

ANNEXURE 12.0

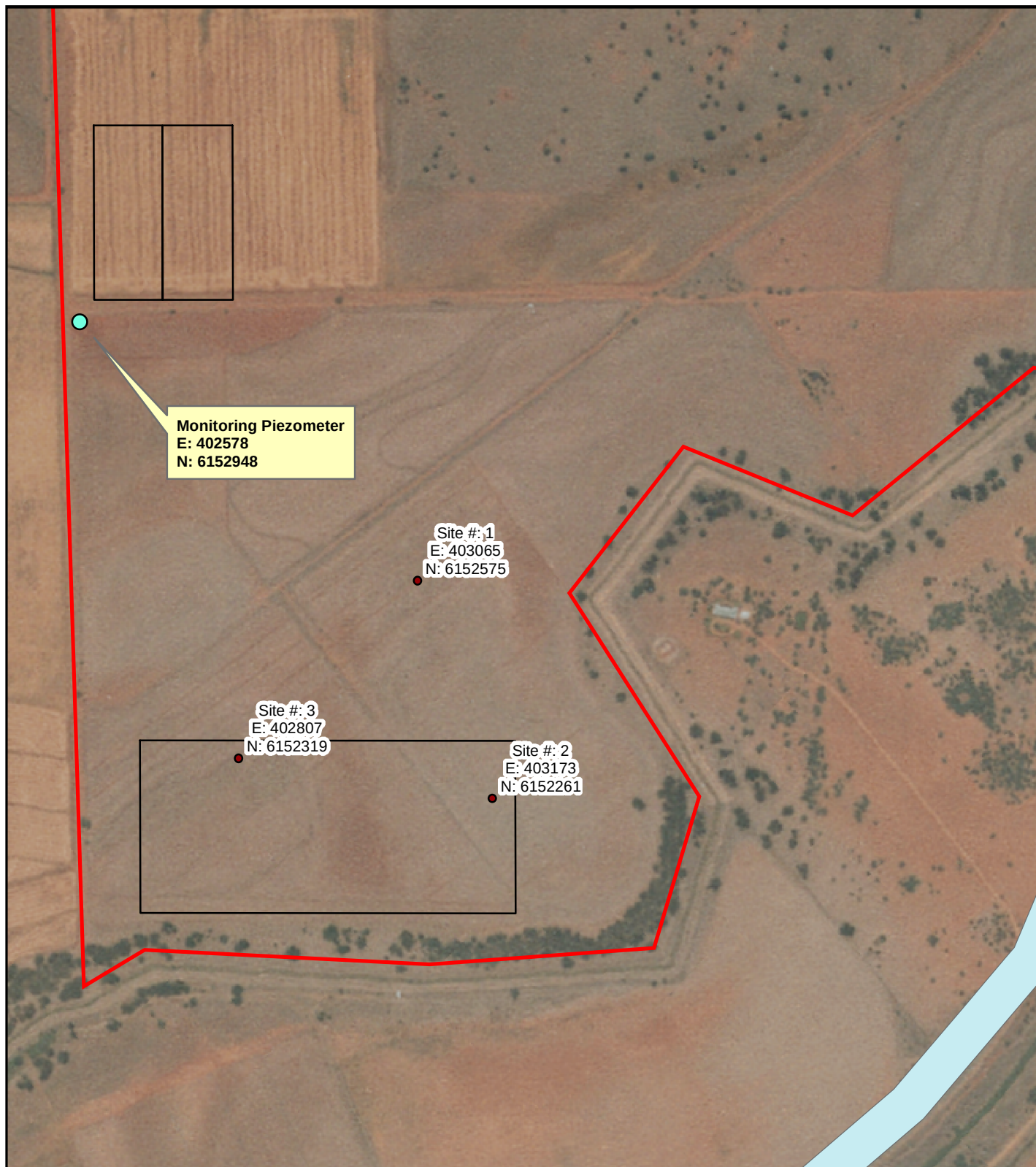
MAP INDICATING PIEZOMETER POSITION AND SOIL SAMPLING SITES

Monitoring Piezometer Location & Surface Soil Samples

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Creation Date: 10/09/2007
File path : D:\Clients-Mapping\4Arrows\Coleambally\Response Document\WGB maps\PPR_piezo_100907
Created by : Christelle Borella, GIS Administrator, Booth Associates
Project : Four Arrows Ethanol Pty Ltd Ethanol Plant & Intensive Dairy Environmental Assessment

Booth Associates



- Proposed Site
- Proposed Piezometer
- Recycled Ponds 300807
- Soil Samples (20/12/06)
- Evaporation basin

0 150 300 600 900 1,200
Meters

É

ANNEXURE 13.0

DRILL LOG FOR PIEZOMETER

FORM A PARTICULARS OF COMPLETED
BORE

VERSION 2004

Driller's Licence No: 1483
Class of Licence: 2
Driller's Name: LOYD ANGOVE
Assistant Driller's Name: WYLS JOHNSON
Contractor: AS ABOVE
New bore ☒ Replacement Bore ☐
Deepened ☐ Enlarged ☐
Reconditioned ☐ Other (specify) _____
Final Depth 14 m

Work Licence No: 40 BC WA 404 578
Name of Licensee: FOUR ARROWS
Intended Use: _____
Completion Date: 14-12-06
DRILLING DETAILS
From (m) To (m) Hole Diameter (mm) Drilling Method Code
0 14 150 7

WATER BEARING ZONES											
From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s)		Test method Code	DDL at end of test (m)	Duration		Salinity (Conductivity or TDS)	
				Individual Aquifer	Cumulative			Hrs	min	Cond. (µS/cm)	TDS (mg/L)
<u>8</u>	<u>13.5</u>	<u>5.5</u>	<u>8</u>			<u>1</u>			<u>10</u>	<u>4240</u>	

CASING / LINER DETAILS
Material OD Wall Thickness From To Method of Fixing Casing Support Method Code
Code (mm) (mm) (m) (m) Code
6 60 12 0 10.5 1 2
Type of casing bottom Code 2
Centralisers installed: No ☐ Yes ☐ (Indicate on Sketch)
Sump installed No ☐ Yes ☐ From m To m
Pressure cemented No ☐ Yes ☐ From m To m
Casing Protector cemented in place No ☐ Yes ☐

WATER ENTRY DESIGN										
General							Screen	Slot Details		
Material	OD	Wall thickness	From	To	Opening type	Fixing	Aperture	Length	Width	Alignment
Code	(mm)	(mm)	(m)	(m)	Code	Code	(mm)	(mm)	(mm)	Code
<u>6</u>	<u>60</u>	<u>12</u>	<u>10.5</u>	<u>13.5</u>	<u>5</u>	<u>1</u>	<u>1</u>	<u>50</u>		<u>2</u>

GRAVEL PACK
Type Grade Grain size (mm) Depth (m) Quantity
From To From To Litres or m³
Rounded ☐ Graded ☐ 5 7 7 14 112
Crushed ☐ Ungraded ☐
Bentonite/Grout seal No ☐ Yes ☐
Method of placement of Gravel Pack Code

BORE DEVELOPMENT
Chemical used for breaking down drilling mud No ☒ Yes ☐ Name: _____
Method Bailing/ Surging ☐ Jetting ☐ Airlifting ☐ Backwashing ☐ Pumping ☐ Other: _____
Duration hrs hrs hrs hrs hrs hrs

DISINFECTION ON COMPLETION
Chemical/s used Quantity applied (litres) Method of application

PUMPING TESTS ON COMPLETION
Test type Date Pump intake depth Initial Water Level (S W L) Pumping rate Water Level at end of pumping (DDL) Duration of Test Recovery
(m) (m) (L/s) (m) (hrs) (m) (hrs) (min)
Multi stage (stepped drawdown)
Stage 1 14-12-06 10 8
Stage 2
Stage 3
Single stage (constant rate)
Height of measuring point above ground level: _____ m Test Method Code See Code Table 4
For DIPNR use only: G W

FORM A PARTICULARS OF COMPLETED
BORE

VERSION 2004

Work Licence No. 40WA 404578

WORK PARTLY BACKFILLED OR ABANDONED						11
Original depth of work :		metres .		Is work partly backfilled : No ☐ Yes ☐		
Is work abandoned : No ☐ Yes ☐		Method of abandonment: Backfilled ☐ Plugged ☐ Capped ☐				
Has any casing been left in the work		No ☐ Yes ☐		From (m) To (m)		
Sealing / fill type Code	From depth (m)	To depth (m)	Sealing / fill type Code	From depth (m)	To depth (m)	

Site chosen by: Hydrogeologist ☐ Geologist ☐ Driller ☐ Diviner ☐ Client ☐ other ☐

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY)			12
Depth		Description	WORK CONSTRUCTION SKETCH
From (m)	To (m)		
0	0.5	BROWN MEDIUM CLAY	
0.5	1.5	GREY BROWN MEDIUM CLAY	
1.5	2	BROWN GREY FINE SAND/CLAY	
2	3	BROWN GREY CLAY	
3	5	GREY BROWN CLAY	
5	8	BROWN GREY CLAY	
8	10.5	BROWN SAND	
10.5	13.5	GREY BROWN GRAVEL	
13.5	14	GREY BROWN CLAY	

WORK NOT CONSTRUCTED BY DRILLING RIG								13
Method of Excavation : Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Bailing ☐ Other :								
Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimensions of liner (m)	From Depth (m)	To Depth (m)	

PLEASE ATTACH COPIES OF THE FOLLOWING IF AVAILABLE						14
Geologist log	No ☐ Yes ☐	Laboratory analysis of water Sample	No ☐ Yes ☐	Pumping test(s)	No ☐ Yes ☐	
Geophysical log	No ☐ Yes ☐	Sieve analysis of aquifer material	No ☐ Yes ☐	Installed Pump details	No ☐ Yes ☐	

LOCATION OF BORE				15
Lot No	DP No	Work Location Coordinates Easting <u>402463</u>	Northing <u>6152764</u> Zone <u>55</u>	
GRS : No ☐ Yes ☒		AMG/AGD ☒ or MGA/GDA ☐ (See explanation)		
Please mark the work site with "X" on the DIPNR CLID map or supply a sketch map of the location Attach the map to this Form A package.				

SIGNATURES		16
Driller Signature: <u>[Signature]</u>	Licensee Signature:	
Date: <u>22-01-07</u>	Date:	

NOTE: If not enough space is provided use a separate piece of paper. Provide details of works location, Drillers License Number and Work License Number.

ANNEXURE 14.0

LANEPIPER GEOTECHNICAL SOILS ANALYSIS

4 ARROWS

ANN 4.0

LANE PIPER PTY LTD

1171 Burke Road, Kew 3101 NATA Accreditation No. 3145

ATTERBERG LIMITS & UNIFIED CLASSIFICATION

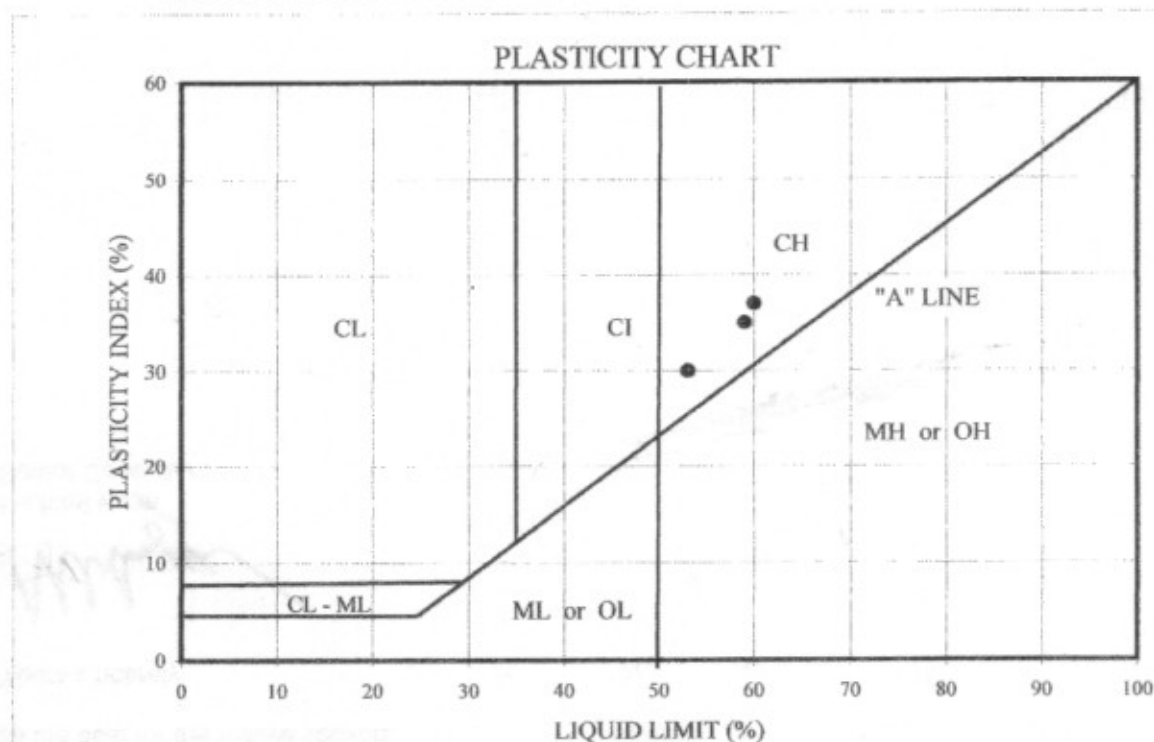
These tests were carried out in accordance with Australian Standard 1289, 3.1.2 (One-Point Method), 3.2.1, 3.3.1, and 2.1.1.

The test was carried out only on the part of the soil finer than 0.425mm

PROJECT: ETHANOL & DAIRY PROJECT**JOB/DOC No.:** 27095/1**OPERATOR:** GDH**LOCATION:** 4 ARROWS, COLEAMBALLY**DATE:** 5/12/06**CLIENT:** BOOTH ASSOC., GRIFFITH, NSW**ISSUE DATE:** 21/12/06

SAMPLE No.			
TESTPIT/BOREHOLE	SITE 1	SITE 2	SITE 3
DEPTH (M)			
PREPARATION METHOD	AIR DRIED DRY SIEVED	AIR DRIED DRY SIEVED	AIR DRIED DRY SIEVED
SAMPLE DESCRIPTION	silty CLAY grey, slightly orange-brown	silty CLAY light brown	silty CLAY grey
SAMPLING METHOD	AS1289.1.2.1.6.5.4	AS1289.1.2.1.6.5.4	AS1289.1.2.1.6.5.4
GROUP SYMBOL	CH	CH	CH
LIQUID LIMIT (%)	59	53	60
PLASTIC LIMIT (%)	24	23	23
PLASTICITY INDEX (%)	35	30	37

Plasticity Chart for classification of fine grained soil - Table A1 AS1726 - 1993

**COMMENTS:**

Test authorized by: Graham Hodgson

Laboratory Manager



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LANE PIPER PTY LTD

1171 Burke Road, Kew 3101 NATA Accreditation No. 3145

ATTERBERG LIMITS & UNIFIED CLASSIFICATION

These tests were carried out in accordance with Australian Standard 1289, 3.1.2 (One-Point Method), 3.2.1, 3.3.1, and 2.1.1.

The test was carried out only on the part of the soil finer than 0.425mm

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC No.: 27095/2

LOCATION: 4 ARROWS, COLEAMBALLY

OPERATOR: GDH

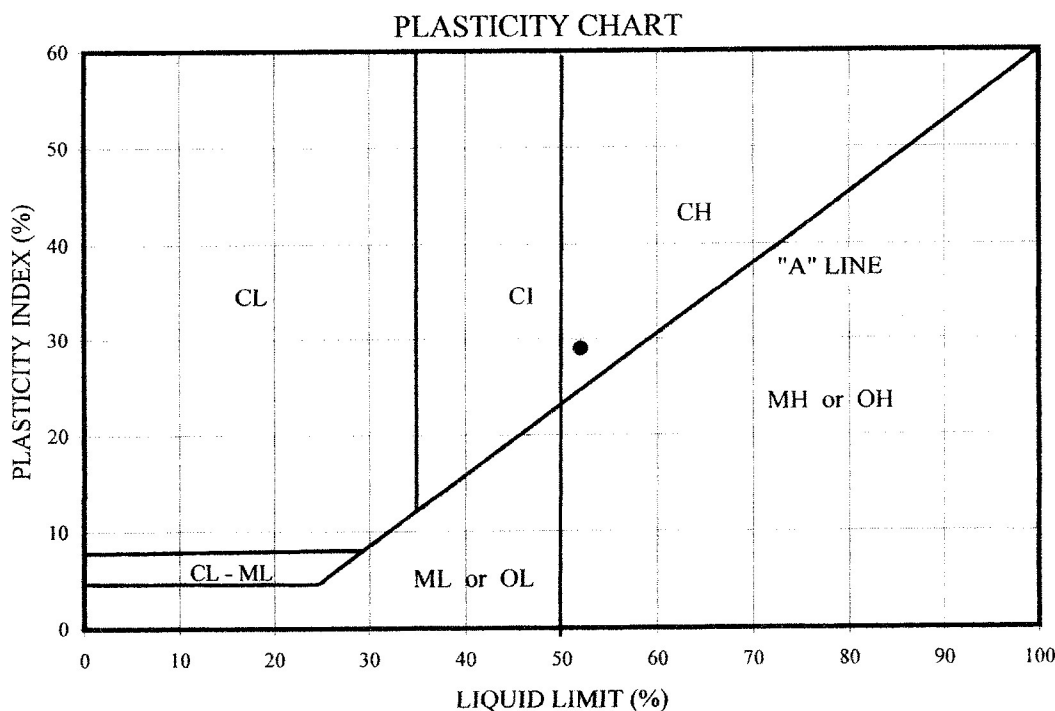
CLIENT: BOOTH ASSOC., GRIFFITH, NSW

DATE: 5/12/06

ISSUE DATE: 21/12/06

SAMPLE No.			
TESTPIT/BOREHOLE	SITE 4		
DEPTH (M)			
PREPARATION METHOD	AIR DRIED DRY SIEVED		
SAMPLE DESCRIPTION	silty CLAY brown		
SAMPLING METHOD	AS1289.1.2.1.6.5.4		
GROUP SYMBOL	CH		
LIQUID LIMIT (%)	52		
PLASTIC LIMIT (%)	23		
PLASTICITY INDEX (%)	29		

Plasticity Chart for classification of fine grained soil - Table A1 AS1726 - 1993



COMMENTS:

Test authorized by: Graham Hodgson

Laboratory Manager



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1171 Burke Rd, Kew 3101 NATA Accreditation No. 3145

STANDARD COMPACTION TEST

This test was carried out in accordance with Australian Standard 1289 Method 5.1.1 and 2.1.1.

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC. No.: 27095/3

DATE: 5/12/06

LOCATION: 4 ARROWS, COLEAMBALLY

ISSUE DATE: 21/12/06

CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW

OPERATOR: GDH

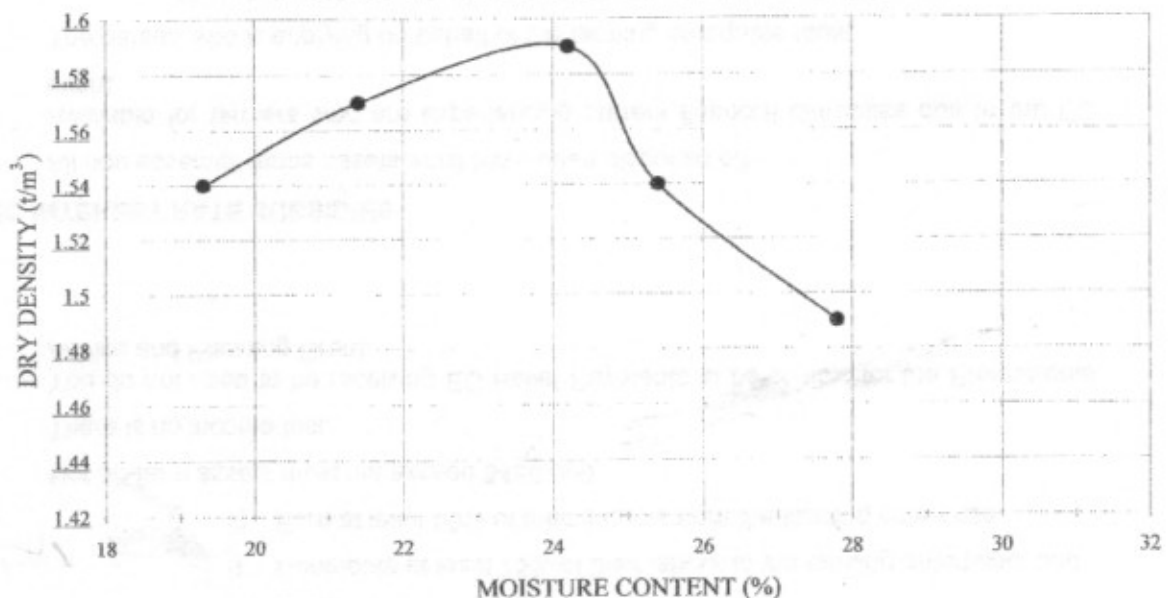
SAMPLE SOURCE / m: SITE 1 (m)

SAMPLE DESCRIPTION: silty CLAY grey & slightly orange-brown

SAMPLING METHOD: AS1289.1.2.1.6.5.4

DURATION OF CURING: 24 HOURS

COMPACTION TYPE:	STANDARD	TOTAL MASS OF SAMPLE (grams):		16190	
MOULD TYPE:	A	RETAINING SIEVE SIZE (mm):		19	
MOULD DIAMETER:	105 mm	MASS RETAINED ON SIEVE (grams):		0	
MOULD VOLUME:	987 cm ³	0 % TOTAL MASS RETAINED			
COMMENTS:					
TEST NO:	1	2	3	4	5
MOISTURE CONTENT (%)	19.3	21.4	24.2	25.4	27.8
DRY DENSITY (t/m ³)	1.54	1.57	1.59	1.54	1.49

MOISTURE CONTENT VS. DRY DENSITY CHART

STANDARD MAXIMUM DRY DENSITY =

1.59 t/m³

STANDARD OPTIMUM MOISTURE CONTENT =

24 %

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Laboratory Manager

GDH 21/12/06

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STANDARD COMPACTION TEST

This test was carried out in accordance with Australian Standard 1289 Method 5.1.1 and 2.1.1.

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC. No.: 27095/4

LOCATION: 4 ARROWS, COLEAMBALLY

DATE: 5/12/06

CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW

ISSUE DATE: 21/12/06

SAMPLE SOURCE / m: SITE 2 (m)

OPERATOR: GDH

SAMPLE DESCRIPTION: silty CLAY light brown

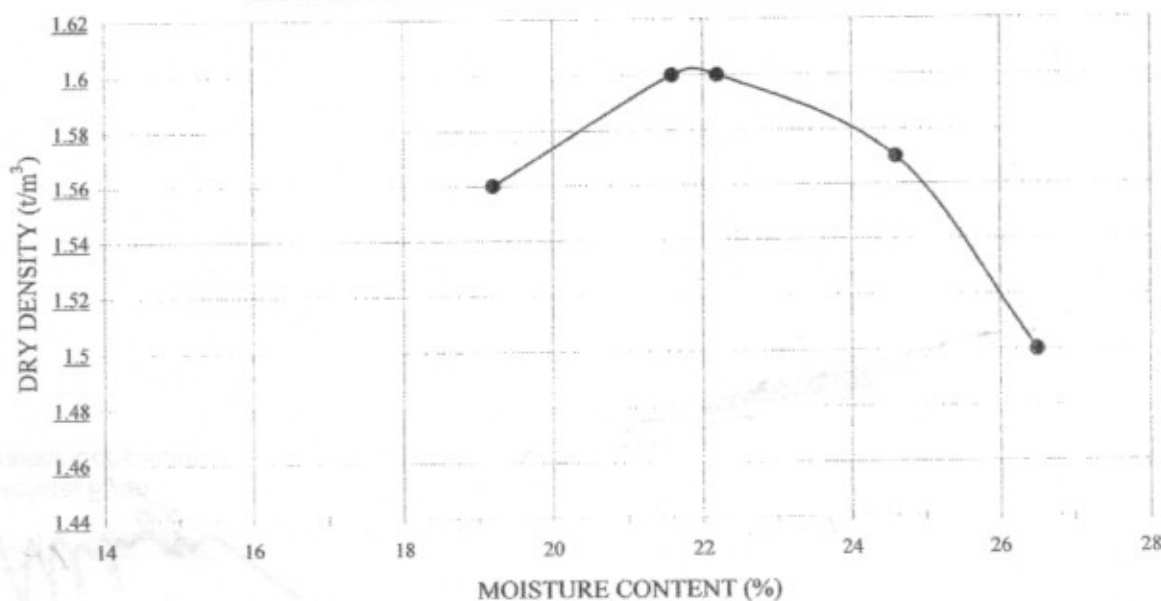
SAMPLING METHOD: AS1289.1.2.1.6.5.4

DURATION OF CURING: 48 HOURS

COMPACTION TYPE:	STANDARD	TOTAL MASS OF SAMPLE (grams):	15660
MOULD TYPE:	A	RETAINING SIEVE SIZE (mm):	19
MOULD DIAMETER:	105 mm	MASS RETAINED ON SIEVE (grams):	0
MOULD VOLUME:	987 cm ³	0 % TOTAL MASS RETAINED	

COMMENTS:

TEST NO:	1	2	3	4	5
MOISTURE CONTENT (%)	19.2	21.6	22.2	24.6	26.5
DRY DENSITY (t/m ³)	1.56	1.6	1.6	1.57	1.5

MOISTURE CONTENT VS. DRY DENSITY CHART

STANDARD MAXIMUM DRY DENSITY =

1.6 t/m³

STANDARD OPTIMUM MOISTURE CONTENT =

22 %

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Laboratory Manager

GDH 21/12/06

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STANDARD COMPACTION TEST

This test was carried out in accordance with Australian Standard 1289 Method 5.1.1 and 2.1.1.

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC. No.: 27095/5

LOCATION: 4 ARROWS, COLEAMBALLY

DATE: 5/12/06

CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW

ISSUE DATE: 21/12/06

SAMPLE SOURCE / m: SITE 3 (m)

OPERATOR: GDH

SAMPLE DESCRIPTION: silty CLAY grey

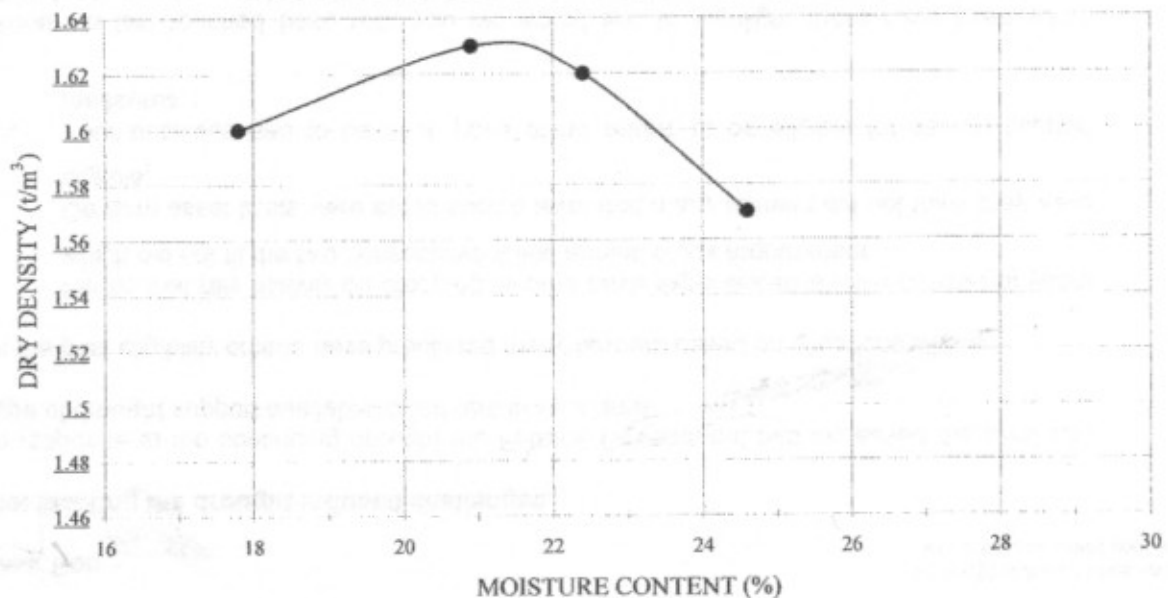
SAMPLING METHOD: AS1289.1.2.1.6.5.4

DURATION OF CURING: 48 HOURS

COMPACTION TYPE:	STANDARD	TOTAL MASS OF SAMPLE (grams):	17110
MOULD TYPE:	A	RETAINING SIEVE SIZE (mm):	19
MOULD DIAMETER:	105 mm	MASS RETAINED ON SIEVE (grams):	0
MOULD VOLUME:	987 cm ³	0 % TOTAL MASS RETAINED	

COMMENTS:

TEST NO:	1	2	3	4	5
MOISTURE CONTENT (%)	17.8	20.9	22.4	24.6	
DRY DENSITY (t/m ³)	1.6	1.63	1.62	1.57	

MOISTURE CONTENT VS. DRY DENSITY CHART

STANDARD MAXIMUM DRY DENSITY =

1.63 t/m³

STANDARD OPTIMUM MOISTURE CONTENT =

21.5 %

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ACCREDITATIONTest authorized by: Graham Hodgson
Laboratory Manager*G. Hodgson* 21/12/06

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1171 Burke Rd, Kew 3101

NATA Accreditation No. 3145

STANDARD COMPACTION TEST

This test was carried out in accordance with Australian Standard 1289 Method 5.1.1 and 2.1.1.

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC. No.: 27095/6

DATE: 5/12/06

LOCATION: 4 ARROWS, COLEAMBALLY

ISSUE DATE: 21/12/06

CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW

OPERATOR: GDH

SAMPLE SOURCE / m: SITE 4 (m)

SAMPLE DESCRIPTION: silty CLAY brown

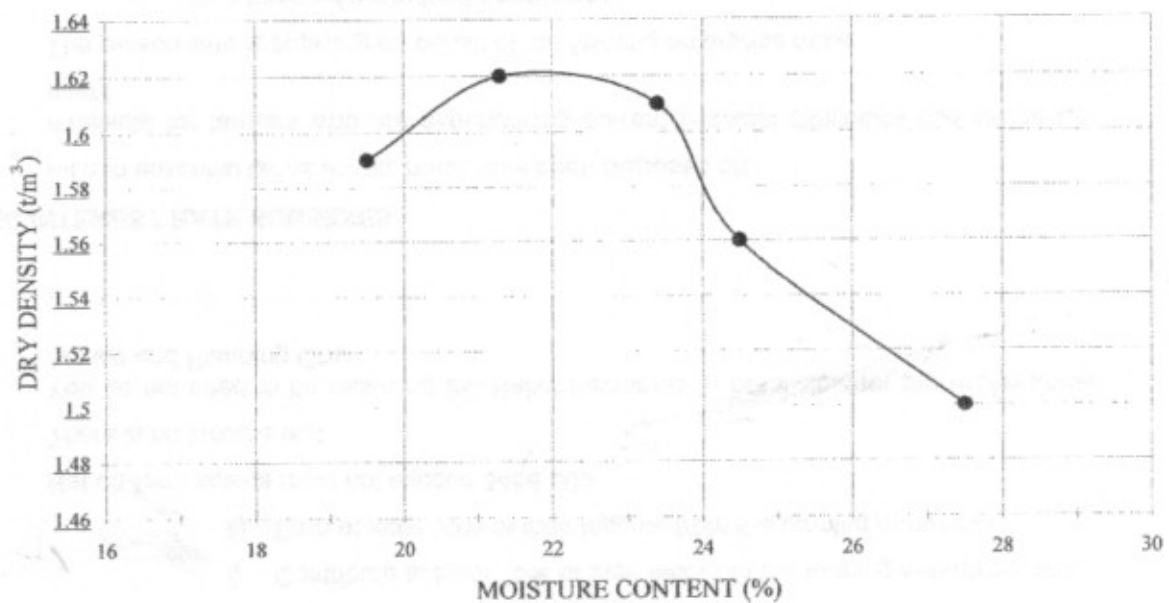
SAMPLING METHOD: AS1289.1.2.1.6.5.4

DURATION OF CURING: 48 HOURS

COMPACTION TYPE:	STANDARD	TOTAL MASS OF SAMPLE (grams):	16010
MOULD TYPE:	A	RETAINING SIEVE SIZE (mm):	19
MOULD DIAMETER:	105 mm	MASS RETAINED ON SIEVE (grams):	0
MOULD VOLUME:	987 cm ³	0 % TOTAL MASS RETAINED	

COMMENTS:

TEST NO:	1	2	3	4	5
MOISTURE CONTENT (%)	19.5	21.3	23.4	24.5	27.5
DRY DENSITY (t/m ³)	1.59	1.62	1.61	1.56	1.5

MOISTURE CONTENT VS. DRY DENSITY CHART

STANDARD MAXIMUM DRY DENSITY =

1.62 t/m³

STANDARD OPTIMUM MOISTURE CONTENT =

22 %

Test authorized by: Graham Hodgson
Laboratory Manager*GDH* 21/12/06

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DETERMINATION OF THE LINEAR SHRINKAGE OF A SOIL (STANDARD METHOD)

These tests were carried out in accordance with Australian Standard 1289 Method 3.4.1.

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC No.: 27095/7

LOCATION: 4 ARROWS, COLEAMBALLY

DATE: 5/12/06

CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW

ISSUE DATE : 21/12/06

SAMPLING METHOD: AS1289.1.2.1.6.5.4

OPERATOR: GDH

Borehole/ Testpit/ Sample No.	Depth in Metres	SAMPLE DESCRIPTION	LINEAR SHRINKAGE %
SITE 1		silty CLAY grey & slightly orange-brown	15.0
SITE 2		silty CLAY light brown	14.5
SITE 3		silty CLAY grey	13.0
SITE 4		silty CLAY brown	16.5

REMARKS: The samples were cured for 24 hours prior to placing in the moulds and air dried for 24 hours prior to oven drying
Samples cracked and curled slightly



Graham Hodgson 21/12/06
Test authorised by: Graham Hodgson
Laboratory Manager

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LANE PIPER PTY LTD

1171 Burke Road, Kew. 3101

DETERMINATION OF TOTAL DISSOLVED SOLIDS (TDS)

These tests were carried out in accordance with Hanna Instruments' instruction manual for T.D.S. Meter No. HI 9034.

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC. No.: 27095/8

LOCATION: COLEAMBALLY

DATE: 5/12/06

CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW

ISSUE DATE: 21/12/06

SAMPLING METHOD: AS1289.1.2.1.6.5.not applicable

OPERATOR: GDH

SAMPLE DESCRIPTIONS

Test No.	Testpit No. / Borehole No.	Depth (m)	Sample Description	TDS mg/L
1	Sample 1		Melbourne Tap Water with NaCl additive	700
2				
3				
4				
5				
6				
7				
8				
9				
10				

REMARKS:

Graham Hodgson 21/12/06

Test authorized by : Graham Hodgson
Laboratory Manager

LANE PIPER PTY LTD

1171 Burke Road, Kew 3101 NATA Accreditation No. 3145

DETERMINATION OF THE PERMEABILITY OF A SOIL FALLING HEAD METHOD FOR A REMOULDED SPECIMEN

This test was carried out in accordance with Australian Standard 1289 Method 6.7.2.
Method 5.1.1 and 2.1.1.

PROJECT: ETHANOL & DAIRY PROJECT JOB/DOC NO.: 27095/9
DATE: 11/12/06
LOCATION: 4 ARROWS, COLEAMBALLY ISSUE DATE: 21/12/06
CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW OPERATOR: GDH
BOREHOLE NO.: SITE 1 TEST NO: 1 DEPTH (m):
DESCRIPTION: silty CLAY grey & slightly orange-brown
SAMPLING METHOD: AS1289.1.2.1.6.5.4

Surcharge Pressure:	2.6kPa
Percent Retained on 9.5mm Sieve:	0%
Moisture Content Before Test:	23.7%
Moisture Content After Test:	30.2%
Sample Dry Density:	1.51 t/m ³
Standard Laboratory Density Ratio:	95%
Standard Laboratory Moisture Ratio:	99%
Moisture Content relative to OMC:	-0.3%
Permeant Used:	Melbourne Tap Water TDS 700mg/L

Coefficient of Permeability at 20°C (k_T) = 1.7×10^{-10} m/s



WORLD RECOGNISED
ACCREDITATION

G. Hodgson 21/12/06

Test authorized by: Graham Hodgson
Laboratory Manager

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DETERMINATION OF THE PERMEABILITY OF A SOIL FALLING HEAD METHOD FOR A REMOULDED SPECIMEN

This test was carried out in accordance with Australian Standard 1289 Method 6.7.2.
Method 5.1.1 and 2.1.1.

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC NO.: 27095/10

DATE: 11/12/06

LOCATION: 4 ARROWS, COLEAMBALLY

ISSUE DATE: 21/12/06

CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW

OPERATOR: GDH

BOREHOLE NO.: SITE 2 TEST NO: 2

DEPTH (m):

DESCRIPTION: silty CLAY light brown

SAMPLING METHOD: AS1289.1.2.1.6.5.4

Surcharge Pressure:	2.6kPa
Percent Retained on 9.5mm Sieve:	0%
Moisture Content Before Test:	22.6%
Moisture Content After Test:	29.0%
Sample Dry Density:	1.51 t/m ³
Standard Laboratory Density Ratio:	95%
Standard Laboratory Moisture Ratio:	103%
Moisture Content relative to OMC:	+0.6%
Permeant Used:	Melbourne Tap Water TDS 700mg/L

Coefficient of Permeability at 20°C (k_T) = 2.3×10^{-10} m/s



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ACCREDITATION

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Laboratory Manager

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LANE PIPER PTY LTD

1171 Burke Road, Kew 3101 NATA Accreditation No. 3145

DETERMINATION OF THE PERMEABILITY OF A SOIL FALLING HEAD METHOD FOR A REMOULDED SPECIMEN

This test was carried out in accordance with Australian Standard 1289 Method 6.7.2.
Method 5.1.1 and 2.1.1.

PROJECT: ETHANOL & DAIRY PROJECT

JOB/DOC NO.: 27095/11

DATE: 5/12/06

LOCATION: 4 ARROWS, COLEAMBALLY

ISSUE DATE: 21/12/06

CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW

OPERATOR: GDH

BOREHOLE NO.: SITE 3 TEST NO: 3

DEPTH (m):

DESCRIPTION: silty CLAY grey

SAMPLING METHOD: AS1289.1.2.1.6.5.4

Surcharge Pressure:	2.6kPa
Percent Retained on 9.5mm Sieve:	0%
Moisture Content Before Test:	21.2%
Moisture Content After Test:	24.7%
Sample Dry Density:	1.54 t/m ³
Standard Laboratory Density Ratio:	95%
Standard Laboratory Moisture Ratio:	101%
Moisture Content relative to OMC:	-0.3%
Permeant Used:	Melbourne Tap Water TDS 700mg/L

Coefficient of Permeability at 20°C (k_T) = 3.8×10^{-10} m/s



WORLD RECOGNISED
ACCREDITATION

Graham Hodgson 21/12/06

Test authorized by: Graham Hodgson
Laboratory Manager

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1171 Burke Road, Kew 3101 NATA Accreditation No. 3145

DETERMINATION OF THE PERMEABILITY OF A SOIL FALLING HEAD METHOD FOR A REMOULDED SPECIMEN

This test was carried out in accordance with Australian Standard 1289 Method 6.7.2.
Method 5.1.1 and 2.1.1.

PROJECT: ETHANOL & DAIRY PROJECT JOB/DOC NO.: 27095/12
DATE: 11/12/06
LOCATION: 4 ARROWS, COLEAMBALLY ISSUE DATE: 21/12/06
CLIENT: BOOTH ASSOCIATES, GRIFFITH, NSW OPERATOR: GDH
BOREHOLE NO.: SITE 4 TEST NO: 4 DEPTH (m):
DESCRIPTION: silty CLAY brown
SAMPLING METHOD: AS1289.1.2.1.6.5.4

Surcharge Pressure:	2.6kPa
Percent Retained on 9.5mm Sieve:	0%
Moisture Content Before Test:	21.0%
Moisture Content After Test:	27.9%
Sample Dry Density:	1.55 t/m ³
Standard Laboratory Density Ratio:	95%
Standard Laboratory Moisture Ratio:	98%
Moisture Content relative to OMC:	-1.0%
Permeant Used:	Melbourne Tap Water TDS 700mg/L

Coefficient of Permeability at 20°C (k_T) = 2.4×10^{-9} m/s



WORLD RECOGNISED
ACCREDITATION

Graham Hodgson 21/12/06

Test authorized by: Graham Hodgson
Laboratory Manager

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