**	Report Date :	**30/01/2017**
Project Name :	**Barcaldine Land Fill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q142A**
Location:	**Barcaldine New Dump , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-10	SAMPLE LOCATION	
Sampling Method :	AS1289.1.2.1 CL 6.5.4	Location (2) 0.5 M Depth	
Sampled By :	Ernie Taylor		
Date Sampled :	24/01/2017		
Date Tested :	24/01/2017		
Material Type :	Clayey Sand	Test Number :	3
Material Source :	Existing	Lot Number :	N/A
Remarks :		Moisture Method :	Q102A

Maximum Size (mm) :	19.0	**Maximum Dry Density (t/m) :**	**1.866**
Oversize Dry (%) :	0.0	**Optimum Moisture Content (%) :**	**12.3**
Oversize Density (t/m³) :	0.0		



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Dean Maloney - Technical Manager
NATA Accreditation Number
19218

Document Code RF125-5

Westest
Materials Testing Services

Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Atterberg Limits Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1214 - 3/1**
Address :	**Ash Street Barcaldine QLD 4725, Barcaldine**	Report Date :	**13/02/2017**
Project Name :	**Barcaldine Landfill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q104D,Q105,Q106**
Location:	**New Landfill Site , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-10			
Test Number :	3			
Date Sampled :	24/01/2017			
Date Tested :	8/02/2017			
Sampled By :	Ernie Taylor			
Sampling Method :	AS1289.1.2.1 CL 6.5.4			
Material Source :	Existing			
Material Type :	Clayey Sand			
Sample Location :	Location (2) 0.5 M Depth			
Lot Number :	N/A			
Moisture Method :	Q102A			
Sample History :	Oven Dried			
Sample Preparation :	Dry			
Notes :	No Cracking or Crumbling			
Mould Length (mm) :	149.73			
Liquid Limit (%) :	25.8			
Plastic Limit (%) :	4.6			
Plasticity Index (%) :	21.2			
Linear Shrinkage (%) :	3.4			
SPECIFICATION DETAILS				
Specification Number :	Base WQ35 Alternative 2			
Liquid Limit - Max :	0			
Plasticity Index - Max :	0			
Linear Shrinkage - Max :	4.5			
Remarks :	-			

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Dean Maloney - Technical Manager
NATA Accreditation Number :
19218

Westest
Materials Testing Services

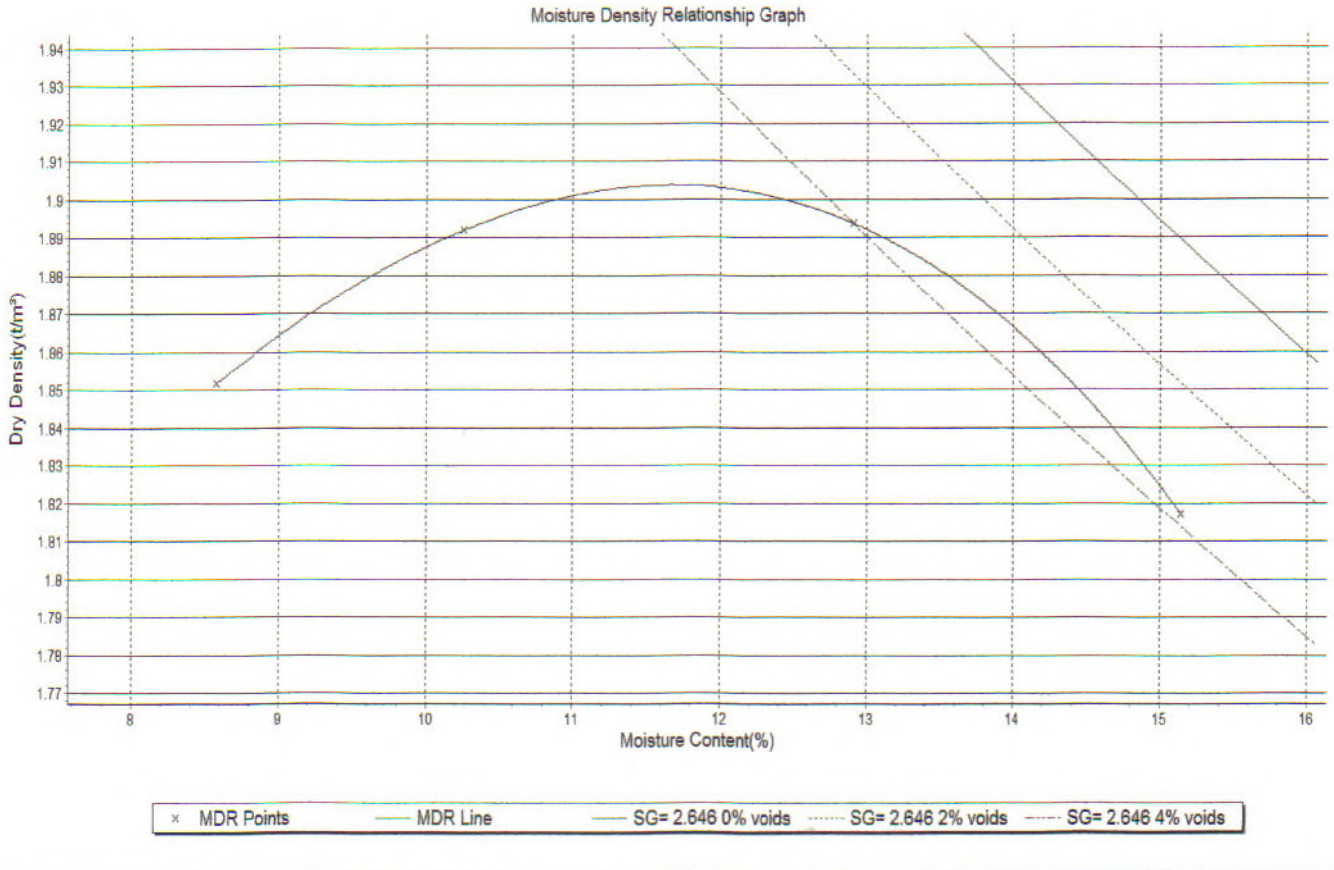
Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidvea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Moisture Density Relationship Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1208 - 4/1**
Address :	**Ash Street Barcaldine QLD 4725**	Report Date :	**30/01/2017**
Project Name :	**Barcaldine Land Fill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q142A**
Location:	**Barcaldine New Dump , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-11	SAMPLE LOCATION	
Sampling Method :	AS1289.1.2.1 CL 6.5.4	Location (2) 1.5 M Depth	
Sampled By :	Ernie Taylor		
Date Sampled :	24/01/2017		
Date Tested :	25/01/2017	Test Number :	4
Material Type :	Clayey Sand	Lot Number :	N/A
Material Source :	Existing	Moisture Method :	Q102A
Remarks :			

Maximum Size (mm) :	19.0	**Maximum Dry Density (t/m) :**	**1.904**
Oversize Dry (%) :	0.0	**Optimum Moisture Content (%) :**	**11.7**
Oversize Density (t/m³) :	0.0		



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Dean Maloney - Technical Manager
NATA Accreditation Number
19218

Document Code RF125-5

Westest
Materials Testing Services

Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Atterberg Limits Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1214 - 4/1**
Address :	**Ash Street Barcaldine QLD 4725, Barcaldine**	Report Date :	**13/02/2017**
Project Name :	**Barcaldine Landfill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q104D,Q105,Q106**
Location:	**New Landfill Site , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-11			
Test Number :	4			
Date Sampled :	24/01/2017			
Date Tested :	9/02/2017			
Sampled By :	Ernie Taylor			
Sampling Method :	AS1289.1.2.1 CL 6.5.4			
Material Source :	Existing			
Material Type :	Clayey Sand			
Sample Location :	Location (2) 1.5 M Depth			
Lot Number :	N/A			
Moisture Method :	Q102A			
Sample History :	Oven Dried			
Sample Preparation :	Dry			
Notes :	No Cracking or Crumbling			
Mould Length (mm) :	149.82			
Liquid Limit (%) :	27.2			
Plastic Limit (%) :	5.4			
Plasticity Index (%) :	21.8			
Linear Shrinkage (%) :	3.2			
SPECIFICATION DETAILS				
Specification Number :	Base WQ35 Alternative 2			
Liquid Limit - Max :	0			
Plasticity Index - Max :	0			
Linear Shrinkage - Max :	4.5			
Remarks :	-			

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Dean Maloney - Technical Manager

NATA Accreditation Number :
19218

Westest
Materials Testing Services

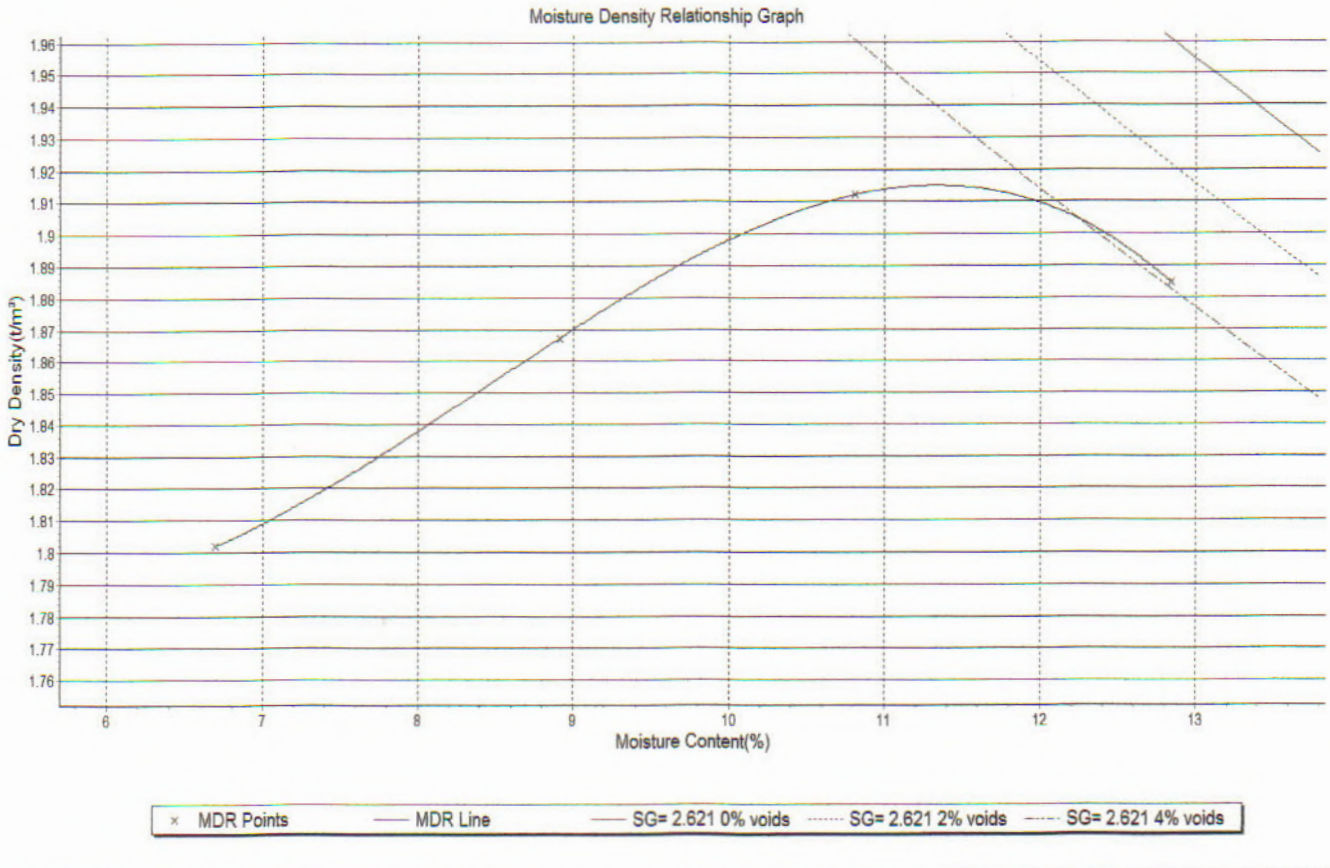
Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Moisture Density Relationship Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1208 - 5/1**
Address :	**Ash Street Barcaldine QLD 4725**	Report Date :	**30/01/2017**
Project Name :	**Barcaldine Land Fill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q142A**
Location:	**Barcaldine New Dump , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-12	SAMPLE LOCATION	
Sampling Method :	AS1289.1.2.1 CL 6.5.4	Location (3) 0.5 M Depth	
Sampled By :	Ernie Taylor		
Date Sampled :	24/01/2017		
Date Tested :	25/01/2017	Test Number :	5
Material Type :	Clayey Sand	Lot Number :	N/A
Material Source :	Existing	Moisture Method :	Q102A
Remarks :			

Maximum Size (mm) :	19.0	**Maximum Dry Density (t/m) :**	**1.915**
Oversize Dry (%) :	0.0	**Optimum Moisture Content (%) :**	**11.3**
Oversize Density (t/m³) :	0.0		



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Westest
Materials Testing Services

Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Atterberg Limits Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1214 - 8/1**
Address :	**Ash Street Barcaldine QLD 4725, Barcaldine**	Report Date :	**13/02/2017**
Project Name :	**Barcaldine Landfill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q104D,Q105,Q106**
Location:	**New Landfill Site , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-12			
Test Number :	5			
Date Sampled :	24/01/2017			
Date Tested :	9/02/2017			
Sampled By :	Ernie Taylor			
Sampling Method :	AS1289.1.2.1 CL 6.5.4			
Material Source :	Existing			
Material Type :	Clayey Sand			
Sample Location :	Location (3) 0.5 M Depth			
Lot Number :	N/A			
Moisture Method :	Q102A			
Sample History :	Oven Dried			
Sample Preparation :	Dry			
Notes :	No Cracking or Crumbling			
Mould Length (mm) :	149.88			
Liquid Limit (%) :	22.0			
Plastic Limit (%) :	2.8			
Plasticity Index (%) :	19.2			
Linear Shrinkage (%) :	2.8			
SPECIFICATION DETAILS				
Specification Number :	Base WQ35 Alternative 2			
Liquid Limit - Max :	0			
Plasticity Index - Max :	0			
Linear Shrinkage - Max :	4.5			
Remarks :	-			

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Dean Maloney - Technical Manager
NATA Accreditation Number :
19218

Westest
Materials Testing Services

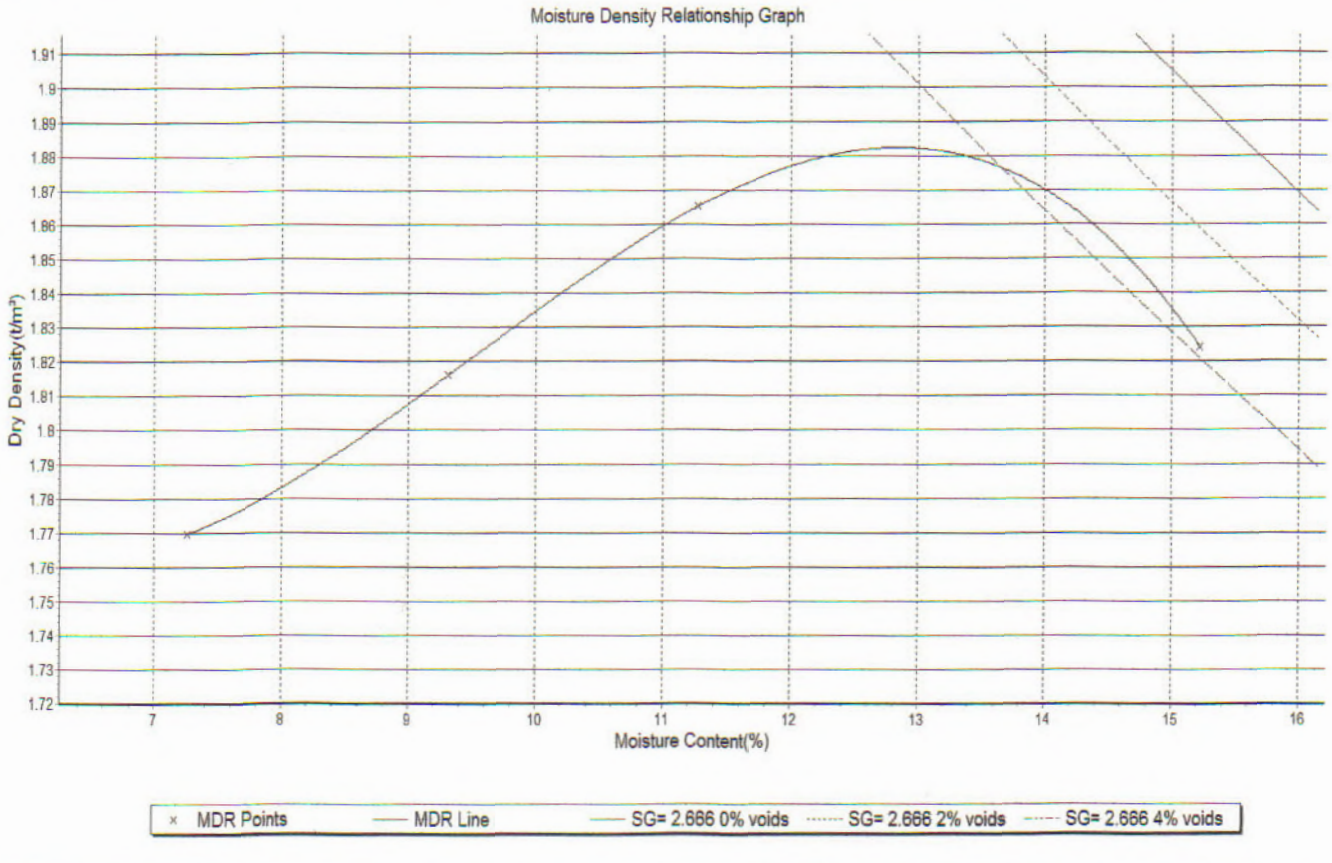
Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Moisture Density Relationship Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1208 - 6/1**
Address :	**Ash Street Barcaldine QLD 4725**	Report Date :	**30/01/2017**
Project Name :	**Barcaldine Land Fill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q142A**
Location:	**Barcaldine New Dump , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-13	SAMPLE LOCATION	
Sampling Method :	AS1289.1.2.1 CL 6.5.4	Location (3) 1.5 M Depth	
Sampled By :	Ernie Taylor		
Date Sampled :	24/01/2017		
Date Tested :	25/01/2017	Test Number :	6
Material Type :	Clayey Sand	Lot Number :	N/A
Material Source :	Existing	Moisture Method :	Q102A
Remarks :			

Maximum Size (mm) :	19.0	**Maximum Dry Density (t/m) :**	**1.882**
Oversize Dry (%) :	0.0	**Optimum Moisture Content (%) :**	**12.8**
Oversize Density (t/m³) :	0.0		



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NATA Accreditation Number
19218

Document Code RF125-5

Westest
Materials Testing Services

Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Atterberg Limits Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1214 - 5/1**
Address :	**Ash Street Barcaldine QLD 4725, Barcaldine**	Report Date :	**13/02/2017**
Project Name :	**Barcaldine Landfill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q104D,Q105,Q106**
Location:	**New Landfill Site , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-13			
Test Number :	6			
Date Sampled :	24/01/2017			
Date Tested :	9/02/2017			
Sampled By :	Ernie Taylor			
Sampling Method :	AS1289.1.2.1 CL 6.5.4			
Material Source :	Existing			
Material Type :	Clayey Sand			
Sample Location :	Location (3) 1.5 M Depth			
Lot Number :	N/A			
Moisture Method :	Q102A			
Sample History :	Oven Dried			
Sample Preparation :	Dry			
Notes :	No Cracking or Crumbling			
Mould Length (mm) :	149.66			
Liquid Limit (%) :	25.4			
Plastic Limit (%) :	6.4			
Plasticity Index (%) :	19.0			
Linear Shrinkage (%) :	2.6			
SPECIFICATION DETAILS				
Specification Number :	Base WQ35 Alternative 2			
Liquid Limit - Max :	0			
Plasticity Index - Max :	0			
Linear Shrinkage - Max :	4.5			
Remarks :	-			

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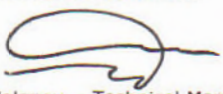


Dean Maloney - Technical Manager
NATA Accreditation Number :
19218

Westest
Materials Testing Services

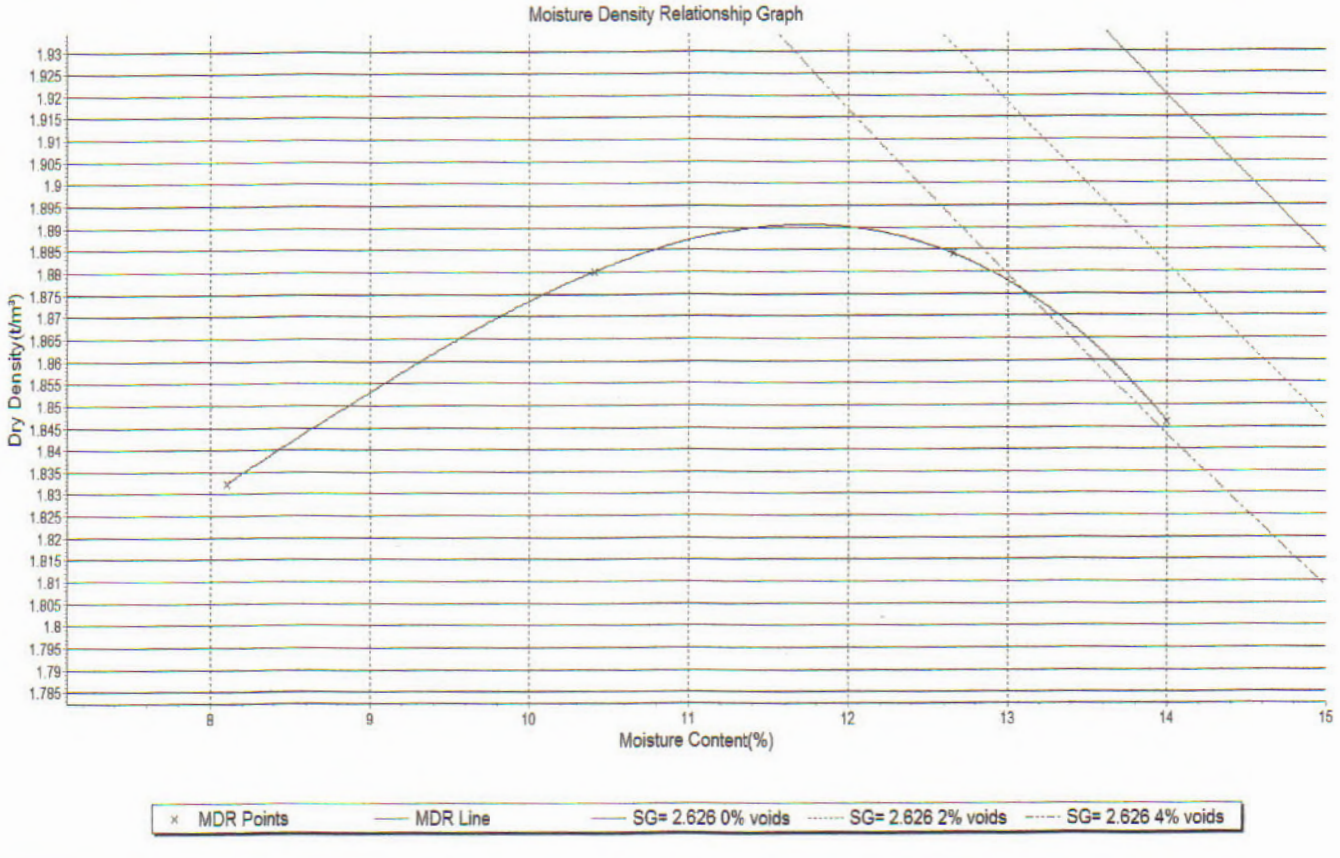
Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Moisture Density Relationship Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1208 - 7/1**
Address :	**Ash Street Barcaldine QLD 4725**	Report Date :	**30/01/2017**
Project Name :	**Barcaldine Land Fill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q142A**
Location:	**Barcaldine New Dump , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-14	SAMPLE LOCATION	
Sampling Method :	AS1289.1.2.1 CL 6.5.4	Location (4) 0.5 M Depth	
Sampled By :	Ernie Taylor		
Date Sampled :	24/01/2017		
Date Tested :	25/01/2017	Test Number :	7
Material Type :	Clayey Sand	Lot Number :	N/A
Material Source :	Existing	Moisture Method :	Q102A
Remarks :			

Maximum Size (mm) :	19.0	**Maximum Dry Density (t/m) :**	**1.891**
Oversize Dry (%) :	0.0	**Optimum Moisture Content (%) :**	**11.7**
Oversize Density (t/m³) :	0.0		



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Dean Maloney - Technical Manager
NATA Accreditation Number
19218

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Westest
Materials Testing Services

Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Atterberg Limits Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1214 - 6/1**
Address :	**Ash Street Barcaldine QLD 4725, Barcaldine**	Report Date :	**13/02/2017**
Project Name :	**Barcaldine Landfill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q104D,Q105,Q106**
Location:	**New Landfill Site , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-14			
Test Number :	7			
Date Sampled :	24/01/2017			
Date Tested :	10/02/2017			
Sampled By :	Ernie Taylor			
Sampling Method :	AS1289.1.2.1 CL 6.5.4			
Material Source :	Existing			
Material Type :	Clayey Sand			
Sample Location :	Location (4) 0.5 M Depth			
Lot Number :	N/A			
Moisture Method :	Q102A			
Sample History :	Oven Dried			
Sample Preparation :	Dry			
Notes :	No Cracking or Crumbling			
Mould Length (mm) :	149.51			
Liquid Limit (%) :	20.4			
Plastic Limit (%) :	13.0			
Plasticity Index (%) :	7.4			
Linear Shrinkage (%) :	3.8			
SPECIFICATION DETAILS				
Specification Number :	Base WQ35 Alternative 2			
Liquid Limit - Max :	0			
Plasticity Index - Max :	0			
Linear Shrinkage - Max :	4.5			
Remarks :	-			

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Dean Maloney - Technical Manager
NATA Accreditation Number :
19218

Westest
Materials Testing Services

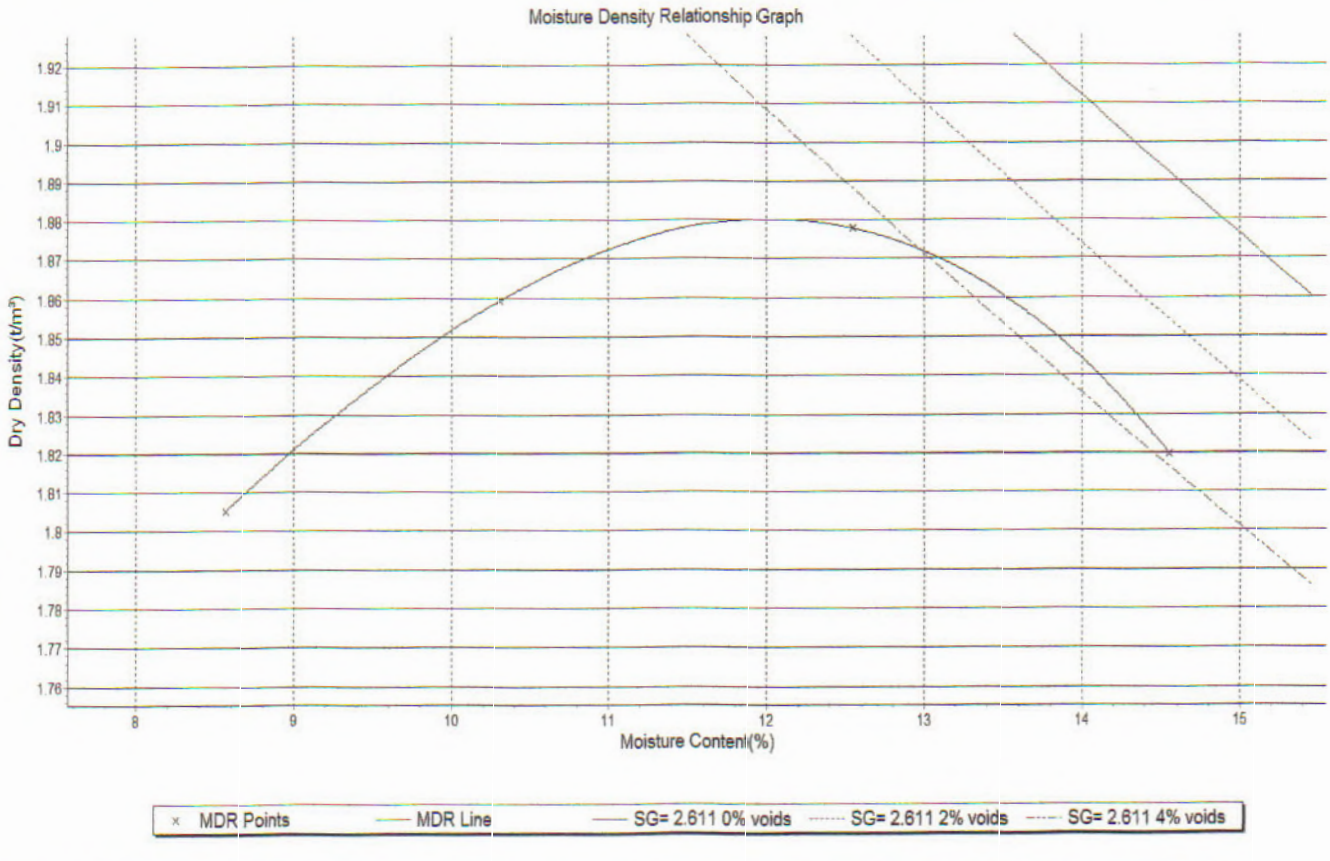
Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Moisture Density Relationship Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1208 - 8/1**
Address :	**Ash Street Barcaldine QLD 4725**	Report Date :	**30/01/2017**
Project Name :	**Barcaldine Land Fill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q142A**
Location:	**Barcaldine New Dump , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-15	SAMPLE LOCATION	
Sampling Method :	AS1289.1.2.1 CL 6.5.4	Location (4) 1.5 M Depth	
Sampled By :	Ernie Taylor		
Date Sampled :	24/01/2017		
Date Tested :	25/01/2017	Test Number :	8
Material Type :	Clayey Sand	Lot Number :	N/A
Material Source :	Existing	Moisture Method :	Q102A
Remarks :			

Maximum Size (mm) :	19.0	**Maximum Dry Density (t/m) :**	**1.88**
Oversize Dry (%) :	0.0	**Optimum Moisture Content (%) :**	**12**
Oversize Density (t/m³) :	0.0		



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Dean Maloney - Technical Manager
NATA Accreditation Number
19218

Westest
Materials Testing Services

Dean Maloney – Technical Manager
A.B.N 74465386381
141 Gidyea Street, **BARCALDINE** Q 4725
Phone: (07) 4651 2934
Mobile: 0428 790 309
Email: westestmaterialstesting@hotmail.com

Atterberg Limits Report

Client :	**Barcaldine Regional Council**	Report Number:	**WT-1214 - 7/1**
Address :	**Ash Street Barcaldine QLD 4725, Barcaldine**	Report Date :	**13/02/2017**
Project Name :	**Barcaldine Landfill Site**	Order Number :	**N/A**
Project Number :	**WT-1214**	Test Method :	**Q104D,Q105,Q106**
Location:	**New Landfill Site , Barcaldine**	**Page 1 of 1**	

Sample Number :	WS17-15			
Test Number :	8			
Date Sampled :	24/01/2017			
Date Tested :	10/02/2017			
Sampled By :	Ernie Taylor			
Sampling Method :	AS1289.1.2.1 CL 6.5.4			
Material Source :	Existing			
Material Type :	Clayey Sand			
Sample Location :	Location (4) 1.5 M Depth			
Lot Number :	N/A			
Moisture Method :	Q102A			
Sample History :	Oven Dried			
Sample Preparation :	Dry			
Notes :	No Cracking or Crumbling			
Mould Length (mm) :	149.64			
Liquid Limit (%) :	21.6			
Plastic Limit (%) :	12.4			
Plasticity Index (%) :	9.2			
Linear Shrinkage (%) :	3.2			
SPECIFICATION DETAILS				
Specification Number :	Base WQ35 Alternative 2			
Liquid Limit - Max :	0			
Plasticity Index - Max :	0			
Linear Shrinkage - Max :	4.5			
Remarks :	-			

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Dean Maloney - Technical Manager
NATA Accreditation Number : 19218

Appendix 2b
Landfill Cell Base Permeability Reports

Cardno Shaping the Future

Cardno Construction Sciences
ABN: 74 128 806 735
Address:
101 High Street,
North Rockhampton QLD 4701

Laboratory: Rockhampton Laboratory
Phone: 07 4928 0044 Fax: 07 4926 1286
Email: constructionsciences_cq@cardno.com.au

PERMEABILITY OF A SOIL

Client:	WESTEST MATERIALS TESTING SERVICES	Report Number:	2128/R/33905-1
Client Address:	141 Gidyea Street, Barcaldine	Project Number:	2128/P/842
Project:	General Testing	Lot Number:	
Location:	QLD	Internal Test Request:	2128/T/13849
Component:	BARCALDINE REGIONAL COUNCIL	Client Reference/s:	WT-1214 - 21/1/17
Area Description:		Report Date / Page:	16/02/2017 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	2128/S/57218	Sample Location	
Sampling Method	Tested As Received	Location	WS17-8
Date Sampled	21/01/2017		Location 1
Sampled By	Client Sampled		0.5m
Date Tested	6/02/2017		
Material Source	Existing	Material Type	Insitu

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard

Maximum Dry Density (t/m³)	1.86400	Optimum Moisture Content (%)	12.4
Dry Density of Sample (t/m³)	1.801	Moisture at Compaction (%)	12.8
Achieved Dry Density Ratio (%)	**96.6**	**Achieved Moisture Ratio (%)**	**103.2**

Surcharge Mass (kg)	5.000	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	17.7	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	3E-009 m/s (3E-007 cm/s)

Remarks

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

Accreditation Number: 1986
Corporate Site Number: 2128

Approved Signatory: Lee Draper
Form ID: W49Rep Rev1

Cardno Construction Sciences
ABN: 74 128 806 735
Address:
101 High Street,
North Rockhampton QLD 4701

Laboratory: Rockhampton Laboratory
Phone: 07 4926 0044 Fax: 07 4926 1286
Email: constructionsciences_cq@cardno.com.au

PERMEABILITY OF A SOIL

Client:	WESTEST MATERIALS TESTING SERVICES	Report Number:	2128/R/33906-1
Client Address:	141 Gidyea Street, Barcaldine	Project Number:	2128/P/842
Project:	General Testing	Lot Number:	
Location:	QLD	Internal Test Request:	2128/T/13849
Component:	BARCALDINE REGIONAL COUNCIL	Client Reference/s:	WT-1214 - 21/1/17
Area Description:		Report Date / Page:	16/02/2017 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	2128/S/57219	Sample Location	
Sampling Method	Tested As Received	Location	WS17-9
Date Sampled	21/01/2017		Location 1
Sampled By	Client Sampled		1.5m
Date Tested	6/02/2017		
Material Source	Existing	Material Type	Insitu

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard

Maximum Dry Density (t/m³)	1.92000	Optimum Moisture Content (%)	11.9
Dry Density of Sample (t/m³)	1.866	Moisture at Compaction (%)	11.7
Achieved Dry Density Ratio (%)	**97.2**	**Achieved Moisture Ratio (%)**	**98.3**

Surcharge Mass (kg)	5.000	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	14.8	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	9E-010 m/s (9E-008 cm/s)

Remarks

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Form ID: W49Rep Rev1

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Cardno Construction Sciences
ABN: 74 128 806 735
Address:
101 High Street,
North Rockhampton QLD 4701

Laboratory: Rockhampton Laboratory
Phone: 07 4928 0044 Fax: 07 4926 1286
Email: constructionsciences_cq@cardno.com.au

PERMEABILITY OF A SOIL

Client:	WESTEST MATERIALS TESTING SERVICES	Report Number:	2128/R/33907-1
Client Address:	141 Gidyea Street, Barcaldine	Project Number:	2128/P/842
Project:	General Testing	Lot Number:	
Location:	QLD	Internal Test Request:	2128/T/13849
Component:	BARCALDINE REGIONAL COUNCIL	Client Reference/s:	WT-1214 - 21/1/17
Area Description:		Report Date / Page:	16/02/2017 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	2128/S/57220	Sample Location	
Sampling Method	Tested As Received	Location	WS17-10
Date Sampled	21/01/2017		Location 2
Sampled By	Client Sampled		0.5m
Date Tested	6/02/2017		
Material Source	Existing	Material Type	Insitu

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard

Maximum Dry Density (t/m³)	1.86600	Optimum Moisture Content (%)	12.3
Dry Density of Sample (t/m³)	1.809	Moisture at Compaction (%)	12.4
Achieved Dry Density Ratio (%)	**96.9**	**Achieved Moisture Ratio (%)**	**100.8**

Surcharge Mass (kg)	5.000	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	16.7	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	9E-010 m/s (9E-008 cm/s)

Remarks

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Corporate Site Number: 2128

Approved Signatory: Lee Draper
Form ID: W49Rep Rev1

Cardno Construction Sciences
ABN: 74 128 806 735
Address:
101 High Street,
North Rockhampton QLD 4701

Laboratory: Rockhampton Laboratory
Phone: 07 4926 0044 Fax: 07 4926 1286
Email: constructionsciences_cq@cardno.com.au

PERMEABILITY OF A SOIL

Client:	WESTEST MATERIALS TESTING SERVICES	Report Number:	2128/R/33908-1
Client Address:	141 Gidyea Street, Barcaldine	Project Number:	2128/P/842
Project:	General Testing	Lot Number:	
Location:	QLD	Internal Test Request:	2128/T/13849
Component:	BARCALDINE REGIONAL COUNCIL	Client Reference/s:	WT-1214 - 21/1/17
Area Description:		Report Date / Page:	16/02/2017 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	2128/S/57221	Sample Location	
Sampling Method	Tested As Received	Location	WS17-11
Date Sampled	21/01/2017		Location 2
Sampled By	Client Sampled		1.5m
Date Tested	6/02/2017		
Material Source	Existing	Material Type	Insitu

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard

Maximum Dry Density (t/m³)	1.90400	Optimum Moisture Content (%)	11.7
Dry Density of Sample (t/m³)	1.847	Moisture at Compaction (%)	11.7
Achieved Dry Density Ratio (%)	**97.0**	**Achieved Moisture Ratio (%)**	**100.0**

Surcharge Mass (kg)	5.000	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	14.9	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	6E-009 m/s (6E-007 cm/s)

Remarks

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Corporate Site Number: 2128

Approved Signatory: Lee Draper
Form ID: W49Rep Rev1

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Cardno Construction Sciences
ABN: 74 128 806 735
Address:
101 High Street,
North Rockhampton QLD 4701

Laboratory: Rockhampton Laboratory
Phone: 07 4928 0044 Fax: 07 4926 1286
Email: constructionsciences_cq@cardno.com.au

PERMEABILITY OF A SOIL

Client:	WESTEST MATERIALS TESTING SERVICES	Report Number:	2128/R/33979-1
Client Address:	141 Gidyea Street, Barcaldine	Project Number:	2128/P/842
Project:	General Testing	Lot Number:	
Location:	QLD	Internal Test Request:	2128/T/13849
Component:	BARCALDINE REGIONAL COUNCIL	Client Reference/s:	WT-1214 - 21/1/17
Area Description:		Report Date / Page:	22/02/2017 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	2128/S/57222	Sample Location	
Sampling Method	Tested As Received	Location	WS17-12
Date Sampled	21/01/2017		Location 3
Sampled By	Client Sampled		0.5m
Date Tested	6/02/2017		
Material Source	Existing	Material Type	Insitu

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard

Maximum Dry Density (t/m³)	1.91500	Optimum Moisture Content (%)	11.3
Dry Density of Sample (t/m³)	1.858	Moisture at Compaction (%)	11.3
Achieved Dry Density Ratio (%)	**97.0**	**Achieved Moisture Ratio (%)**	**100.0**

Surcharge Mass (kg)	5.000	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	13.7	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	2E-009 m/s (2E-007 cm/s)

Remarks

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Corporate Site Number: 2128

Approved Signatory: Lee Draper
Form ID: W49Rep Rev1

Cardno Shaping the Future

Cardno Construction Sciences
ABN: 74 128 806 735
Address:
101 High Street,
North Rockhampton QLD 4701

Laboratory: Rockhampton Laboratory
Phone: 07 4926 0044 Fax: 07 4926 1286
Email: constructionsciences_oq@cardno.com.au

PERMEABILITY OF A SOIL

Client:	WESTEST MATERIALS TESTING SERVICES	Report Number:	2128/R/33996-1
Client Address:	141 Gidyea Street, Barcaldine	Project Number:	2128/P/842
Project:	General Testing	Lot Number:	
Location:	QLD	Internal Test Request:	2128/T/13849
Component:	BARCALDINE REGIONAL COUNCIL	Client Reference/s:	WT-1214 - 21/1/17
Area Description:		Report Date / Page:	23/02/2017 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	2128/S/57223	Sample Location	
Sampling Method	Tested As Received	Location	WS17-13
Date Sampled	21/01/2017		Location 3
Sampled By	Client Sampled		1.5m
Date Tested	6/02/2017		
Material Source	Existing	Material Type	Insitu

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard

Maximum Dry Density (t/m³)	1.88200	Optimum Moisture Content (%)	12.8
Dry Density of Sample (t/m³)	1.822	Moisture at Compaction (%)	13.0
Achieved Dry Density Ratio (%)	**96.8**	**Achieved Moisture Ratio (%)**	**101.6**

Surcharge Mass (kg)	5.000	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	15.1	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	8E-010 m/s (8E-008 cm/s)

Remarks

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Cardno Shaping the Future

Cardno Construction Sciences
ABN: 74 128 806 735
Address:
101 High Street,
North Rockhampton QLD 4701

Laboratory: Rockhampton Laboratory
Phone: 07 4926 0044 Fax: 07 4926 1286
Email: constructionsciences_cq@cardno.com.au

PERMEABILITY OF A SOIL

Client:	WESTEST MATERIALS TESTING SERVICES	Report Number:	2128/R/33997-1
Client Address:	141 Gidyea Street, Barcaldine	Project Number:	2128/P/842
Project:	General Testing	Lot Number:	
Location:	QLD	Internal Test Request:	2128/T/13849
Component:	BARCALDINE REGIONAL COUNCIL	Client Reference/s:	WT-1214 - 21/1/17
Area Description:		Report Date / Page:	23/02/2017 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	2128/S/57224	Sample Location	
Sampling Method	Tested As Received	Location	WS17-14
Date Sampled	21/01/2017		Location 4
Sampled By	Client Sampled		0.5m
Date Tested	6/02/2017		
Material Source	Existing	Material Type	Insitu

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard

Maximum Dry Density (t/m³)	1.89100	Optimum Moisture Content (%)	11.7
Dry Density of Sample (t/m³)	1.829	Moisture at Compaction (%)	12.0
Achieved Dry Density Ratio (%)	**96.7**	**Achieved Moisture Ratio (%)**	**102.6**

Surcharge Mass (kg)	5.000	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	14.1	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	8E-010 m/s (8E-008 cm/s)

Remarks

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

NATA

Accreditation Number: 1986
Corporate Site Number: 2128

Approved Signatory: Lee Draper
Form ID: W49Rep Rev1

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ABN: 74 128 806 735
Address:
101 High Street,
North Rockhampton QLD 4701

Laboratory: Rockhampton Laboratory
Phone: 07 4928 0044 Fax: 07 4926 1286
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PERMEABILITY OF A SOIL

Client:	WESTEST MATERIALS TESTING SERVICES	Report Number:	2128/R/33998-1
Client Address:	141 Gidyea Street, Barcaldine	Project Number:	2128/P/842
Project:	General Testing	Lot Number:	
Location:	QLD	Internal Test Request:	2128/T/13849
Component:	BARCALDINE REGIONAL COUNCIL	Client Reference/s:	WT-1214 - 21/1/17
Area Description:		Report Date / Page:	23/02/2017 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	2128/S/57225	Sample Location	
Sampling Method	Tested As Received	Location	WS17-15
Date Sampled	21/01/2017		Location 4
Sampled By	Client Sampled		1.5m
Date Tested	6/02/2017		
Material Source	Existing	Material Type	Insitu

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard

Maximum Dry Density (t/m³)	1.88000	Optimum Moisture Content (%)	12.0
Dry Density of Sample (t/m³)	1.822	Moisture at Compaction (%)	12.1
Achieved Dry Density Ratio (%)	**96.9**	**Achieved Moisture Ratio (%)**	**100.8**

Surcharge Mass (kg)	5.000	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	15.1	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	2E-009 m/s (2E-007 cm/s)

Remarks

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