FUGRO ENGINEERING SERVICES LIMITED

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Our Ref: JMC/TPD/R39632
Your Ref: --

17 May 2004

For the attention of Mr I Colley

Marcus Hodges Environment Limited
28 Barnfield Road
Exeter
Devon
EX1 1RX

Dear Sirs

Re: Laboratory Testing - Malmesbury Avon Catchment

Please find enclosed the laboratory test results and a test certificate for two samples from the above project.

The laboratory test results enclosed with this letter give the soil properties of individual specimens tested under specified conditions. Individual results or groups of results may not be appropriate for use as design parameters for some geotechnical analyses. The samples may be non-representative, disturbed internally or prepared tested under conditions suited for different geotechnical applications. Unless the selection of design parameters is discussed in this report, it is recommended that the advice of an appropriately qualified and experienced specialist is sought.

With regard to disposal of the remaining samples, it is our normal practice to dispose of the samples after one calendar month from the date of issue of the final report. We will do so without notice unless we hear from you within one month. If you wish us to store the samples after this period we will do so on your written request. Any storage in excess of one month will be charged at the enclosed scheduled rates.

This now completes the schedule testing to date. Thank you for consulting Fugro Engineering Services for your testing needs. Should you have any queries, please do not hesitate to contact Mr A Hill in our Soils Laboratory.

Yours faithfully
FUGRO ENGINEERING SERVICES LIMITED

J M CHAYTOR
Enc

TEST CERTIFICATE

Your Ref:	--	17 May 2004
Our Ref:	AMH/TPD/R39632	

For the attention of: **Mr I Colley**
Marcus Hodges Environment Limited
28 Barnfield Road
Exeter
Devon
EX1 1RX

Location: **Malmesbury Avon Catchment.**

Description: **Two core samples of soil.**

Date Received: **December 2003.**

Test Procedures: Determination of permeability in a triaxial cell.
B.S. 1377 : Part 6 : 1990. Method 6.

A M Hill
Principal Technician
for FUGRO ENGINEERING SERVICES LIMITED

Tests marked with an asterisk fall outside the accreditation status of the laboratory.

GENERAL NOTES ON LABORATORY TEST RESULTS

1. TEST METHODS

The tests reported on the following sheets have been carried out in accordance with the methods given in BS 1377 : 1990 'Methods of test for Soils for civil engineering purposes, subject to a small number of variances as described below under the respective headings. These notes also serve as keysheets to any notation used in reporting the laboratory tests.

2. KEY TO NOTATION OF SAMPLE TYPE

D: Disturbed sample.

B: Bulk disturbed sample.

U: General purpose open drive tube sample.

P: Piston sample.

TW: Thin wall sample.

RC: Rotary core sample.

3. CLASSIFICATION TESTS

% passing 425µm: this figure is only correctly reported when 'WS' is shown in the 'Method' of preparation column. For 'HP' and 'AR', the reported figure is an estimate only.

WS: sample prepared by Wet Sieving.

HP: sample prepared by Hand Picking (removal) of gravel sized fragments.

AR: sample tested As Received.

NP: non-plastic.

4. COMPACTION RELATED TESTS

Sample preparation: **Individual** indicates test carried out on individual sub-samples.

Single indicates test carried out on a single sample.

Assumed values of particle density are reported in brackets e.g. (2.67)

5. SAMPLE DESCRIPTIONS

The sample descriptions shown on the test report sheets are the technician's visual descriptions of the test samples, in accordance with Clause 9.1 of Part 1 of BS 1377 : 1990 and do not necessarily comply with the requirements of BS 5930 : 1983. For a more comprehensive description of the soil samples to BS 5930, reference should be made to the exploratory hole records, or an engineering description can be provided on request.

6. INTERPRETATION OF TEST RESULTS

Laboratory test results in this report give the soil properties of individual specimens tested under specified conditions. Individual results or groups of results may not be appropriate for use as design parameters for some geotechnical analyses. The samples may be non-representative, disturbed internally, or prepared and tested under conditions suited for different geotechnical applications. Unless the selection of design parameters is discussed in this report, it is recommended that the advice of an appropriately qualified and experienced specialist is sought.

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No	: LD1 / 1	Date	: February 2004
Sample Depth (m)	: 80.00 - 81.50	Specimen Depth (m)	: 80.35
Specimen Details		Drainage Conditions	: Both ends
Sample Type	: Core	Sample Orientation	: Vertical
		Preparation Method	: Machine prepared
Sample Description	: Hard grey CLAYSTONE		

INITIAL PROPERTIES	Moisture Content	%	10
	Bulk Density	Mg/m ^{3}	2.35
	Dry Density	Mg/m ^{3}	2.12
	Height	mm	105.8
	Diameter	mm	107.8
	Particle Density Assumed	Mg/m ^{3}	2.70
	Degree of Saturation	%	104
	Voids Ratio		0.2715
PERMEABILITY STAGE	Cell Pressure	kPa	1300
	Base Pressure	kPa	253
	Top Pressure	kPa	351
	Pressure Difference	kPa	98
	Mean effective stress	kPa	998.4
	Direction of Flow - Downwards		
	Flow Rate	mL/min	6.78E-05
FINAL PROPERTIES	Moisture Content	%	11
	Bulk Density	Mg/m ^{3}	2.38
	Dry Density	Mg/m ^{3}	2.13
	Voids Ratio		0.2659

20 - 16

Coefficient of permeability, k (m/s), at 20 deg. C.	**1.3E-12**

1.12×10^{-7} m/d

Variation from BS 1377 and reason :

Remarks on testing :

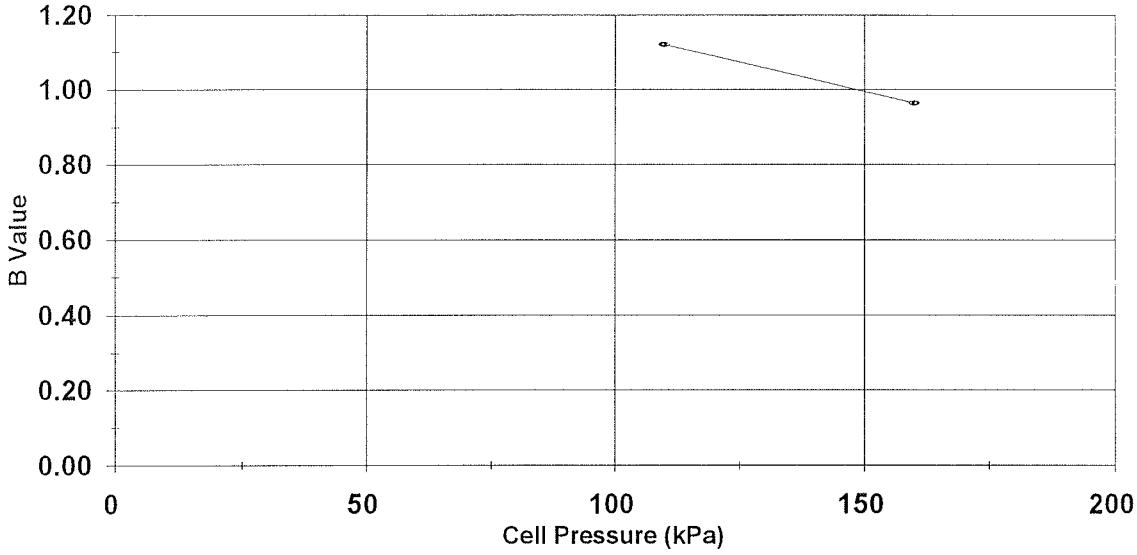
		Input by D Hill	Date 23/02/2004	Checked by AP Doubtet.	Date 17/05/2004.		
		Project RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT				Contract R39632	Figure 2 of 10

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

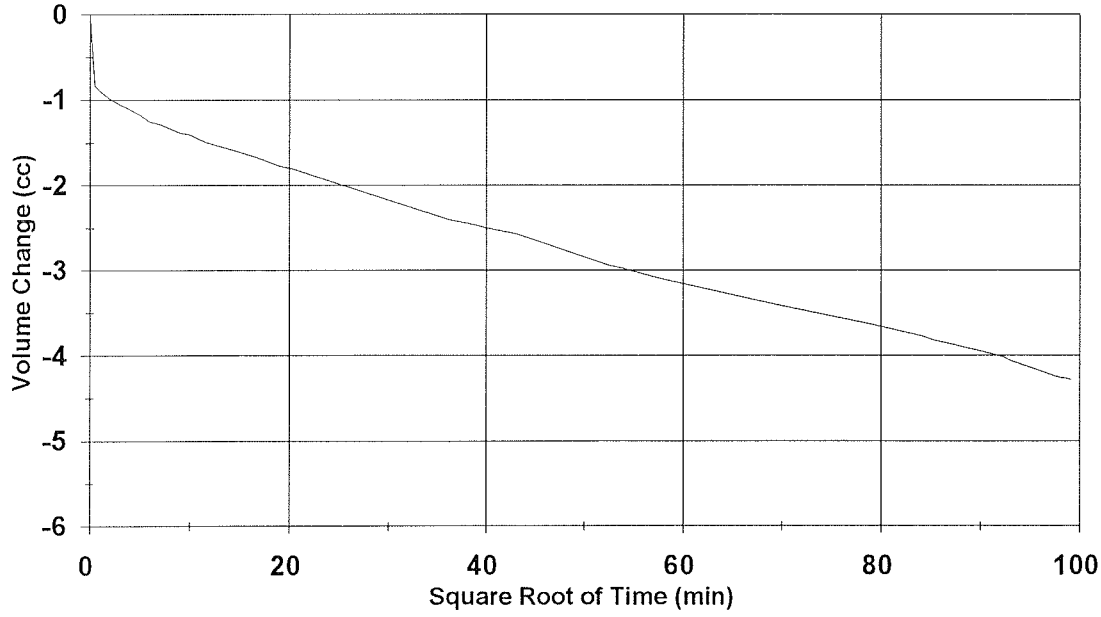
Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No : LD1 / 1
Date : February 2004
Sample Depth (m) : 80.00 - 81.50
Specimen Depth (m) : 80.35

SATURATION STAGE BS 1377 : Part 6 Method 5.4	Method : Saturation by increments of cell pressure and back pressure		
	Pressure Increments	kPa	50
	Pressure Differential	kPa	10
	Final Cell Pressure	kPa	160
	Final Pore Pressure	kPa	160
	Final Pore Pressure Coefficient B		0.96



CONSOLIDATION STAGE BS 1377 : Part 8 Method 6	Cell Pressure	kPa	1300
	Back Pressure	kPa	300
	Effective Cell Pressure	kPa	1000
	Initial Pore Pressure	kPa	730
	Final Pore Pressure	kPa	309
	Dissipation of Pore Pressure	%	98
	Change in Volume	%	0.44
	Coeff. of Consolidation (isotropic)	m^2/yr	-
	Coeff. of Volume Compressibility (isotropic)	m^2/MN	0.011

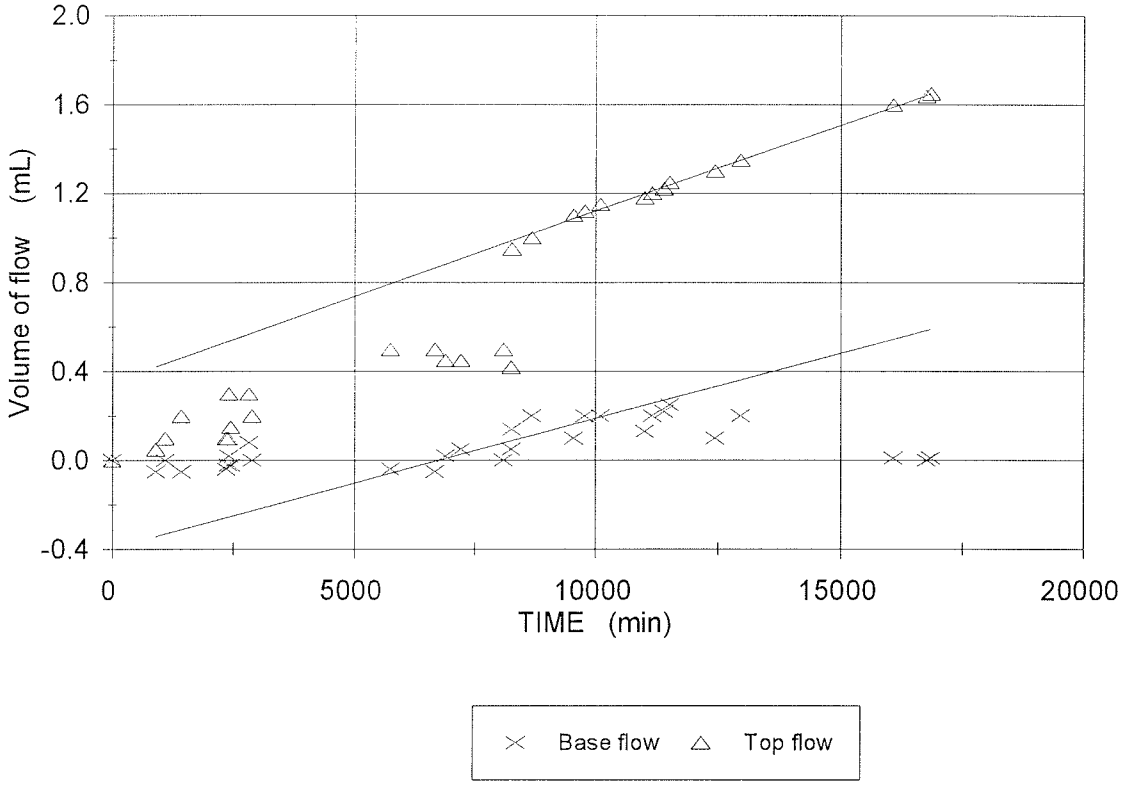


	Input by	Date	Checked by	Date		
	D Hill	23/02/2004	AP Doubtet.	17/05/2004.		
	Project	RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT			Contract	R39632
					Figure	3 of 10

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No :	LD1 / 1	Date	: February 2004
Sample Depth (m) :	80.00 - 81.50	Specimen Depth (m)	: 80.35



		Input by	Date	Checked by	Date		
		D Hill	23/02/2004	AP Doubleday.	17/05/2004.		
	Project	RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT				Contract	R39632
						Figure	4 of 10

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No : LD2 / 1
Sample Depth (m) : 101.50 - 102.10
Specimen Details
Sample Type : Core

Sample Description : Dense dark grey fine SAND

Date : March 2004
Specimen Depth (m) : 101.70
Drainage Conditions : Both ends
Sample Orientation : Horizontal
Preparation Method : Extruded and hand trimmed

INITIAL PROPERTIES	Moisture Content	%	22
	Bulk Density	Mg/m ^{3}	2.00
	Dry Density	Mg/m ^{3}	1.64
	Height	mm	76.1
	Diameter	mm	37.7
	Particle Density Assumed	Mg/m ^{3}	2.70
	Degree of Saturation	%	92
	Voids Ratio		0.6512
PERMEABILITY STAGE	Cell Pressure	kPa	1300
	Base Pressure	kPa	250
	Top Pressure	kPa	350
	Pressure Difference	kPa	100
	Mean effective stress	kPa	1000
	Direction of Flow - Downwards		
	Flow Rate	mL/min	1.33E+01
FINAL PROPERTIES	Moisture Content	%	23
	Bulk Density	Mg/m ^{3}	2.02
	Dry Density	Mg/m ^{3}	1.65
	Voids Ratio		0.6374

Coefficient of permeability, k (m/s), at 20 deg. C.	**1.4E-06**

Variation from BS 1377 and reason :

Remarks on testing :

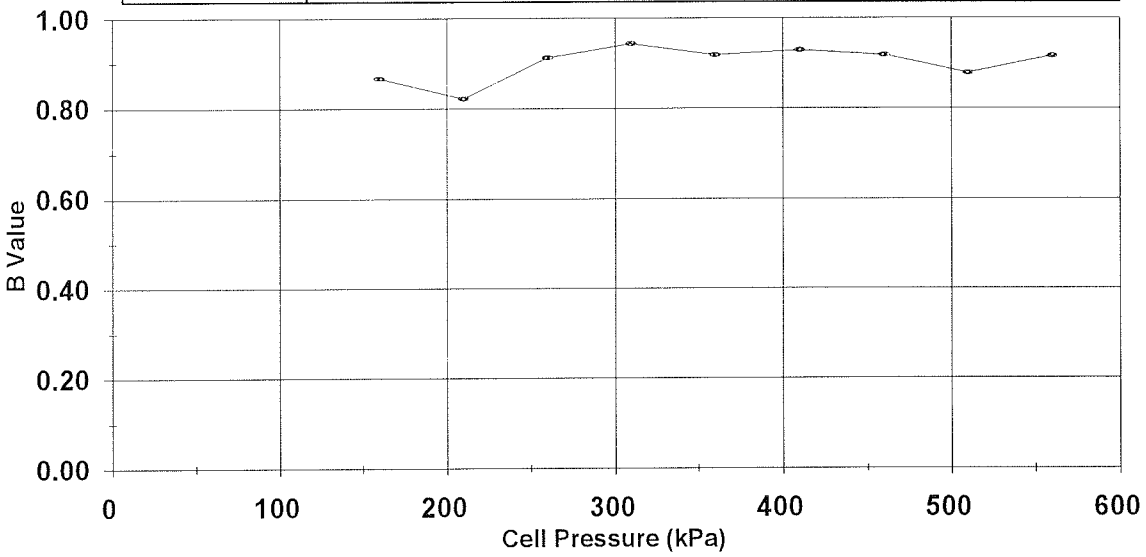
		Input by D Hill	Date 29/03/2004	Checked by AP Doubtfire.	Date 17/05/2004.		
	Project RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT					Contract R39632	
						Figure 5 of 10	

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

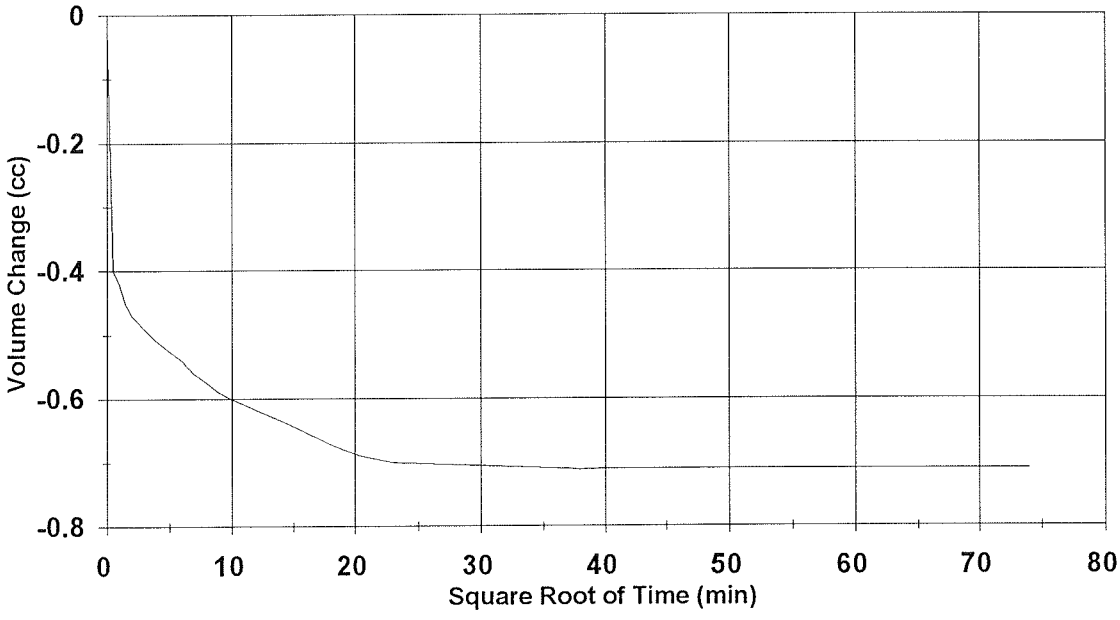
Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No : LD2 / 1
Sample Depth (m) : 101.50 - 102.10
Date : March 2004
Specimen Depth (m) : 101.70

SATURATION STAGE BS 1377 : Part 6 Method 5.4	Method : Saturation by increments of cell pressure and back pressure		
	Pressure Increments	kPa	50
	Pressure Differential	kPa	10
	Final Cell Pressure	kPa	560
	Final Pore Pressure	kPa	550
	Final Pore Pressure Coefficient B		0.92



CONSOLIDATION STAGE BS 1377 : Part 8 Method 6	Cell Pressure	kPa	1300
	Back Pressure	kPa	300
	Effective Cell Pressure	kPa	1000
	Initial Pore Pressure	kPa	974
	Final Pore Pressure	kPa	309
	Dissipation of Pore Pressure	%	99
	Change in Volume	%	0.84
	Coeff. of Consolidation (isotropic)	m^2/yr	479
	Coeff. of Volume Compressibility (isotropic)	m^2/MN	0.013

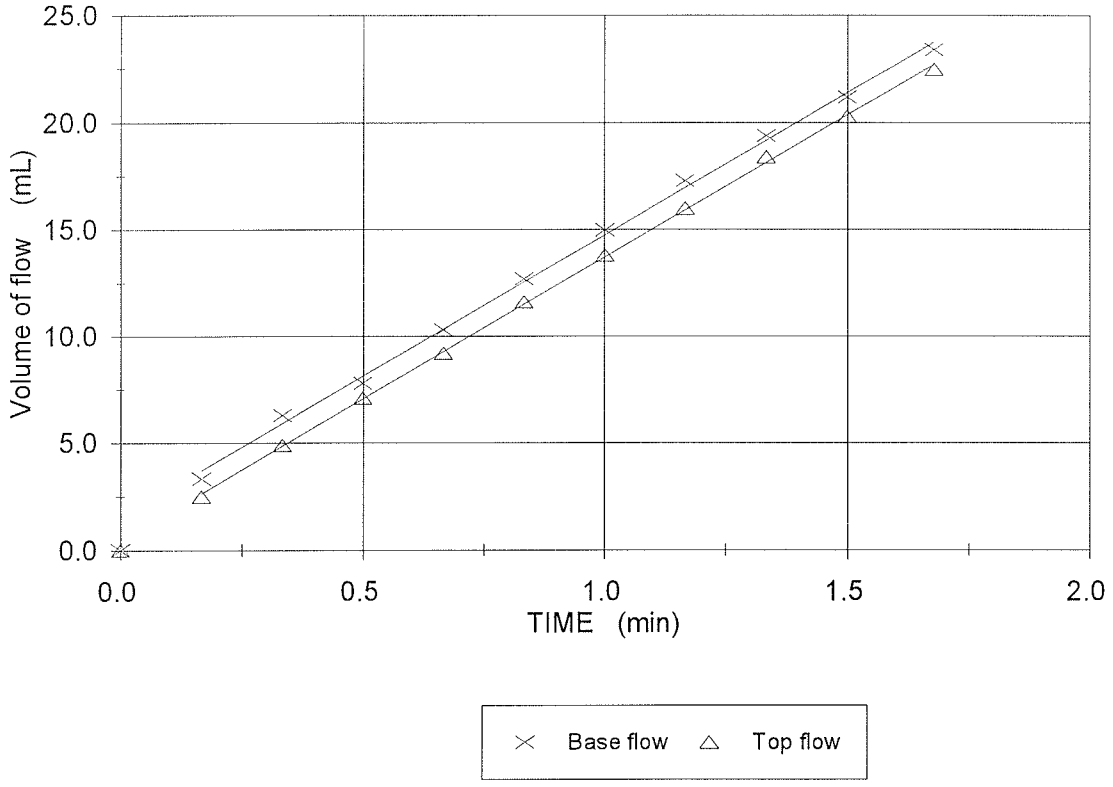


		Input by D Hill	Date 29/03/2004	Checked by AP Doubleday	Date 17/05/2004	
FUGRO	Project RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT				Contract R39632	Figure 6 of 10

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No : LD2 / 1
Sample Depth (m) : 101.50 - 102.10
Date : March 2004
Specimen Depth (m) : 101.70



		Input by	Date	Checked by	Date		
		D Hill	29/03/2004	AP Bubbles.	17/05/2004.		
	Project: RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT					Contract: R39632	
						Figure: 7 of 10	

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No	: LD2 / 1	Date	: March 2004
Sample Depth (m)	: 101.50 - 102.10	Specimen Depth (m)	: 101.52
Specimen Details		Drainage Conditions	: Both ends
Sample Type	: Core	Sample Orientation	: Vertical
		Preparation Method	: Extruded and hand trimmed

Sample Description : Dense dark grey fine SAND

INITIAL PROPERTIES	Moisture Content	%	20
	Bulk Density	Mg/m ^{3}	2.01
	Dry Density	Mg/m ^{3}	1.68
	Height	mm	104.2
	Diameter	mm	105.5
	Particle Density Assumed	Mg/m ^{3}	2.70
	Degree of Saturation	%	88
	Voids Ratio		0.6107
PERMEABILITY STAGE	Cell Pressure	kPa	1450
	Base Pressure	kPa	325
	Top Pressure	kPa	575
	Pressure Difference	kPa	250
	Mean effective stress	kPa	1000
	Direction of Flow - Downwards		
	Flow Rate	mL/min	7.28E+01
FINAL PROPERTIES	Moisture Content	%	21
	Bulk Density	Mg/m ^{3}	2.09
	Dry Density	Mg/m ^{3}	1.72
	Voids Ratio		0.5671

Coefficient of permeability, k (m/s), at 20 deg. C.	**5.5E-07**

Variation from BS 1377 and reason :

Remarks on testing :

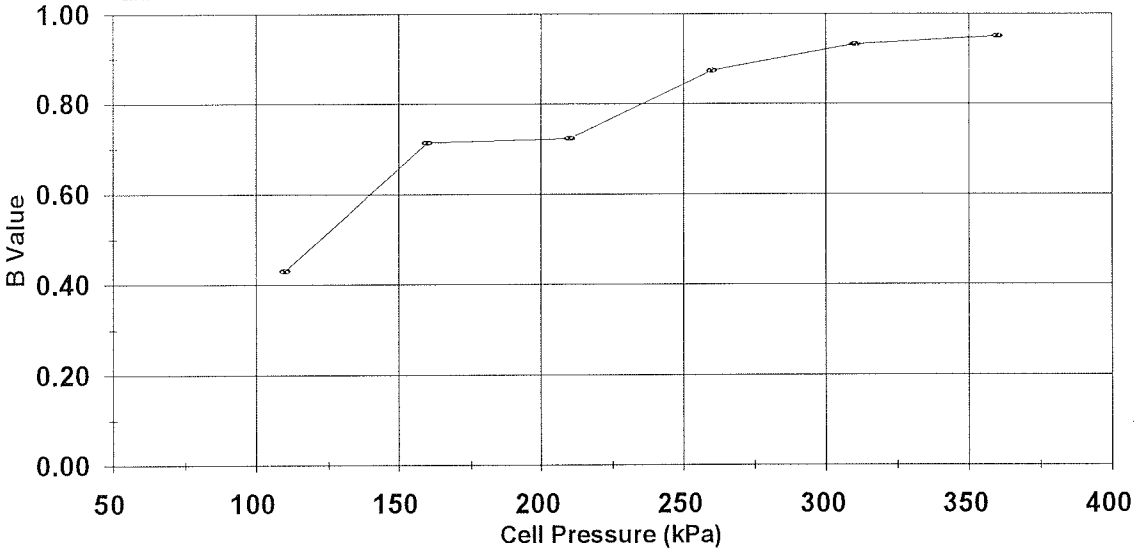
		Input by D Hill	Date 12/03/2004	Checked by AP Doubtfire	Date 17/05/2004		
	Project RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT					Contract R39632	Figure 8 of 10

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

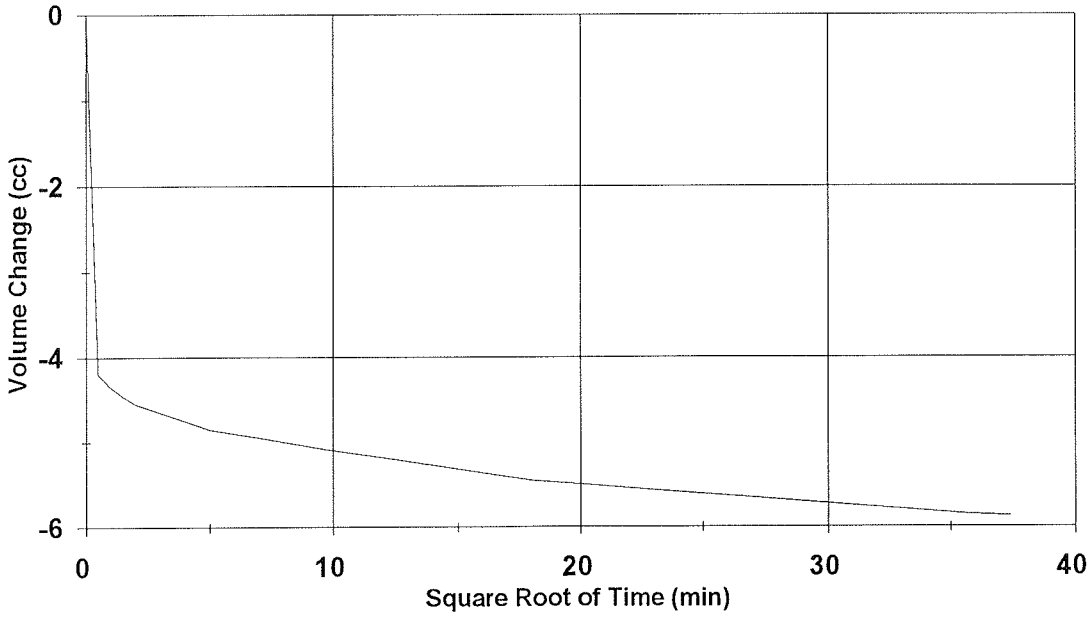
Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No : LD2 / 1
Sample Depth (m) : 101.50 - 102.10
Date : March 2004
Specimen Depth (m) : 101.52

SATURATION STAGE BS 1377 : Part 6 Method 5.4	Method : Saturation by increments of cell pressure and back pressure		
	Pressure Increments	kPa	50
	Pressure Differential	kPa	10
	Final Cell Pressure	kPa	360
	Final Pore Pressure	kPa	346
	Final Pore Pressure Coefficient B		0.95



CONSOLIDATION STAGE BS 1377 : Part 8 Method 6	Cell Pressure	kPa	1450
	Back Pressure	kPa	450
	Effective Cell Pressure	kPa	1000
	Initial Pore Pressure	kPa	918
	Final Pore Pressure	kPa	453
	Dissipation of Pore Pressure	%	99
	Change in Volume	%	2.7
	Coeff. of Consolidation (isotropic)	m²/yr	36972
	Coeff. of Volume Compressibility (isotropic)	m²/MN	0.058



		Input by D Hill	Date 12/03/2004	Checked by A Doubtet.	Date 17/05/2004.

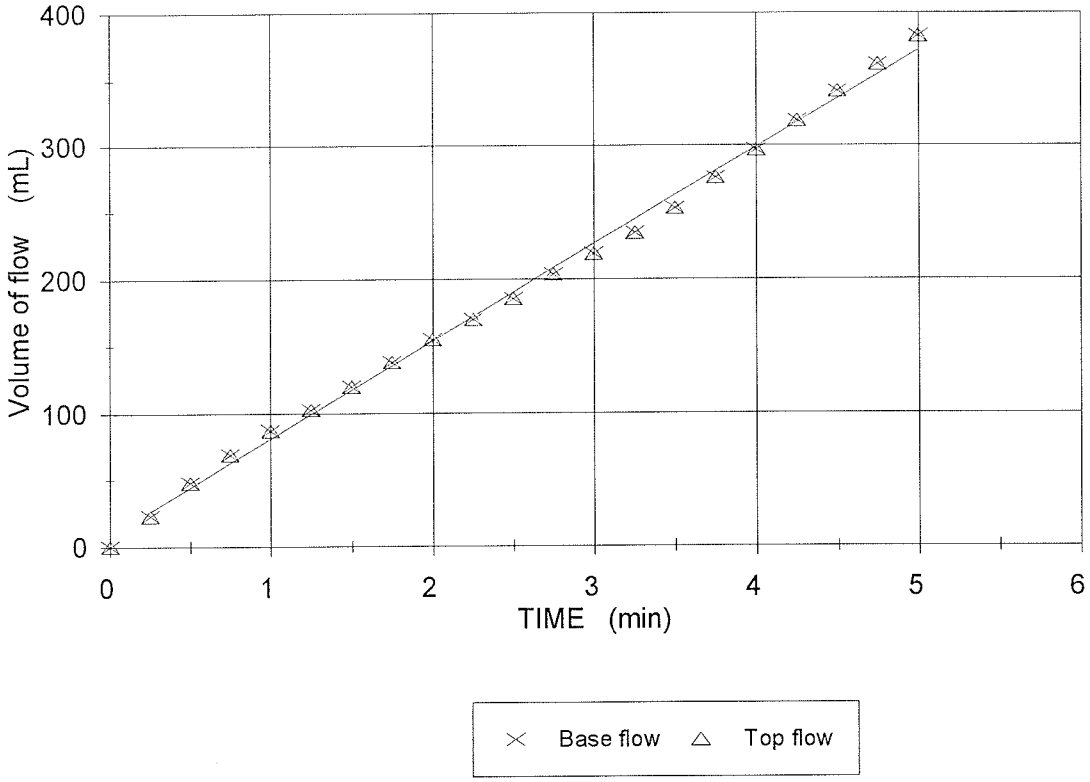
Project RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT	Contract R39632	
	Figure 9 of 10	

DETERMINATION OF PERMEABILITY IN A TRIAXIAL CELL

Constant head : BS 1377 : Part 6 : 1990. Method 6

Borehole/Sample No : LD2 / 1
Sample Depth (m) : 101.50 - 102.10

Date : March 2004
Specimen Depth (m) : 101.52



		Input by	Date	Checked by	Date		
		D Hill	12/03/2004	AP Doubtet.	17/05/2004.		

Project: RESTORING RIVER FLOWS MALMESBURY AVON CATCHMENT	Contract: R39632	
	Figure: 10 of 10	