WYG Ireland
part of the WYG group

Monaghan County Council

Glaslough Waste Water Treatment Works - Waste Water Discharge Licence Application (D0347-01)

Request for Further Information

Date: June 2010

1 Introduction

1.1 Background

This document forms Monaghan County Council's response to the EPA correspondence of 31st May 2010 relating to the Glaslough WWDLA (D0347-01) and compliance requirements in accordance with Regulation 16 of the Waste Water Discharge (Authorisation) Regulations 2007.

2 Regulation 16 Compliance Requirements

2.1 Clarify the frequency of sludge removal from the settlement ponds and method of sludge disposal;

The sludge pond at Glaslough has not been filled to the point that it requires sludge removal. One sludge pond is used at a time, hence when this pond fills up there will be a switch over to the second sludge pond. This will allow for the sludge in sludge pond 1 to dry up. This sludge will then be sent to the sludge press at Monaghan WWTP for pressing and further use.

2.2 Provide a summary of monitoring undertaken at the facility over the last twelve months, and provide a summary of the monitoring results including: influent flow rates, flow rates between ponds and effluent discharge rate, quality of effluent as sampled between ponds and the final effluent discharge to the receiving water, groundwater monitoring wells, lysimeters/piezometers ambient receiving water etc.;

Sampling Regime

Grab water samples are taken from the ICW influent and effluent points and upstream and downstream monitoring points. Groundwater samples are collected from eight piezometric wells (BH1-BH8) placed within the ICW system and along the suspected flow paths of contaminants. Samples of pond water infiltration are collected from six gravity pan lysimeters (L1-L6) placed 700 mm below the pond beds of the first three ponds (see **Map 1**).

The collected water samples are analysed for the following parameters:

- Nitrogen: total nitrogen, ammonia, nitrate.
- Phosphorus: total phosphorus, molybdate reactive phosphate.
- Organic matter: BOD, COD, SS.

The following physical parameters are also measured: dissolved oxygen, pH, temperature, redox potential, electrical conductivity, total and faecal coliforms.

All samples are collected approximately weekly and analysed the same day according to standard methods.

Sampling Results

Table 1 below provides a summary of the influent and effluent monitoring data taken over the last twelve months (mean and max values). The number of samples taken is outlined by *n*.

TABLE 1						
Parameter	**Influent**			**Effluent**		
	Mean	**Max**	***n***	**Mean**	**Max**	***n***
COD (mg O_2/L)	1091	3650	132	37	101	135
BOD_5 (mg O_2/L)	769	2450	121	5	22	130
TSS (mg/L)	2377	24010	128	8	34	127
Total Nitrogen (mg N/L)	44.63	90	100	2.07	9.2	107
Total Phosphorus (mg P/L)	7.48	21.5	130	0.15	0.95	135
Ammonia (mg N/L)	34.59	71.3	132	0.82	8.2	139
Nitrate (mg N/L)	6.81	32.3	112	0.31	1.6	121
Molybdate Reactive Phosphate (mg P/L)	4.29	12	128	0.09	0.9	134

Table 2 below provides a summary of the upstream and downstream monitoring data taken over the last twelve months (mean and max values). The number of samples taken is outlined by *n*.

TABLE 2						
Parameter	**Upstream**			**Downstream**		
	Mean	**Max**	***n***	**Mean**	**Max**	***n***
COD (mg O_2/L)	35	101	121	34	101	120
BOD_5 (mg O_2/L)	3	30	114	3	12	114
TSS (mg/L)	10	96	115	8	90	115
Total Nitrogen (mg N/L)	1.99	11.2	94	1.94	6.1	94
Total Phosphorus (mg P/L)	0.14	0.76	120	0.13	0.56	119
Ammonia (mg N/L)	0.49	1.5	121	0.48	1.5	119
Nitrate (mg N/L)	0.94	2.2	111	0.94	2.1	111
Molybdate Reactive Phosphate (mg P/L)	0.08	0.3	116	0.08	0.3	115

Table 3 below provides a summary of groundwater quality at the ICW (mean values)

TABLE 3								
Parameter	**BH1**	**BH2**	**BH3**	**BH4**	**BH5**	**BH6**	**BH7**	**BH8**
COD (mg O_2/L)	15	12	47	12	9	34	41	31
BOD_5 (mg O_2/L)	2.24	1.31	6.03	1.26	2.65	3.69	6.42	4.51
Total Nitrogen (mg N/L)	0.89	0.92	4.75	0.83	0.72	1.97	3.43	2.30
Total Phosphorus (mg P/L)	0.27	0.36	0.95	0.22	0.16	0.67	0.29	0.27
Ammonia (mg N/L)	0.40	0.61	4.89	0.12	0.67	2.34	4.67	1.47
Nitrate (mg N/L)	0.19	0.26	0.63	0.36	0.29	0.67	0.61	0.37
Molybdate Reactive Phosphate (mg P/L)	0.17	0.24	0.25	0.13	0.15	0.29	0.13	0.11

Table 4 below provides the monthly water discharge (m^3 day^{-1}) between ICW ponds (mean values)

TABLE 4							
Month	**Flow Rate (m^3 day^{-1})**						
	Influent	**Sludge Pond**	**Outflow Pond 1**	**Outflow Pond 2**	**Outflow Pond 3**	**Outflow Pond 4**	**Effluent**
Mar 2009	99.67	81.92	88.00	81.37	92.64	106.95	83.09
Apr 2009	130.36	114.51	108.91	94.94	88.81	97.98	76.73
May 2009	118.65	100.00	123.84	120.89	140.82	165.18	142.77
June 2009	85.10	72.47	76.02	64.38	61.62	55.05	29.90
July 2009	118.50	101.72	97.93	90.45	91.13	101.28	78.12
Aug 2009	137.74	123.21	117.61	114.27	116.36	128.30	119.27
Sept 2009	76.24	55.95	73.67	74.34	107.72	131.20	111.97
Oct 2009	106.71	87.70	69.90	53.29	36.50	37.88	21.98
Nov 2009	249.11	225.75	260.67	273.33	312.48	349.85	358.70
Dec 2009	112.16	94.79	134.90	157.45	249.82	317.98	307.49
Jan 2010	100.80	82.73	103.53	109.55	130.59	160.34	153.90
Feb 2010	92.79	73.96	83.98	85.63	92.24	110.35	102.39
Mar 2010	65.99	53.98	56.64	49.90	41.60	36.13	22.56

Table 5 below provides the water quality of pond water infiltrating to the lysimeters (mean values

TABLE 5						
Parameter	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
COD (mg O_2/L)	47	74	9	135	56	278
BOD_5 (mg O_2/L)	8.06	5.83	1.70	4.04	8.11	2.45
Total Nitrogen (mg N/L)	16.56	4.89	1.60	12.52	16.09	7.94
Total Phosphorus (mg P/L)	0.34	0.38	0.27	0.41	0.55	0.16
Ammonia (mg N/L)	8.45	6.05	1.77	11.17	16.72	5.38
Nitrate (mg N/L)	5.72	0.99	0.50	2.01	1.25	2.75
Molybdate Reactive Phosphate (mg P/L)	1.90	1.09	1.02	1.11	0.61	2.37

2.3 Provide a map of the integrated constructed wetland showing the location for all groundwater monitoring wells, lysimeters/piezometers installed on-site; include 6 digit national grid references, 6E, 6N.

Map 1 overleaf displays the locations of all monitoring boreholes and lysimeters installed on-site.

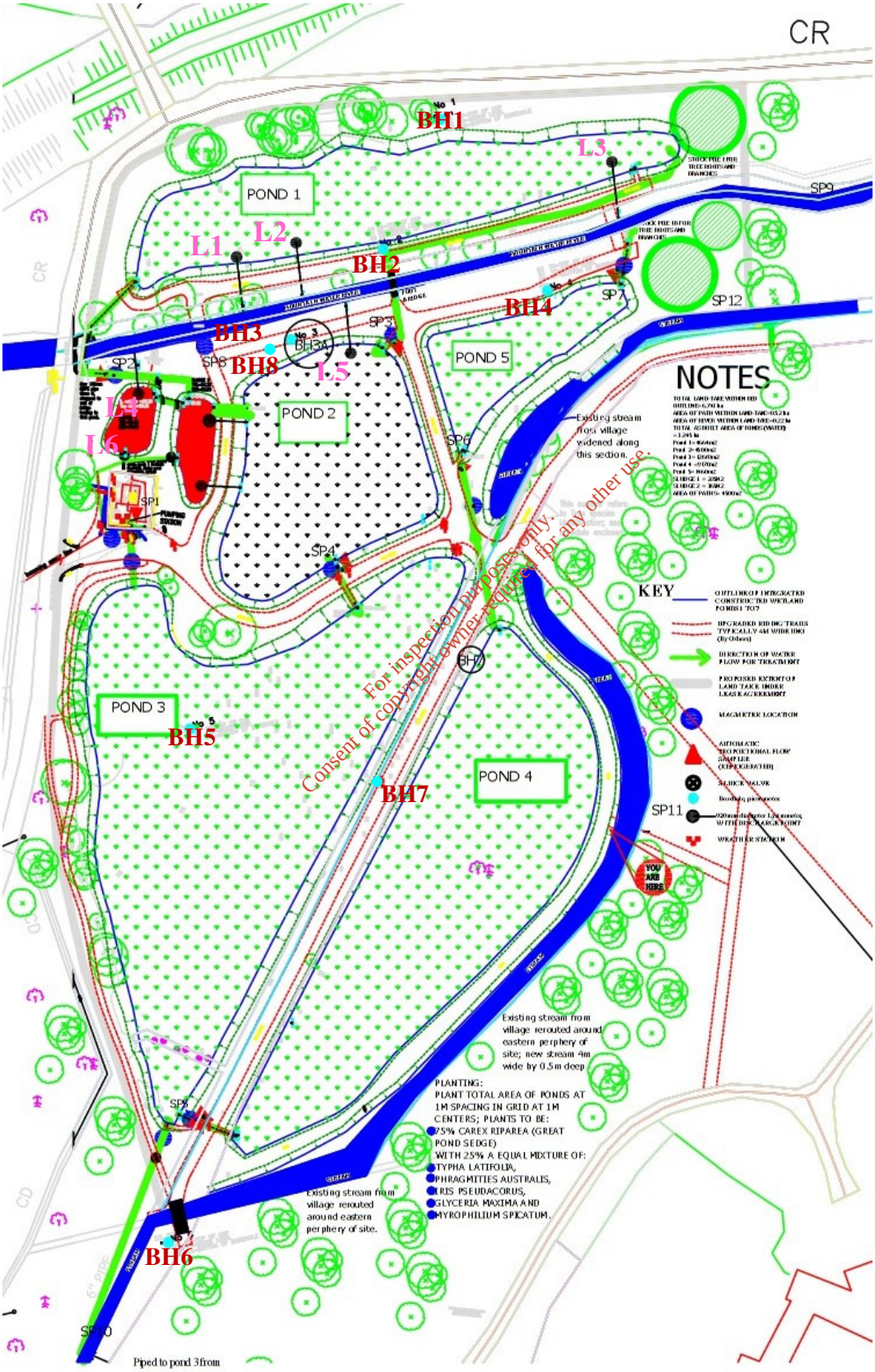
Table 6 below displays the NGR of groundwater monitoring points at ICW:

TABLE 6		
Piezometer	**Easting**	**Northing**
BH1	272184	342261
BH2	272166	342218
BH3	272140	342183
BH4	272228	342200
BH5	272100	342049
BH6	272098	341864
BH7	272185	342048
BH8	272142	342177

Table 7 below displays the NGR of lysimeters installed at Glaslough ICW:

TABLE 6		
Lysimeters	**Easting**	**Northing**
L1	272057	342221
L2	272078	342226
L3	272189	342254
L4	272022	342173
L5	272097	342187
L6	272017	342151

Map 1 Lysimeters (L1-L6) & Monitoring Boreholes (BH1-BH8) Locations



2.4 Provide details of the maximum and average discharge parameter concentrations (including number of samples results are based upon) for BOD, COD, Suspended Solids, Orthophosphates, Total Phosphorous, Total Nitrogen and ammonia;

Table 8 below provides a summary of the influent and effluent monitoring data taken over the last twelve months (mean and max values). The number of samples taken is outlined by *n.*

TABLE 8						
Parameter	**Influent**			**Effluent**		
	Mean	**Max**	**n**	**Mean**	**Max**	**n**
COD (mg O_2/L)	1091	3650	132	37	101	135
BOD_5 (mg O_2/L)	769	2450	121	5	22	130
TSS (mg/L)	2377	24010	128	8	34	127
Total Nitrogen (mg N/L)	44.63	90	100	2.07	9.2	107
Total Phosphorus (mg P/L)	7.48	21.5	130	0.15	0.95	135
Ammonia (mg N/L)	34.59	71.3	132	0.82	8.2	139
Nitrate (mg N/L)	6.81	32.3	112	0.31	1.6	121
Molybdate Reactive Phosphate (mg P/L)	4.29	12	128	0.09	0.9	134

Table 9 below provides a summary of the upstream and downstream monitoring data taken over the last twelve months (mean and max values). The number of samples taken is outlined by *n*.

TABLE 9						
Parameter	**Upstream**			**Downstream**		
	Mean	**Max**	**n**	**Mean**	**Max**	**n**
COD (mg O_2/L)	35	101	121	34	101	120
BOD5 (mg O_2/L)	3	30	114	3	12	114
TSS (mg/L)	10	96	115	8	90	115
Total Nitrogen (mg N/L)	1.99	11.2	94	1.94	6.1	94
Total Phosphorus (mg P/L)	0.14	0.76	120	0.13	0.56	119
Ammonia (mg N/L)	0.49	1.5	121	0.48	1.5	119
Nitrate (mg N/L)	0.94	2.2	111	0.94	2.1	111
Molybdate Reactive Phosphate (mg P/L)	0.08	0.3	116	0.08	0.3	115

2.5 Provide details of the site investigations undertaken, including trial holes and boreholes installed, soil testing, prior to construction of the Integrated Constructed Wetlands. Provide a conceptual cross section of the site based on the investigations completed prior to construction and information gathered during construction. In addition provide details of confirmation testing undertaken during construction, including sign off of construction works; Provide details to demonstrate that permeability of the ponds is a minimum of $k = 1 \times 10^{-8}$ m/s.

Appendix A contains Glaslough Site Investigation reports. Cross sections of the site are contained in **Appendix B.**

Table 10 below shows the permeability of ponds as calculated from the rate of infiltration to the lysimeters.

TABLE 10			
Ponds	**Permeability (x 10^{-9} m/s)**		
	Mean	**Standard Deviation**	**Number of samples**
Sludge Pond	4.38	3.92	15
Pond 1	3.82	1.14	15
Pond 2	11.9	8.19	15

2.6 An emergency overflow is identified at the pumping station at the inlet works, clarify if this emergency overflow discharges to the receiving water or is directed to an integrated constructed wetland pond, include grid reference of the discharge point; and

The emergency overflow located at the pumping station is directed to discharge into Pond 2 (NGR 272054, 342128). This emergency overflow was originally designed to discharge to the Mountain Water River just upstream of the outfall locations at NGR 272029E, 342194N.

2.7 Demonstrate that the effluent discharge, via the primary discharge point, to the receiving water does not cause an exceedence of the European Communities Environmental Objectives (Surface Water) Regulations 2009 for parameters including BOD, Total Ammonia, and Molybdate Reactive Phosphorous (MRP).

Mountain Water River

Table 11 below provides an overview of the Mountain Water River in terms of the goal of achieving Good Ecological Status. The most important objective within the European Water Framework Directive (WFD) is to achieve a 'Good Ecological Status' (GES) for all waters, by 2015 (Source: *Blackwater Management Unit Action Plan, www.nsshare.com*).

TABLE 11					
Biological Elements	**Supporting Elements**		**Objective**	**Date Objective to be Achieved**	**OVERALL STATUS**
Macroinvertebrate (Q)	**Physio-Chemical**	**Ecological Status**			
P	M	P	GES	2021	**POOR**

As can be seen from **Table 11** above, the overall status of the Mountain Water River is Poor. The date now set for this water body for achieving Good Ecological Status is 2021.

Water Quality & Dilution Capacity

The water quality downstream of the WWTW discharge point is slightly better than the water quality upstream (see **Table 12** and **Table 13** below), which would indicate that the plant is not affecting water quality of the receiving water body.

There is significant dilution available in the Mountain Water River at the primary discharge at mean river flow. Approximately 936 dilutions are available on the basis of an average discharge volume of 123.75m^3/day and a mean river flow of 1.34m^3/s.

During very dry weather periods there is a very low flow discharge from the ICW or in some cases no discharge flow (*e.g.* there has been no flow from the ICW for May and June 2010). For the purposes of the

95%ile river flow (0.02m^3/s), a conservative ICW discharge flow of 10m^3/d has been used for the purposes this assessment. However, it should be noted that this is considered the worst case scenario based on historical information. The ICW is not like a conventional waste water treatment plants where the outflow equals the inflow, owing to trans-evaporation coupled with a large free surface area.

During the 95%ile river flow (0.02m^3/s), there is significant dilution available in the Mountain Water River at the primary discharge. Approximately, 173 dilutions (worst case) are available on the basis of 95%ile flow of the river and the low flow discharge from the ICW.

TABLE 12

Parameter	Upstream			Downstream		
	Mean	Max	n	Mean	Max	n
COD (mg O_2/L)	35	101	121	34	101	120
BOD_5 (mg O_2/L)	3	30	114	3	12	114
TSS (mg/L)	10	96	115	8	90	115
Total Nitrogen (mg N/L)	1.99	11.2*	94	1.94	6.1	94
Total Phosphorus (mg P/L)	0.14	0.76	120	0.13	0.56	119
Ammonia (mg N/L)	0.49	1.5	121	0.48	1.5	119
Nitrate (mg N/L)	0.94	2.2	111	0.94	2.1	111
Molybdate Reactive Phosphate (mg P/L)	0.08	0.3	116	0.08	0.3	115

*Ammonia effluent concentration elevated due to ponds being frozen for a period during winter 2009-2010. During this time period effluent ammonia was approximately 10 mg/L.

TABLE 13

Parameter	Pond water	Monitoring Points	
	Effluent (95%ile)	Upstream (95%ile)	Downstream (95%ile)
COD (mg O_2/L)	65.20	84.00	74.05
BOD_5 (mg O_2/L)	11.75	8.00	6.08
TSS (mg/L)	28.70	61.50	19.50
Total Nitrogen (mg N/L)	7.40	3.24	3.61
Total Phosphorus (mg P/L)	0.64	0.27	0.28
Ammonia (mg N/L)	6.09*	1.17	1.22
Nitrate (mg N/L)	0.63	1.80	1.65
Molybdate Reactive Phosphate (mg P/L)	0.64	0.18	0.16

* Ammonia effluent concentration elevated due to ponds being frozen for a period during winter 2009-2010. During this time period effluent ammonia was approximately 10 mg/L.

Assimilative Capacity & European Communities Environmental Objectives (Surface Water) Regulations 2009

The Assimilative Capacity of the receiving waters is a measure of its ability or suitability to absorb waste water discharges whilst complying with relevant legislation and water quality objectives.

An overview of the impacts of the effluent discharge on the receiving water with special reference to the European Communities Environmental Objectives (Surface Water) Regulations 2009 is outlined below.

BOD:

Total Amount Discharge to River (Mean Values):

With an average effluent discharge volume of 123.75m³/day, the total amount of BOD discharged to the Mountain Water River is:

123,750l/day x 5mg/l = **0.62kg/day**

Resulting BOD Concentration in the River (Mean Values):

The resulting BOD concentration in the river resulting from the effluent input can be estimated using the following Formula:

$$CR = \frac{(C_{back} * Q_{back}) + (C_d * Q_d)}{(Q_{back} + Q_d)}$$

Where;

CR = resulting concentration in river (mg O_2/l)

C_d = average concentration in discharge (5 mg O_2/l)

C_{back} = concentration in river u/s of discharge (3 mg O_2/l)

Q_{back} = flow of river (l/d) (average flow 1.34 m³/s) = 115,776,000l/d

Q_d = discharge volume (l/d) 123,750l/d

1m³/s = 86,400,000 l/d

Therefore:

CR = [(3 x 115,776,000) + (5 x 123,750)] / [115,776,000 + 123,750]

Resulting Concentration in River (CR) = 3.002 mg O_2/l (based on Mean Values)

Total Amount Discharge to River (95%ile Values):

With a low flow discharge volume of 10m³/day, the total amount of BOD discharged to the Mountain Water River is:

10,000 l/day x 11.75mg/l = **0.11kg/day**

Note: A conservative ICW discharge flow of $10m^3/d$ has been used for the purposes this assessment. It should be noted that this is considered the worst case scenario based on historical information.

Resulting BOD Concentration in the River (95%ile Values):

The resulting BOD concentration in the river resulting from the effluent input can be estimated using the following Formula:

$$CR = \frac{(C_{back} * Q_{back}) + (C_d * Q_d)}{(Q_{back} + Q_d)}$$

Where;

CR = resulting concentration in river (mg/l)

C_d = average concentration in discharge (11.75mg O_2/l)

C_{back} = concentration in river u/s of discharge (8mg O_2/l)

Q_{back} = flow of river (l/d) (95%ile 0.02 m^3/s) = 1,728,000l/d

Q_d = discharge volume (l/d) 10,000l/d (conservative discharge flow used)

$1m^3/s$ = 86,400,000 l/d

Therefore:

CR = [(8 x 1,728,000) + (11.75 x 10,000)] / [1,728,000 + 10,000]

Resulting Concentration in River (CR) = 8.022mg N/l

BOD Summary

There is no assimilative capacity for BOD based on the mean or 95%ile BOD standards under S.I. No. 272 of 2009, as the mean and 95%ile concentrations of BOD upstream of the discharge point for 2009-2010

(3mg O_2/l and 8mg O_2/l respectively) are greater than the water quality standards (≤1.5 mg O_2/l and ≤2.6mg O_2/l respectively) (see **Table 14** below).

Based on the average discharge concentration and mean river flow, the BOD load in the discharge will result in a predicted contribution of 0.002mg O_2/l or 0.07%. Based on 95%ile values, a contribution of 0.02mg O_2/l or 0.25% is predicted. Hence, it is predicted that the effluent discharge contributes very marginally to downstream BOD levels (see **Table 14**).

TABLE 14 BOD ASSIMILATIVE CALCULATIONS

Parameter	Values Based on	% Available Capacity	Background (mg N/l)	Effluent Discharge (mg/l)	Contribution from Primary Discharge (mg/l)	Predicted Downstream Quality	Relevant Standard
BOD	Mean	None	3	5	0.002	3.002	≤1.5 mg O_2/l
	95%ile	None	8	11.75	0.02[1]	8.022	≤2.6 mg O_2/l

[1] During very dry weather periods there is a very low flow discharge from the ICW or in some cases no discharge. A conservative ICW discharge flow of 10m^3/d has been used for the purposes this assessment. However, it should be noted that this is considered the worst case scenario based on historical information.

Monaghan County Council monitoring results (Data 2009-2010), indicate an average upstream BOD concentration of 3mg O_2/l and 95%ile upstream concentration of 8mg O_2/l and an average downstream monitoring result of 3mg O_2/l /l N and 95%ile concentration of 6.08mg O_2/l. These results would indicate that predicted results are in fact overstating the real impact of the discharge from Glaslough in terms of BOD.

In summary, although the upstream and downstream monitoring results indicate that the river is not achieving the BOD standards stipulated for good status (mean or 95%ile) in the European Communities Objectives (Surface Water) Regulations, 2009 (S.I. No. 272 of 209), the results above and Monaghan County Councils monitoring results (see **Tables 11** and **12**) would indicate that the effluent discharge from the Glaslough WWTW is not having a significant impact on the receiving waters and thereby is not contributing to the failure of this waterbody to comply with the European Communities Objectives (Surface Water) Regulations in terms of BOD.

Ammonia:

Total Amount Discharge to River (Mean Values):

With an average effluent discharge volume of 123.75m³/day, the total amount of ammonia discharged to the Mountain Water River is:

123,750l/day x 0.82mg/l = **0.1kg/day**

Resulting Ammonia Concentration in the River (Mean Values):

The resulting ammonia concentration in the river resulting from the effluent input can be estimated using the following Formula:

CR = $\frac{(C_{back} * Q_{back}) + (C_d * Q_d)}{(Q_{back} + Q_d)}$

Where;

CR = resulting concentration in river (mg/l)

C_d = average concentration in discharge (0.82mg/l)

C_{back} = concentration in river u/s of discharge (0.49mg/l)

Q_{back} = flow of river (l/d) (average flow 1.34 m³/s) = 115,776,000l/d)

Q_d = discharge volume (l/d) 123,750l/d

$1m^3/s$ = 86,400,000 l/d

Therefore:

CR = [(0.49 x 115,776,000) + (0.82 x 123,750)] / [115,776,000 + 123,750]

Resulting Concentration in River (CR) = 0.49035mg/l (based on mean values)

Total Amount Discharge to River (95%ile Values):

With an average effluent discharge volume of 10m³/day, the total amount of ammonia discharged to the Mountain Water River is:

10,000 l/day x 6.09mg/l = **0.06kg/day** (see Notes 1 and 2 below)

Note 1: A conservative ICW discharge flow of $10m^3/d$ has been used for the purposes this assessment. It should be noted that this is considered the worst case scenario based on historical information.
Note 2: Ammonia effluent concentration elevated due the ponds being frozen for a while during winter 2009-2010. During this time period effluent ammonia was approximately 10 mg/L.

Resulting Ammonia Concentration in the River (95%ile Values):

The resulting ammonia concentration in the river resulting from the effluent input can be estimated using the following Formula:

$$CR = \frac{(C_{back} * Q_{back}) + (C_d * Q_d)}{(Q_{back} + Q_d)}$$

Where;

CR = resulting concentration in river (mg/l)

C_d = average concentration in discharge (6.09mg/l)

C_{back} = concentration in river u/s of discharge (1.17mg/l)

Q_{back} = flow of river (l/d) (average flow 0.02 m^3/s) = 1,728,000l/d)

Q_d = discharge volume (l/d) 10,000l/d (conservative discharge volume used)

$1m^3/s$ = 86,400,000 l/d

Therefore:

CR = [(1.17 x 1728000) + (6.09 x 10,000)] / [1728000 + 10,000]

Resulting Concentration in River (CR) = 1.1983mg/l (based on 95%ile values)

Ammonia Summary

There is no assimilative capacity for ammonia based on the mean or 95%ile standards under S.I. No. 272 of 2009, as the average and 95%ile concentrations of ammonia upstream for 2009-2010 (0.49mg N/l and 1.17mg N/l respectively) are greater than the water quality standards (≤0.065mg/l and ≤0.14mg/l respectively) (see **Table 15** below).

Based on the average discharge concentration and mean river flow, the ammonia load in the discharge will result in a predicted contribution downstream of 0.00035mg/l or 0.7%. Based on 95%ile values, a predicted contribution of 0.02830mg/l or 2% is predicted (see **Table 15** above).

TABLE 15 AMMONIA ASSIMILATIVE CALCULATIONS							
Para-meter	**Values based on**	**% Available Capacity**	**Background (mg N/l)**	**Effluent Discharge (mg/l)**	**Contribution from Primary Discharge (mg/l)**	**Predicted Downsteam Quality**	**Relevant Standard**
Ammonia	Mean	None	0.49	0.82[1]	0.00035	0.49035	≤0.065 (Mean)
	95%ile	None	1.17	6.09[1]	0.02830[2]	1.1983	≤0.14 (95%ile)

[1] Ammonia effluent concentration elevated due the ponds being frozen for a while during winter 2009-2010. During this time period effluent ammonia was approximately 10 mg/L.

[2] During very dry weather periods there is a very low flow discharge from the ICW or in some cases no discharge. A conservative ICW discharge flow of 10m^3/d has been used for the purposes this assessment. However, it should be noted that this is considered the worst case scenario based on historical information.

In summary, although the upstream and downstream monitoring results indicate that the river is not achieving the ammonia standards stipulated for good status (mean or 95%ile) in the European Communities Objectives (Surface Water) Regulations, 2009 (S.I. No. 272 of 209), the results above and Monaghan County Councils monitoring results (see **Tables 11** and **12**) would indicate that the effluent discharge from the Glaslough WWTW is not having a significant impact on the receiving waters and thereby is not contributing to the failure of this waterbody to comply with the European Communities Objectives (Surface Water) Regulations in terms of ammonia.

MRP:

Total Amount Discharge to River (Mean Values):

With an average effluent discharge volume of 123.75m^3/day, the total amount of MRP discharged to the Mountain Water River is:

123,750l/day x 0.09mg/l = **0.01kg/day**

Resulting MRP Concentration in the River (Mean Values):

The resulting MRP concentration in the river resulting from the effluent input can be estimated using the following Formula:

$$CR = \frac{(C_{back} * Q_{back}) + (C_d * Q_d)}{(Q_{back} + Q_d)}$$

Where;

CR = resulting concentration in river (mg/l)

C_d = average concentration in discharge 0.09mg/l)

C_{back} = concentration in river u/s of discharge (0.08mg/l)

Q_{back} = flow of river (l/d) (average flow 1.34 m^3/s) = 115,776,000l/d

Q_d = discharge volume (l/d) 123,750l/d

$1m^3/s$ = 86,400,000 l/d

Therefore:

CR = [(0.08 x 115,776,000) + (0.09 x 123,750)] / [115,776,000 + 123,750]

Resulting Concentration in River (CR) =0.08001mg N/l

Total Amount Discharge to River (95%ile Values):

With an average effluent discharge volume of $10m^3$/day, the total amount of MRP discharged to the Mountain Water River is:

10,000 l/day x 0.64mg/l = **0.006kg/day**

Resulting MRP Concentration in the River (95%ile Values):

The resulting MRP concentration in the river resulting from the effluent input can be estimated using the following Formula:

$$CR = \frac{(C_{back} * Q_{back}) + (C_d * Q_d)}{(Q_{back} + Q_d)}$$

Where;

CR = resulting concentration in river (mg/l)

C_d = average concentration in discharge (0.64mg/l)

C_{back} = concentration in river u/s of discharge (0.18mg/l)

Q_{back} = flow of river (l/d) (average flow 0.02 m^3/s) = 1,728,000l/d)

Q_d = discharge volume (l/d) 10,000l/d (conservative discharge volume used)

$1m^3/s$ = 86,400,000 l/d

Therefore:

CR = [(0.18 x 1,728,000) + (0.64 x 10,000)] / [1,728,000 + 10,000]

Resulting Concentration in River (CR) =0.1826mg N/l

MRP Summary

There is no assimilative capacity for MRP based on the mean or 95%ile standards under S.I. No. 272 of 2009, as the mean and 95%ile concentrations of MRP upstream for 2009-2010 (0.08mg P/l and 0.18 mg P/l respectively) are greater than the respective water quality standards (≤0.035mg P/l Mean and ≤0.075mg P/l 95%ile) (see **Table 16** below).

TABLE 16 MRP ASSIMILATIVE CALCULATIONS

Parameter	Values based on	% Available Capacity	Background (mg N/l)	Effluent Discharge (mg/l)	Contribution from Primary Discharge (mg/l)	Predicted Downstream Quality	Relevant Standard
MRP (mg P/l)	Mean	None	0.08	0.09	0.00001067	0.0800106	≤0.035 (Mean)
	95%ile	None	0.18	0.64	0.0026[1]	0.1826	≤0.075 (95%ile)

[1] During very dry weather periods there is a very low flow discharge from the ICW or in some cases no discharge. A conservative ICW discharge flow of $10m^3/d$ has been used for the purposes this assessment. However, it should be noted that this is considered the worst case scenario based on historical information.

Based on the mean discharge concentration and mean river flow, the MRP load in the discharge will result in a predicted contribution of 0.00001067mg P/l or 0.01% to the mean MRP river load downstream of the discharge point. Based on 95%ile values, a predicted contribution of 0.0026mg P/l or 1% is predicted. Hence, indicating that the effluent discharge contributes very marginally to downstream MRP levels.

Monaghan County Council monitoring results (see **Table 11** and **Table 12**) indicate an average upstream MRP concentrations of 0.08mg P/l (mean) and 95%ile concentration of 0.18 mg P/l and an average downstream monitoring result of 0.08 mg P/l (mean) and 95%ile concentration of 0.16mg P/l. These results would indicate that predicted results are overstating the real impact of the discharge from Glaslough in terms of MRP.

In summary, although the upstream and downstream monitoring results indicate that the river is not achieving the MRP standards stipulated for good status (mean or 95%ile) in the European Communities

Objectives (Surface Water) Regulations, 2009 (S.I. No. 272 of 209), the results above and Monaghan County Councils monitoring results (see **Tables 11** and **12**) would indicate that the effluent discharge from the Glaslough WWTW is not having a significant impact on the receiving waters and thereby is not contributing to the failure of this waterbody to comply with the European Communities Objectives (Surface Water) Regulations in terms of MRP.

Assimilative Capacity based on the Assumption that the Mountain Water River is at, at least, Good Ecological Status

As part of this Further Information Request we also looked at the assimilative capacity with the assumption that the Mountain Water River is at, at least, Good Ecological Status as a result of measures applied in the broader catchment. As noted in **Table 11**, the overall status of the Mountain Water River at present is Poor; and the date set for achieving Good Ecological Status has been extended to 2021. Therefore for these assimilative capacity calculations we have used the standards, introduced by the European Communities Environmental Objectives (Surface Waters) Regulations, as the river background concentrations *i.e.* Good Ecological Status.

Table 17 below summarises the waste assimilative capacity for BOD, Ammonia and MRP based on the assumption that the Mountain Water River is at, at least, Good Ecological Status.

	TABLE 17 BOD, AMMONIA & MRP ASSIMILATIVE CALCULATIONS - MOUNTAIN WATER RIVER AT GOOD ECOLOGICAL STATUS					
Parameter	**Values based on**	**Background (mg N/l)**	**Effluent Discharge (mg/l) (Current Effluent)**	**Contribution from Primary Discharge (mg/l)**	**Predicted Downstream Quality (mg/l)**	**Relevant Standard**
BOD	Mean	1.5[1]	5	0.0095 (0.6%)	1.5095	≤1.5 (Mean)
	95%ile	2.6[1]	11.75	0.0526 (2%)	2.6526	≤2.6 (95%ile)
Ammonia	Mean	0.065[1]	0.82	0.0020 (3%)	0.0670	≤0.065 (Mean)
	95%ile	0.14[1]	6.09 [2]	0.0034 (2%)	0.1434	≤0.14 (95%ile)
MRP	Mean	0.035[1]	0.09	0.0001 (0.4%)	0.03515	≤0.035 (Mean)
	95%ile	0.075[1]	0.64	0.0033 (4%)	0.0783	≤0.075 (95%ile)

[1]Current Effluent Concentrations used; S.I. No 272 of 2009 Good Status Standards used for background river concentrations.
[2] Ammonia effluent concentration elevated due the ponds being frozen for a while during winter 2009-2010. During this time period effluent ammonia was approximately 10 mg/L.

Additional Note: For the mean assimilative calculations the Discharge Flow Rate is based on 1,750 PE (Design PE) (315m^3/d) as the Good Ecological Status target for the water body extended to 2021. A conservative ICW discharge flow of 10m^3/d has been used for the 95%ile scenario.

The results in **Table 17** demonstrate that the predicted contribution of the discharge effluent on the downstream BOD, Ammonia and MRP concentrations is negligible. As noted above, this is based on using the mean and 95%ile Good Ecological Status concentrations, as per S.I. No. 272 of 2009, as the background upstream river water quality concentrations.

It can be concluded, based on results in **Table 17,** that the Glaslough ICW effluent discharge (based on Design PE of 1,750) will not adversely affect the Good Ecological Status of the Mountain Water River when this status is achieved.

Appendix A

Glaslough Site Investigation Reports

REPORT NO.	WINDOW SAMPLE RECORD SHEETS	IGSL Limited
CONTRACT: Glaslough Monaghan		PROBE NO.: WS1
		SHEET: 1 of 1
CLIENT: Monaghan County Council	PROBE WEIGHT (DPL,DPM,DPH): DPH	DATE STARTED: 09.02.09
	HAMMER MASS (kg): 50	DATE COMPLETED: 09.02.09
ENGINEER:	FALL HEIGHT (mm): 500	PROBED BY:
	90° CONE DIAMETER (mm): 43.7	LOGGED BY: IOD
LOCATION: Glaslough Monaghan	SPECIFIC WORK PER BLOW (kJ/m^2): 167	GROUND LEVEL (mOD):
	BLOWS COUNTED OVER (mm): 100	DATUM:

DOWNHOLE DEPTH (m)	SOIL DESCRIPTION	Depth (m)	WINDOW SAMPLE DEPTH	RECOVERY (%)	BLOWCOUNT	ELEVATION (mOD)	DEPTH (m)	BLOWS PER 100mm
0.0								
	Subsoil	0.10					0.10	
	MADE GROUND (brown silty clay with occasional bands of grey sand and some fine gravel. Root hairs and fibres noted along with fragments of red brick)						0.20	
							0.30	
							0.40	
-0.5							0.50	
							0.60	
							0.70	
							0.80	
							0.90	
-1.0							1.00	
							1.10	
		1.20					1.20	
	Firm to stiff mottled grey brown silty CLAY with some organic traces						1.30	
							1.40	
-1.5			*Sample taken for Triaxial Perm*					
							1.60	
							1.70	
							1.80	
							1.90	
-2.0							2.00	
		2.10					2.10	
	Soft very silty CLAY						2.20	
							2.30	
		2.40					2.40	
-2.5	Firm black organic (peaty) SILT						2.50	
			Sample taken for Atterburg					
							2.70	
		2.80					2.80	
	Loose to mediumd ense fine grey silty SAND						2.90	
-3.0							3.00	
							3.10	
							3.20	
							3.30	
							3.40	
-3.5			*Sample taken for PSD*					
							3.60	
							3.70	
							3.80	
							3.90	
-4.0							4.00	
							4.10	
							4.20	
							4.30	
							4.40	
-4.5		4.50					4.50	
							4.60	
	Soft grey SILT		*Sample taken for Triaxial Perm*					
							4.80	
5.0		5.00					4.90	
	Window Sample End						5.00	

GRAPHIC PROBE RECORD

0 10 20 30 40

COMMENTS:
WaterSeepage @ 2.80m

INSTALLATIONS:
Standpipe installed to 5.00m with cover

REPORT NO.	WINDOW SAMPLE RECORD SHEETS	IGSL Limited
CONTRACT: Glaslough Monaghan		PROBE NO.: WS2
		SHEET: 1 of 1
CLIENT: Monaghan County Council	PROBE WEIGHT (DPL,DPM,DPH): DPH	DATE STARTED: 09.02.09
	HAMMER MASS (kg): 50	DATE COMPLETED: 09.02.09
ENGINEER:	FALL HEIGHT (mm): 500	PROBED BY:
	90° CONE DIAMETER (mm): 43.7	LOGGED BY: IOD
LOCATION: Glaslough Monaghan	SPECIFIC WORK PER BLOW (kJ/m^2): 167	GROUND LEVEL (mOD):
	BLOWS COUNTED OVER (mm): 100	DATUM:

DOWNHOLE DEPTH (m)	SOIL DESCRIPTION	Depth (m)	WINDOW SAMPLE DEPTH	RECOVERY (%)	BLOWCOUNT	ELEVATION (mOD)	DEPTH (m)	BLOWS PER 100mm
0.0	Topsoil	0.10					0.10	
	MADE GROUND (brown silty clay with occasional bands of grey sand and some fine gravel. Root hairs and fibres noted along with fragments of red brick)						0.20	
							0.30	
							0.40	
-0.5							0.50	
							0.60	
							0.70	
							0.80	
							0.90	
-1.0							1.00	
							1.10	
							1.20	
							1.30	
							1.40	
-1.5		1.50					1.50	
	Firm brown very silty sandy CLAY with occasional fine gravel (possible made ground)						1.60	
							1.70	
							1.80	
							1.90	
-2.0							2.00	
		2.10					2.10	
	Soft brown slightly sandy SILT with some black organic flecks						2.20	
							2.30	
							Sample taken for Triaxial Perm	
-2.5							2.50	
		2.60					2.60	
							2.70	
	Loose grey silty fine SAND	2.80					2.80	
							2.90	
-3.0	Soft brown PEAT	3.00					3.00	
							3.10	
	Loose grey silty fine SAND						3.20	
		3.30					3.30	
							3.40	
-3.5	Soft to firm brown PEAT						3.50	
							3.60	
							3.70	
							3.80	
		3.90					3.90	
-4.0	Medium dense brown silty / clayey SAND (possible very sandy silty Clay)						4.00	
							4.10	
							4.20	
							4.30	
							4.40	
-4.5							4.50	
							4.60	
							4.70	
							4.80	
5.0		5.00					4.90	
	Window Sample End						5.00	

GRAPHIC PROBE RECORD

0 10 20 30 40

COMMENTS:
Water ingress @ 2.10m

INSTALLATIONS:
Standpipe installed to 5.00m with cover

Summary of Classification Tests

BS1377:Part 2:1990, clauses 3.2, 4.3, 5.3 & 5.4

BH/TP No.	Sample No.	Depth (m)	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	<425µm %	Preparation	Description	Classification
WS1		2.50	D	66	155	49	106	92	WS	Grey organic slightly sandy CLAY	C E
WS1		4.75	D	21	31	17	14	100	WS	Grey slightly sandy CLAY	C L
WS2		2.50	D	46.3	83	35	48	93	WS	Greyish brown slightly sandy slightly gravelly CLAY	C V

Notes: NAT - tested as received WS - Wet sieved (425µm) NP - Non Plastic

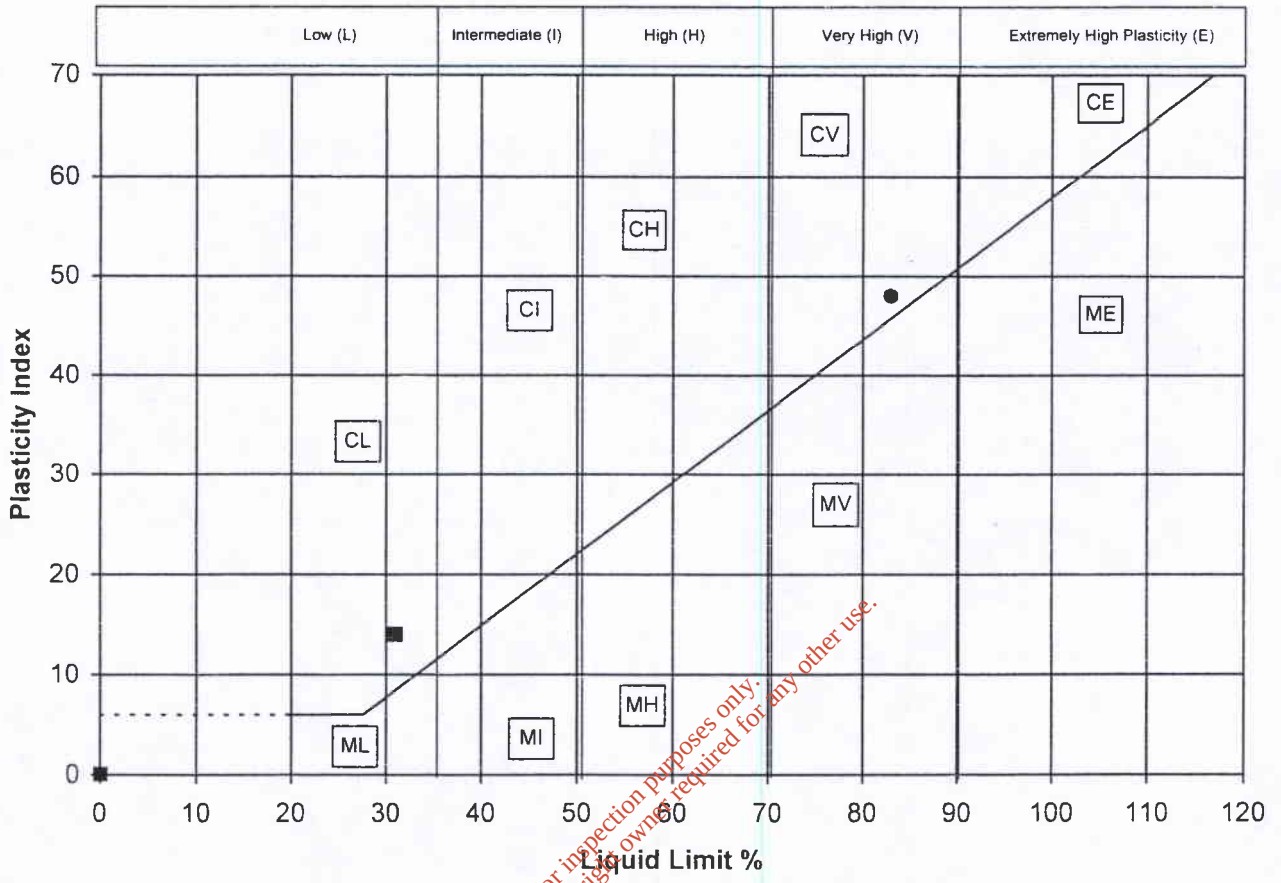
IGSL	Contract	GLASLOUGH MONAGHAN		Contract No. 14038
	Issued By	Date		Page
		02/04/2009		of

Plasticity Chart - Summary of Liquid & Plastic Limit Tests

BS1377:Part 2:1990, clauses 3.2, 4 & 5

Chart in accordance with BS5930:1999, fig.18

Contract No. 14038 Contract: GLASLOUGH MONAGHAN



Code	BH/TP	Sample	Depth (m)	MC%	LL%	PL%	PI%	%<425µm	Description
▲	WS1		2.50	66	155	49	106	92	Grey organic slightly sandy CLAY
■	WS1		4.75	21	31	17	14	100	Grey slightly sandy CLAY
●	WS2		2.50	46.3	83	35	48	93	Greyish brown slightly sandy slightly gravelly CLAY
◆									
×									
+									
△									
□									
○									
◇									
▲									
■									
●									
◆									
×									
+									
△									

NP denotes specimen is non-plastic.

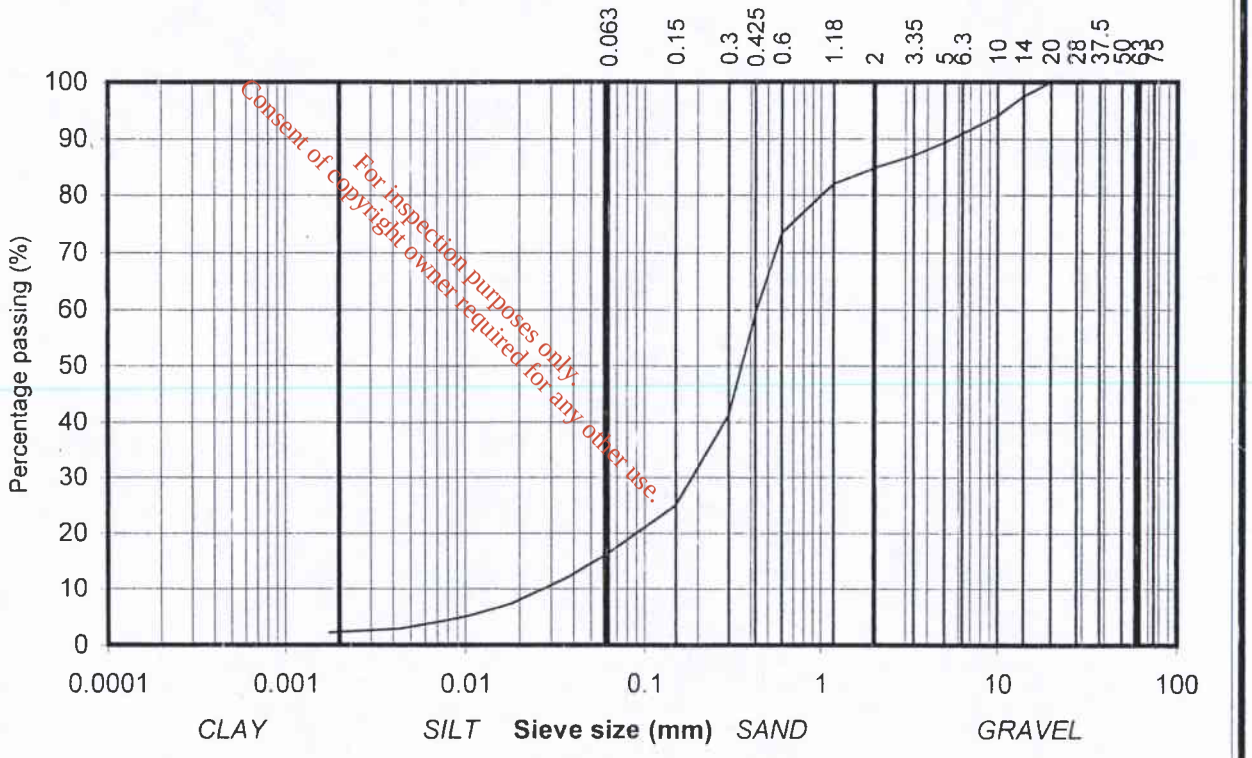
	Issued by	Date			Page
IGSL		02/04/2009			

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	100	
28	100	
20	100	
14	97	
10	94	
6.3	91	
5	89	
3.35	87	
2	85	SAND
1.18	82	
0.6	73	
0.425	59	
0.3	41	
0.15	25	
0.063	16	SILT/CLAY
0.038	12	
0.027	10	
0.018	7	
0.010	5	
0.007	4	
0.004	3	
0.002	2	

Contract No: 14038
Contract: GLASLOUGH MONAGHAN
BH/TP No: WS1
SAMPLE No.: 0 SAMPLE TYPE: D
DEPTH (m): 3.50
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Grey clayey/silty, gravelly, SAND



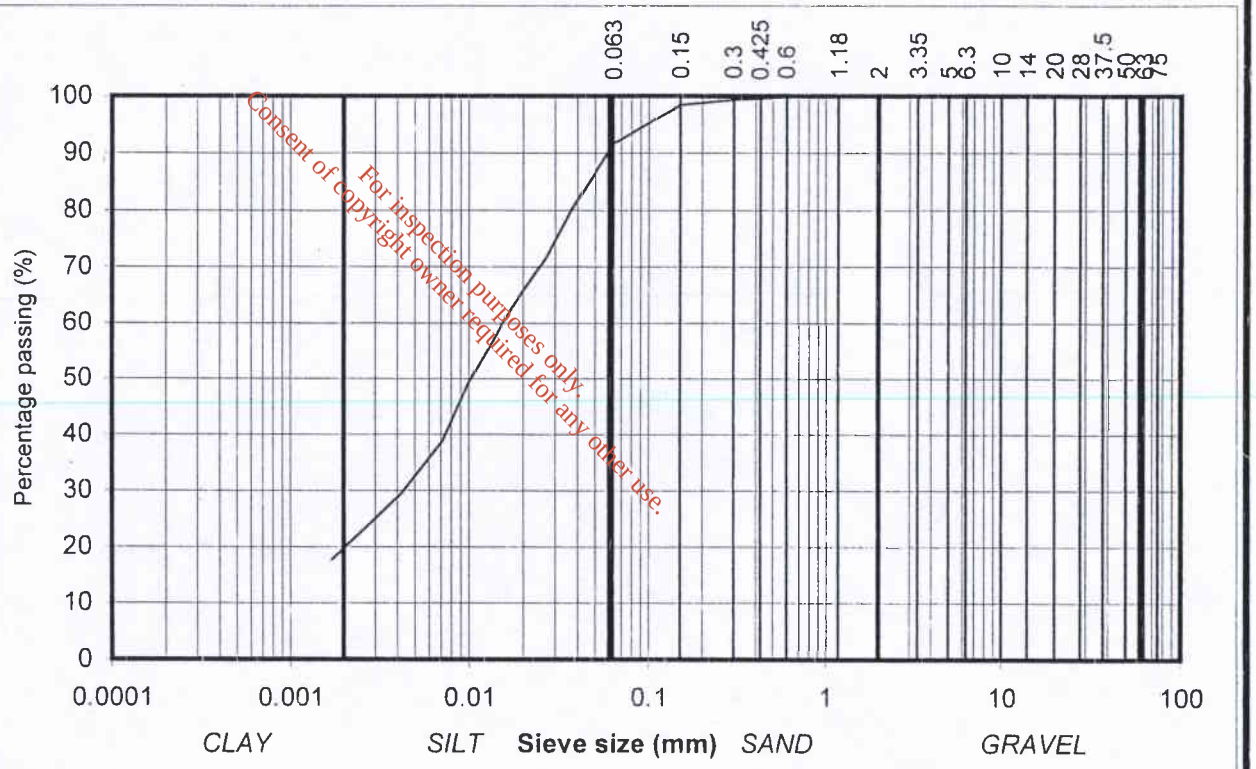
IGSL	Issued By	Date:			Page no:
	D Connolly	02/04/2009			1 of 1

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	
50	100	
37.5	100	
28	100	
20	100	
14	100	GRAVEL
10	100	
6.3	100	
5	100	
3.35	100	
2	100	
1.18	100	
0.6	100	
0.425	100	SAND
0.3	99	
0.15	98	
0.063	92	
0.037	80	
0.027	71	
0.017	63	
0.010	49	SILT/CLAY
0.007	39	
0.004	29	
0.002	18	

Contract No: 14038
Contract: GLASLOUGH MONAGHAN
BH/TP No: WS1
SAMPLE No.: 0 SAMPLE TYPE: D
DEPTH (m): 4.75
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Grey slightly sandy, CLAY



IGSL	Issued By	Date:			Page no:
	D Connolly	02/04/2009			1 of 1

IGSL LIMITED, UNIT F, M7 BUSINESS PARK, NAAS, CO.KILDARE. PSD V3.1 12.01

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	100	
28	100	
20	100	
14	100	
10	100	
6.3	100	
5	100	
3.35	100	
2	98	SAND
1.18	97	
0.6	94	
0.425	93	
0.3	90	
0.15	80	
0.063	65	SILT/CLAY
0.038	52	
0.027	45	
0.018	38	
0.010	30	
0.007	26	
0.004	19	
0.002	12	

Contract No: 14038

Contract: GLASLOUGH MONAGHAN

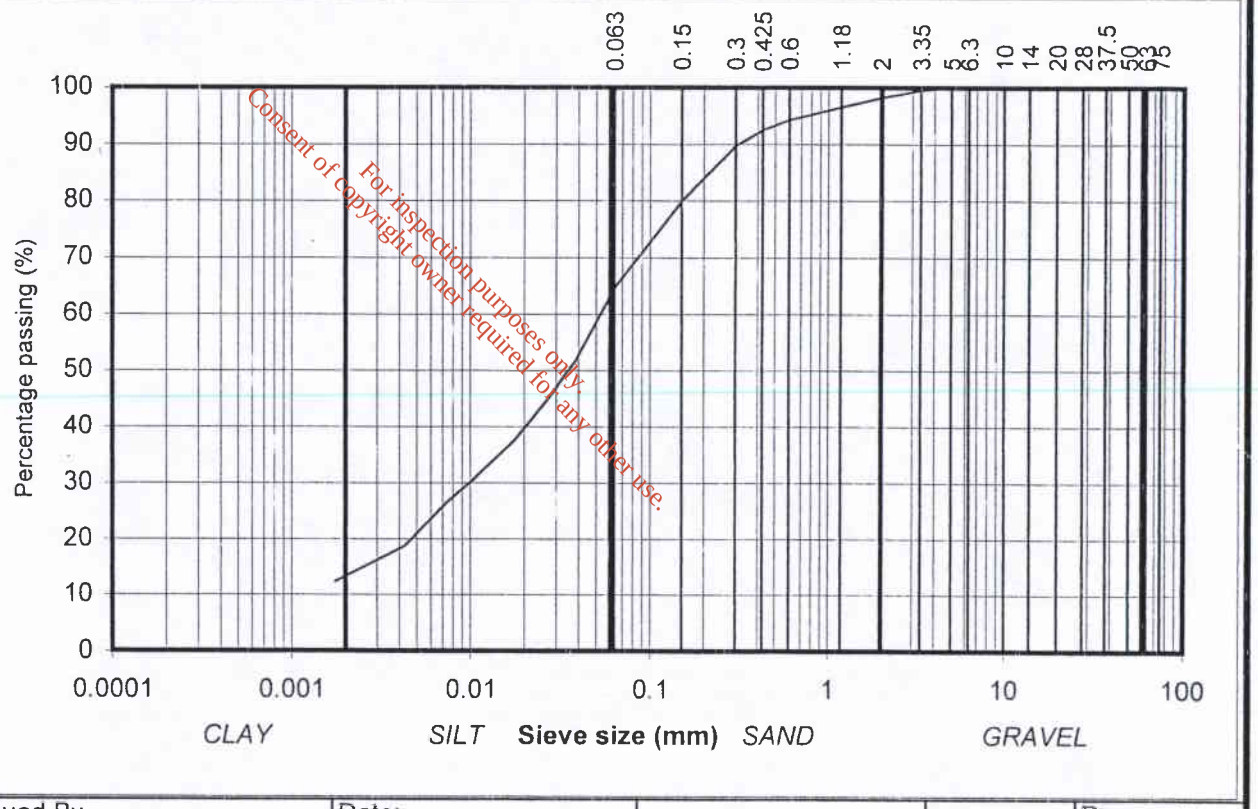
BH/TP No: WS2

SAMPLE No.: 0 SAMPLE TYPE: D

DEPTH (m): 2.50

TEST METHOD: Wet sieve and hydrometer

DESCRIPTION: Greenish brown slightly sandy, slightly gravelly, CLAY



IGSL	Issued By	Date:			Page no:
	D Connolly	02/04/2009			1 of 1

Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Contract: Glaslough Monaghan — Contract No. 14038

Location: WS1 @1.5m — Sample No.

Method of Preparation: Undisturbed

Description: Greenish brown mottled grey slightly sandy CLAY with organic material

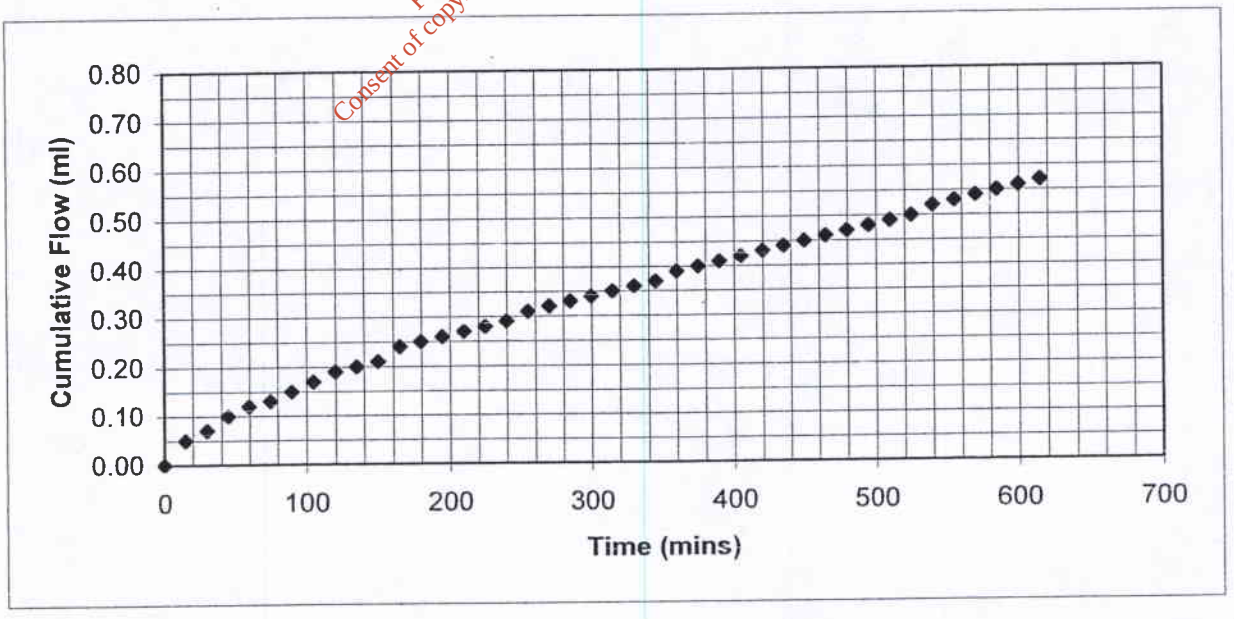
Specimen Dimensions: Height (mm) 76.0 Diameter (mm) 38.0

Specimen Conditions:	Initial	Final
Moisture Content (%)	55	53
Bulk Density (Mg/m^3)	1.72	1.72
Dry Density (Mg/m^3)	1.11	1.12

Saturation Stage
Method: Cell & back pressure stages — Final *B* Value: 0.95
Duration of Stage (days): 2

Consolidation Stage
Cell Pressure (kPa) 350 — Back Pressure (kPa) 300
Volume change (ml) 2.61 — Duration of Stage (days) 3

Permeability Stage
Mean Effective Stress 45 — Hydraulic gradient 13
Coefficient of Permeability (m/s) 8.03E-09 — Duration of Stage (days) 1



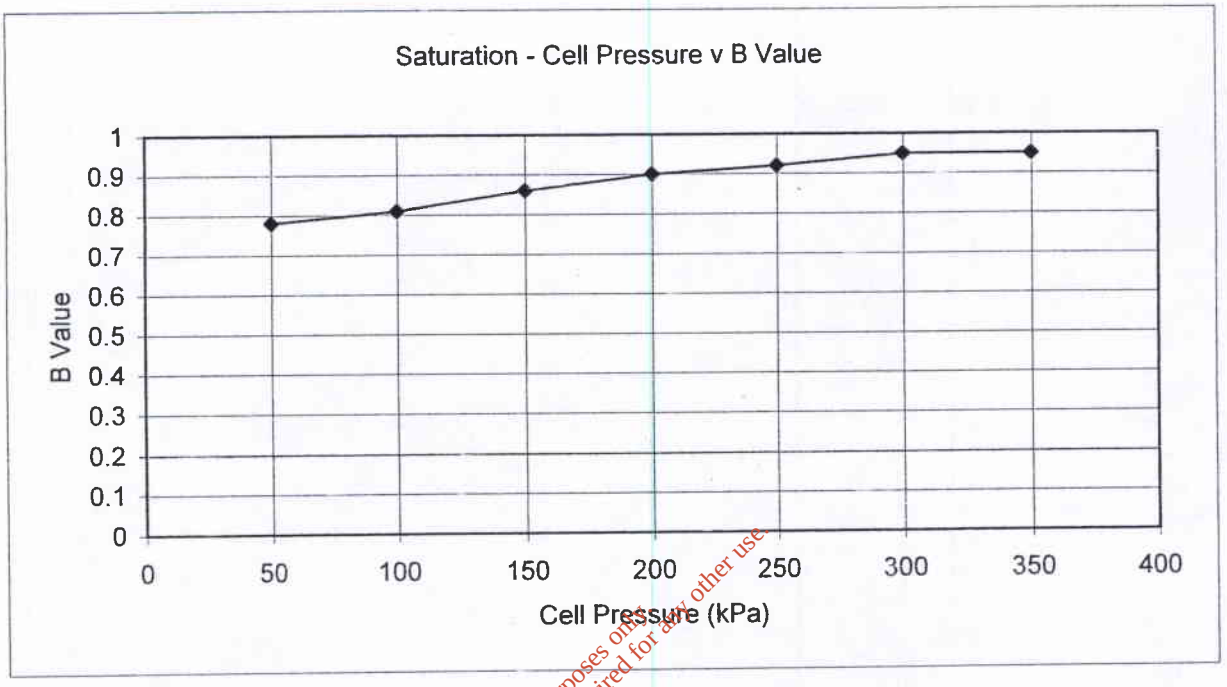
Total duration of test (days) 6

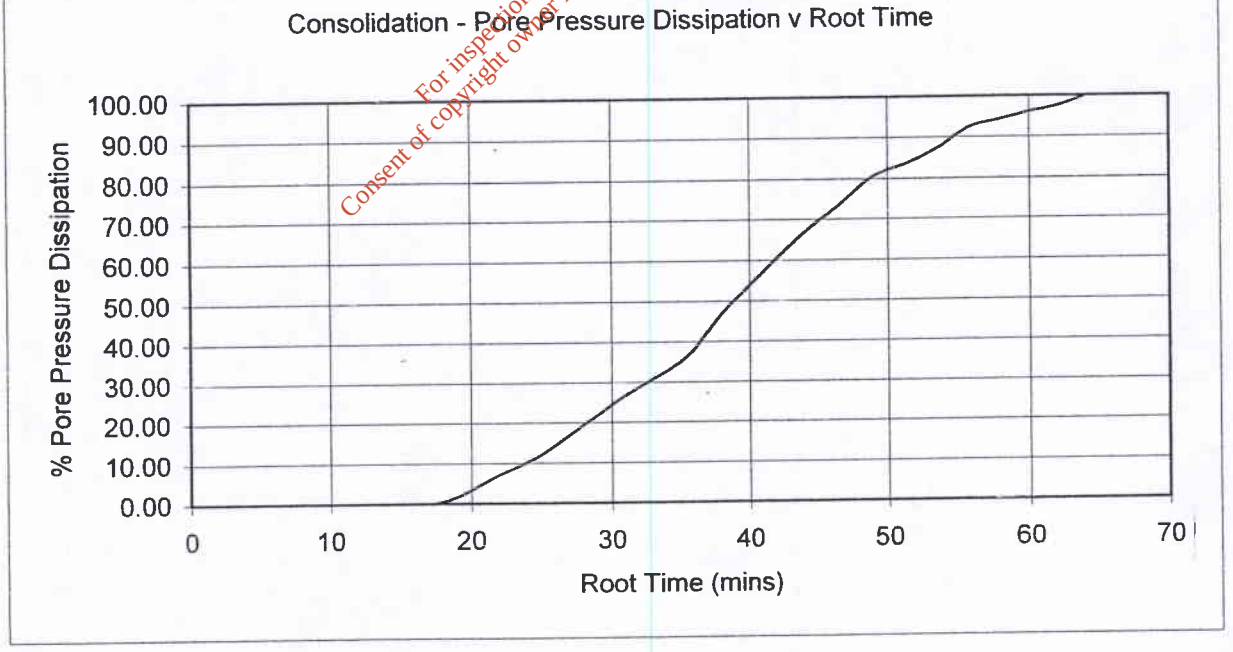
Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Location: WS1 @1.5m

Sample No.





Compiled by	Date	Checked by	Date	
	01/04/09			Page 2 of 2

Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

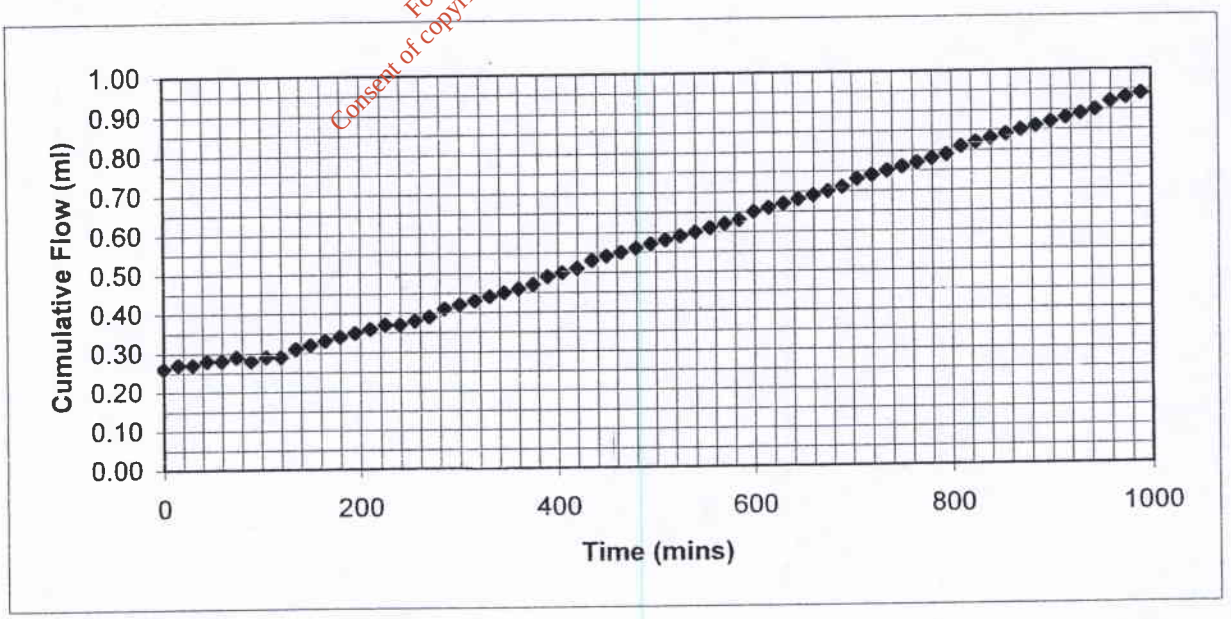
Contract:	Glaslough Monaghan	Contract No.	14038
Location:	WS1 @ 4.75m	Sample No.	
Method of Preparation:	Undisturbed		
Description:	Grey sandy CLAY		
Specimen Dimensions:	Height (mm) 76.0	Diameter (mm)	38.0

Specimen Conditions:	Initial	Final
Moisture Content (%)	21	20
Bulk Density (Mg/m^3)	2.07	2.06
Dry Density (Mg/m^3)	1.70	1.71

Saturation Stage
Method: Cell & back pressure stages — Final *B* Value: 0.95
Duration of Stage (days): 3

Consolidation Stage
Cell Pressure (kPa) 350 — Back Pressure (kPa) 300
Volume change (ml) 0.32 — Duration of Stage (days) 1

Permeability Stage
Mean Effective Stress 45 — Hydraulic gradient 13
Coefficient of Permeability (m/s) 8.12E-09 — Duration of Stage (days) 1



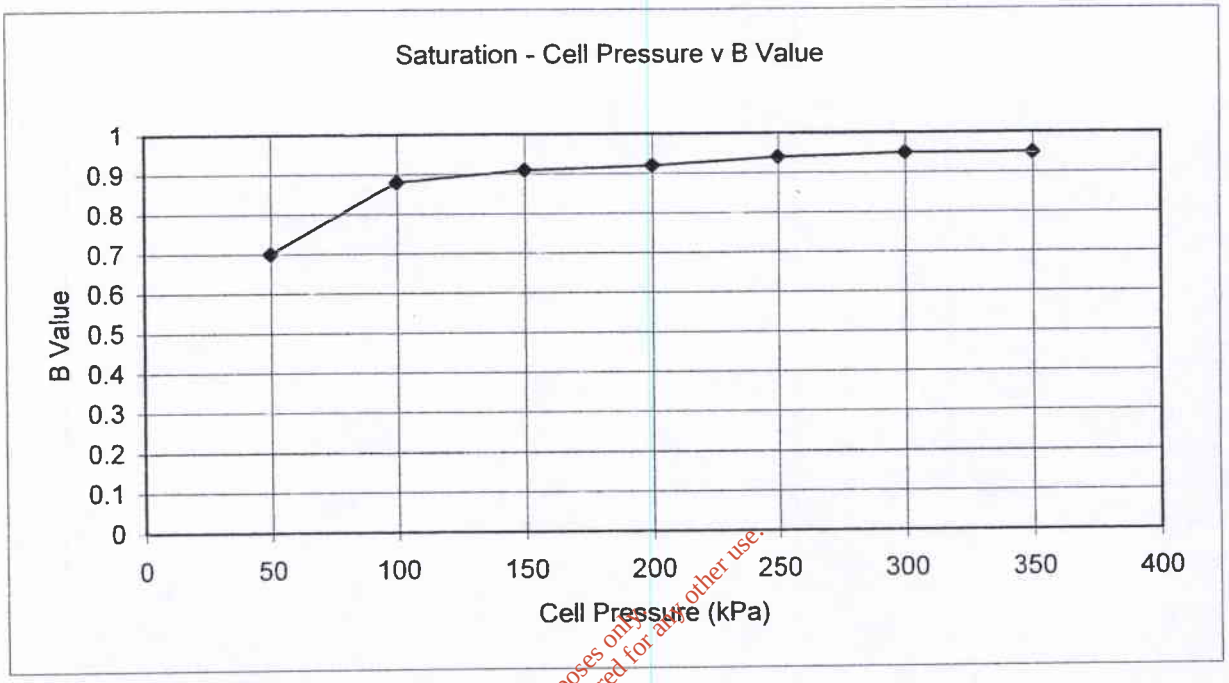
Total duration of test (days) 5

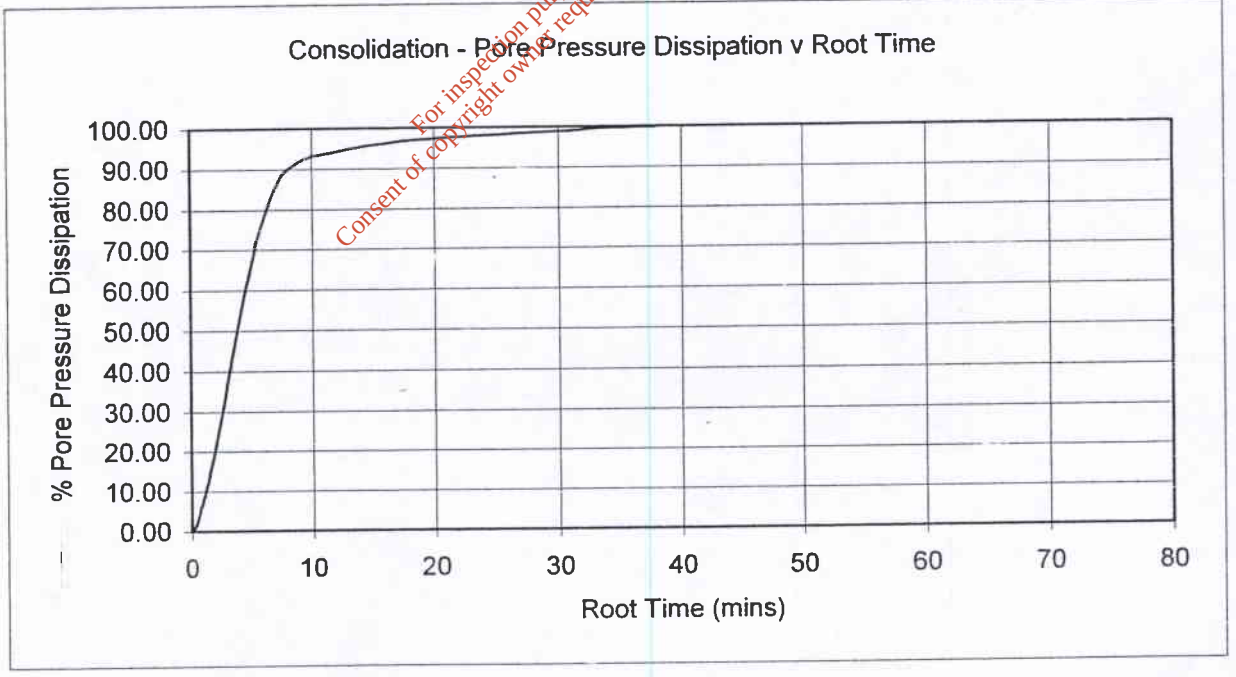
Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Location: WS1 @ 4.75m

Sample No.





Compiled by	Date	Checked by	Date	
	31/03/09			Page 2 of 2

Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Contract: Glaslough Monaghan — Contract No. 14038

Location: WS2 @ 2.6m — Sample No.

Method of Preparation: Undisturbed

Description: Greenish brown mottled grey CLAY with organic material

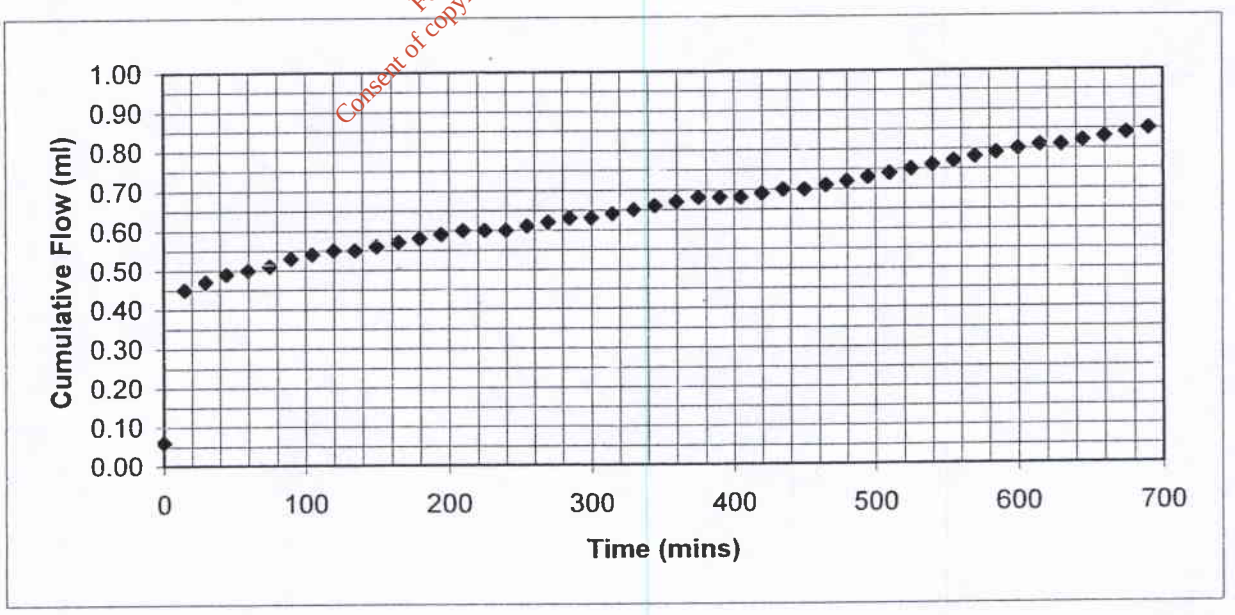
Specimen Dimensions: Height (mm) 76.0 Diameter (mm) 38.0

Specimen Conditions:	Initial	Final
Moisture Content (%)	44	39
Bulk Density (Mg/m^3)	1.70	1.69
Dry Density (Mg/m^3)	1.18	1.22

Saturation Stage
Method: Cell & back pressure stages — Final *B* Value: 0.96
Duration of Stage (days): 3

Consolidation Stage
Cell Pressure (kPa) 350 — Back Pressure (kPa) 300
Volume change (ml) 2.82 — Duration of Stage (days) 4

Permeability Stage
Mean Effective Stress 45 — Hydraulic gradient 13
Coefficient of Permeability (m/s) 6.30E-09 — Duration of Stage (days) 1

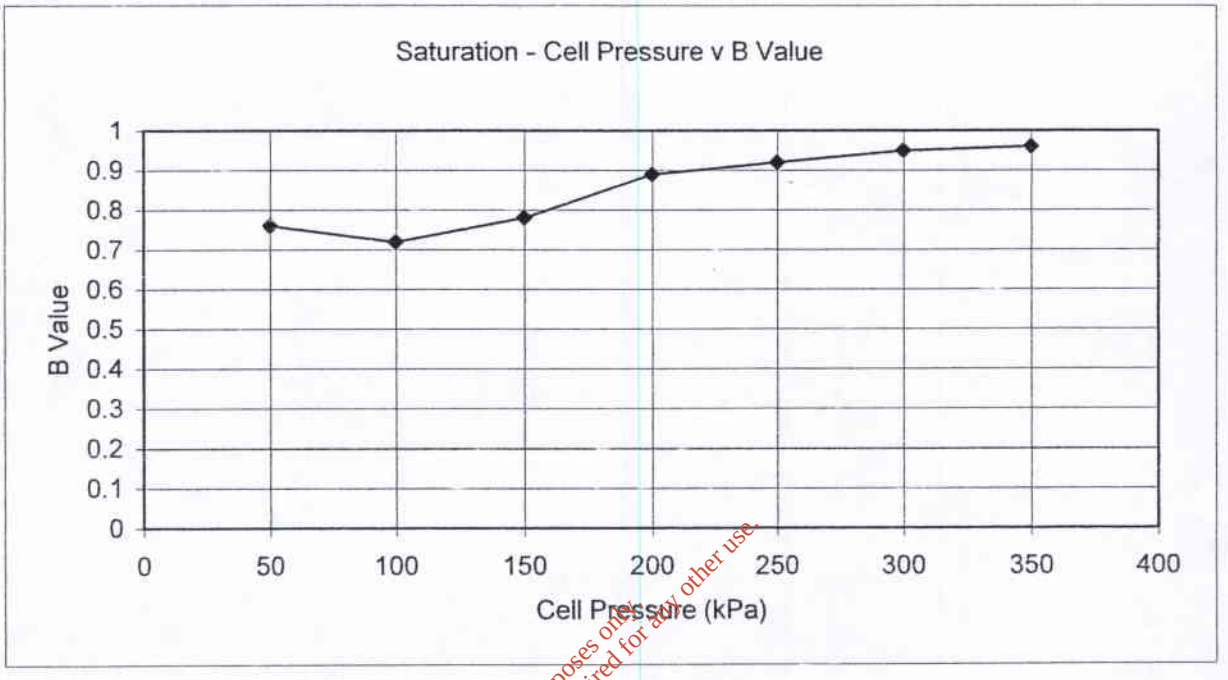


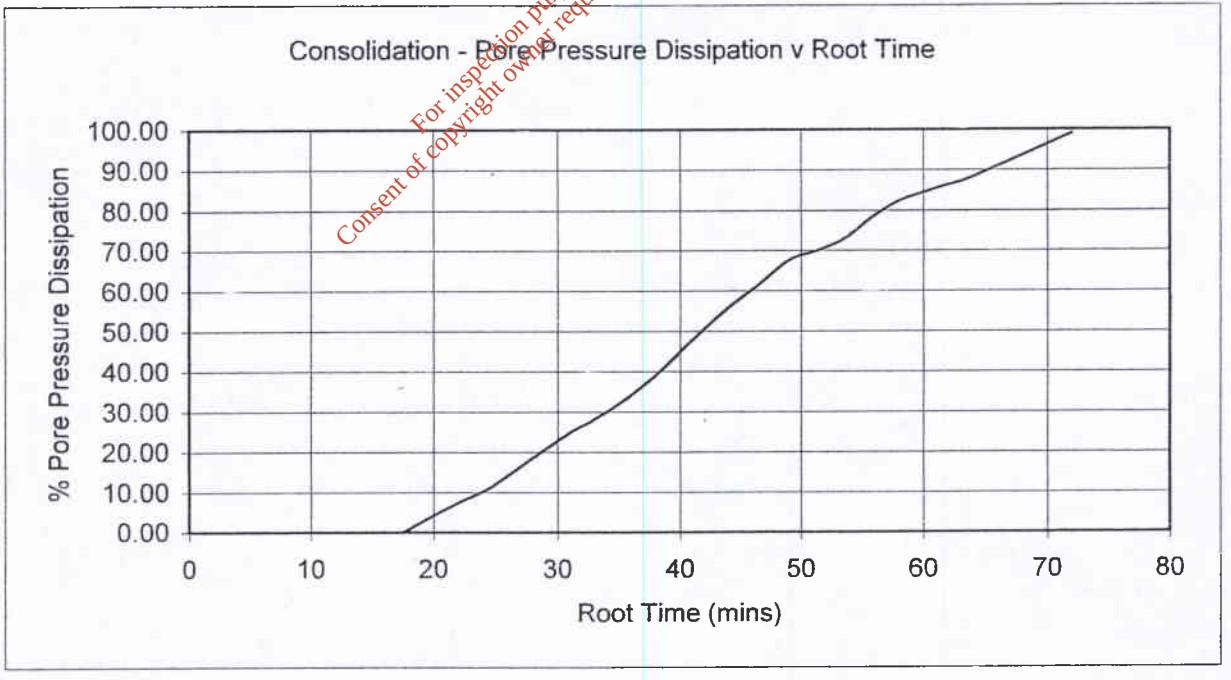
Total duration of test (days) 8

Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Location: WS2 @ 2.6m Sample No.





Compiled by	Date	Checked by	Date	
	31/03/09			Page 2 of 2

TEST REPORT: Moisture Content & Plastic/Liquid Limits

BS1377:Part 2:1990, clauses 3.2, 4.3, 4.4, 5.3 & 5.4

BH	Sample No.	Depth (m)	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	<425µm %	Preparation	Description	Classification
	2/9/RW1		B	46	74	45	29	96	WS	Greyish brown slightly sandy slightly gravely SILT with roots	M V
	2/9/RW2		B	130	128	90	38	86	WS	Dark brown slightly sandy slightly gravely SILT with many roots	M E

IGSL Ltd.

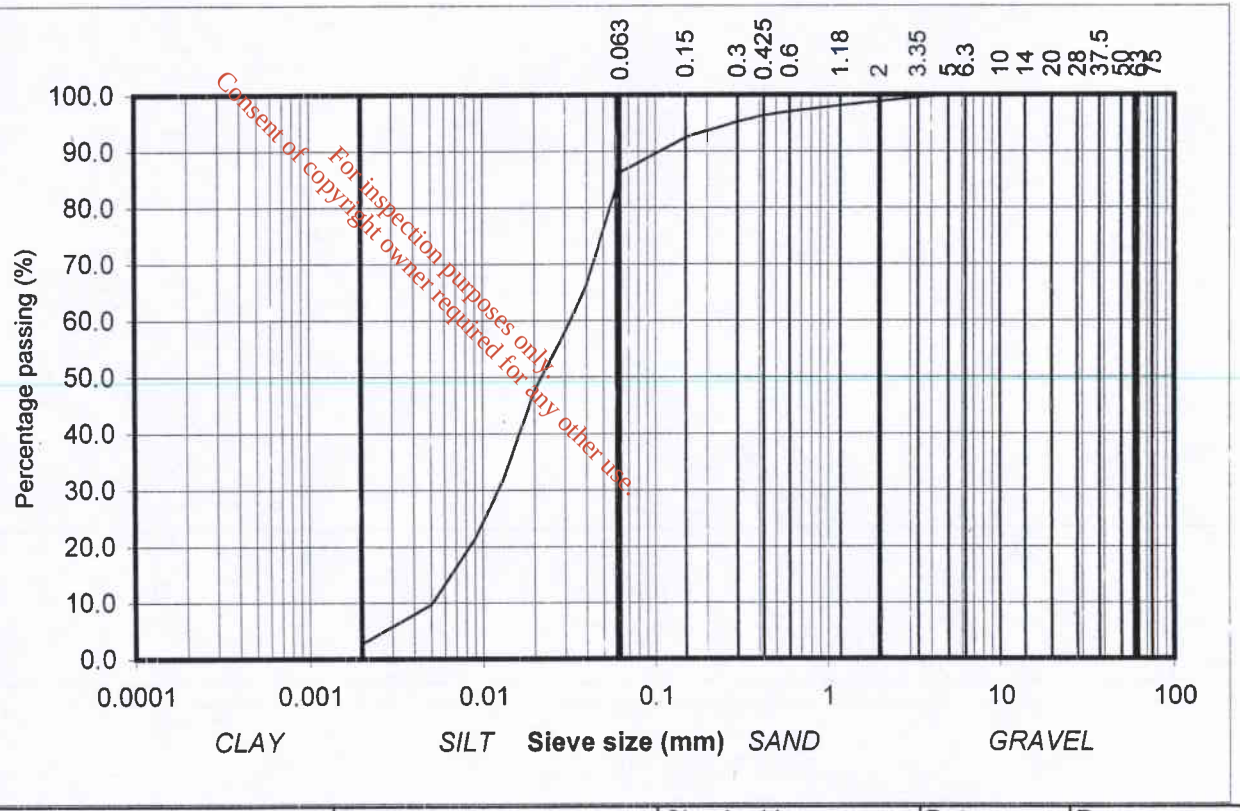
Contract				Contract No.
Glaslough				11093
Compiled By	Date	Approved By	Date	Page
J Barrett	22/09/05			1 of 1

Determination of Particle Size Distribution

BS1377:Part 2:1990 , clauses 9.2 & 9.5

particle size	% passing	
75	100.0	COBBLES
63	100.0	
50	100.0	
37.5	100.0	
28	100.0	
20	100.0	GRAVEL
14	100.0	
10	100.0	
6.3	100.0	
5	100.0	
3.35	99.5	–
2	98.8	
1.18	98.1	
0.6	97.0	SAND
0.425	96.3	
0.3	95.3	
0.15	92.5	
0.063	86.3	
0.04	66.2	
0.03	58.0	
0.02	47.6	SILT/CLAY
0.013	31.7	
0.009	21.4	
0.005	9.6	
0.002	2.7	

Contract No: 11093
Contract: Glaslough
BH/TP No: Adjacent to River
SAMPLE No.: 2/9RW1
DEPTH (m):
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Greyish brown slightly sandy, slightly gravelly, SILT



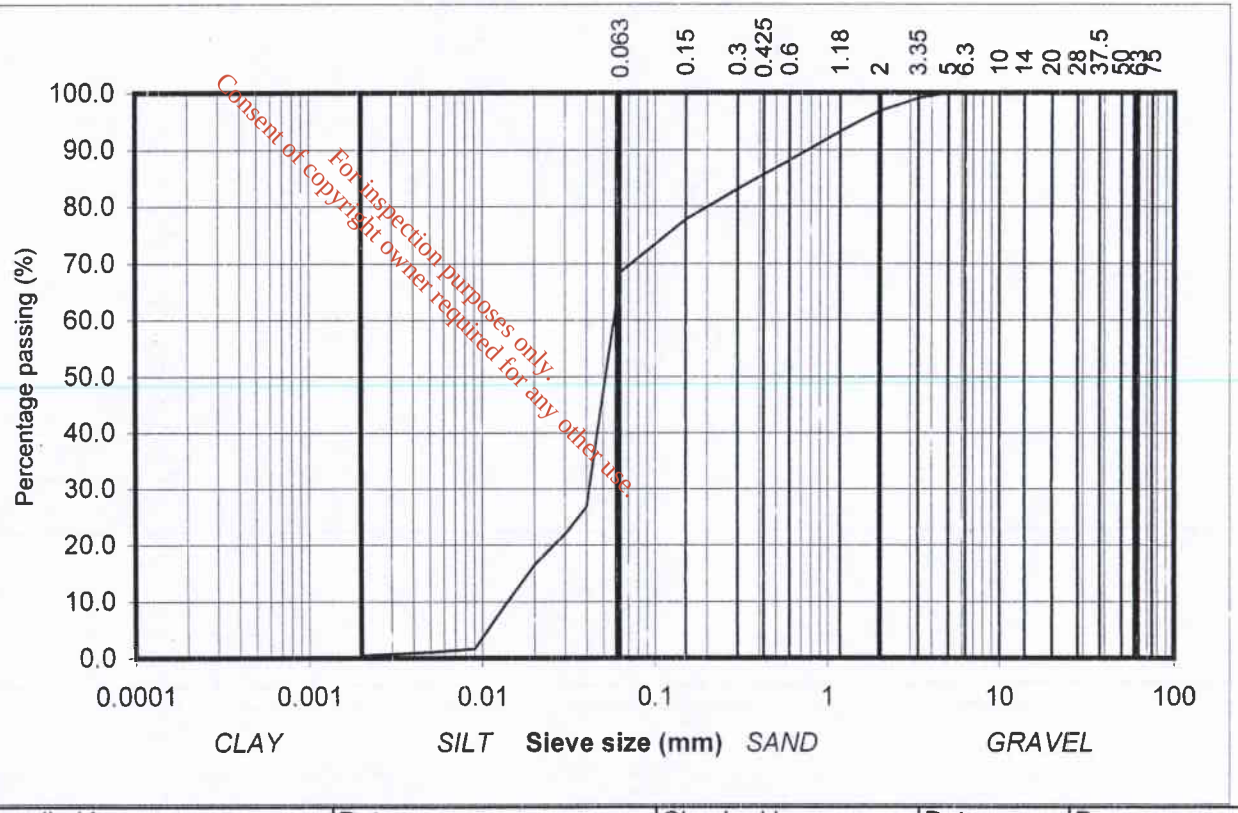
IGSL	Compiled by:	Date:	Checked by:	Date:	Page no:
	J Barrett	22/09/2005			1 of 1

Determination of Particle Size Distribution

BS1377:Part 2:1990 , clauses 9.2 & 9.5

particle size	% passing	
75	100.0	COBBLES
63	100.0	
50	100.0	
37.5	100.0	
28	100.0	
20	100.0	
14	100.0	GRAVEL
10	100.0	
6.3	100.0	
5	100.0	
3.35	99.1	
2	96.8	
1.18	93.3	
0.6	88.2	
0.425	85.7	SAND
0.3	83.1	
0.15	77.7	
0.063	68.5	
0.04	26.8	
0.03	21.9	
0.02	16.4	
0.013	8.8	SILT/CLAY
0.009	1.6	
0.005	1.1	
0.002	0.5	

Contract No: 11093
Contract: Glaslough
BH/TP No: Wooded Area
SAMPLE No.: 2/9RW2
DEPTH (m):
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Dark brown slightly sandy, slightly gravelly, SILT



IGSL

Compiled by:	Date:	Checked by:	Date:	Page no:
J Barrett	22/09/2005			1 of 1

IGSL LIMITED, UNIT F, M7 BUSINESS PARK, NAAS, CO.KILDARE. PSD V3.1 12.01

Test Report

Report No.

MOISTURE CONDITION VALUE (MCV)

Contract: Glaslough Contract No: 11093

Locaton	Sample No.	Depth of Sample	Sample Description	Moisture Content %	MCV	Material <20mm
Adjacent to river	2/9/RW1		Greyish brown slightly sandy slightly gravelly SILT with roots	46	7.1	100
Wooded area	2/9/RW2		Dark brown slightly sandy slightly gravely SILT with many roots	130	<1	100

Compiled by | Date | Checked by | Date | Page 1 of 1

Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Contract:	Glaslough	Contract No.	11093
Location:	Adjacent to river	Sample No.	2/9/RW1

Method of Preparation: Remoulded 2.5kg rammer at as received moisture content

Description: Greyish brown slightly sandy slightly gravelly SILT with fine roots

Specimen Dimensions: Height (mm) 104.1 Diameter (mm) 99.8

Specimen Conditions:	Initial	Final
Moisture Content (%)	43	43
Bulk Density (Mg/m^3)	1.73	1.78
Dry Density (Mg/m^3)	1.21	1.24

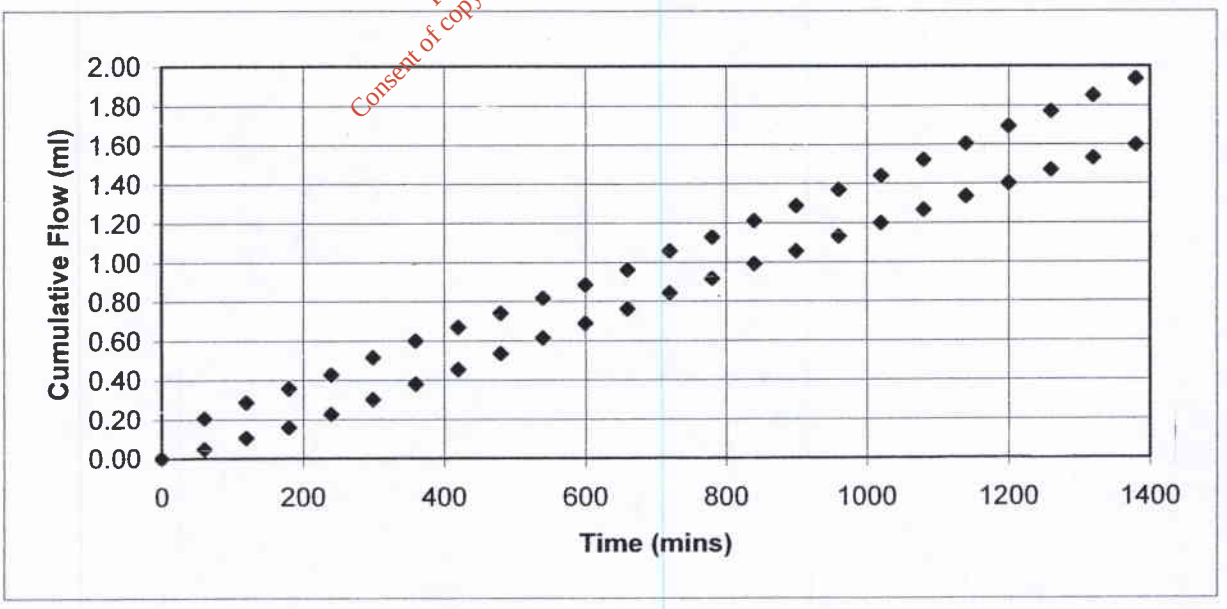
Saturation Stage
Method: Cell & back pressure stages Final *B* Value: 0.99
Duration of Stage (days): 6

Consolidation Stage

Cell Pressure (kPa)	400	Back Pressure (kPa)	300
Volume change (ml)	22.85	Duration of Stage (days)	6

Permeability Stage

Mean Effective Stress	85	Hydraulic gradient	29
Coefficient of Permeability (m/s)	9.07E-11	Duration of Stage (days)	1



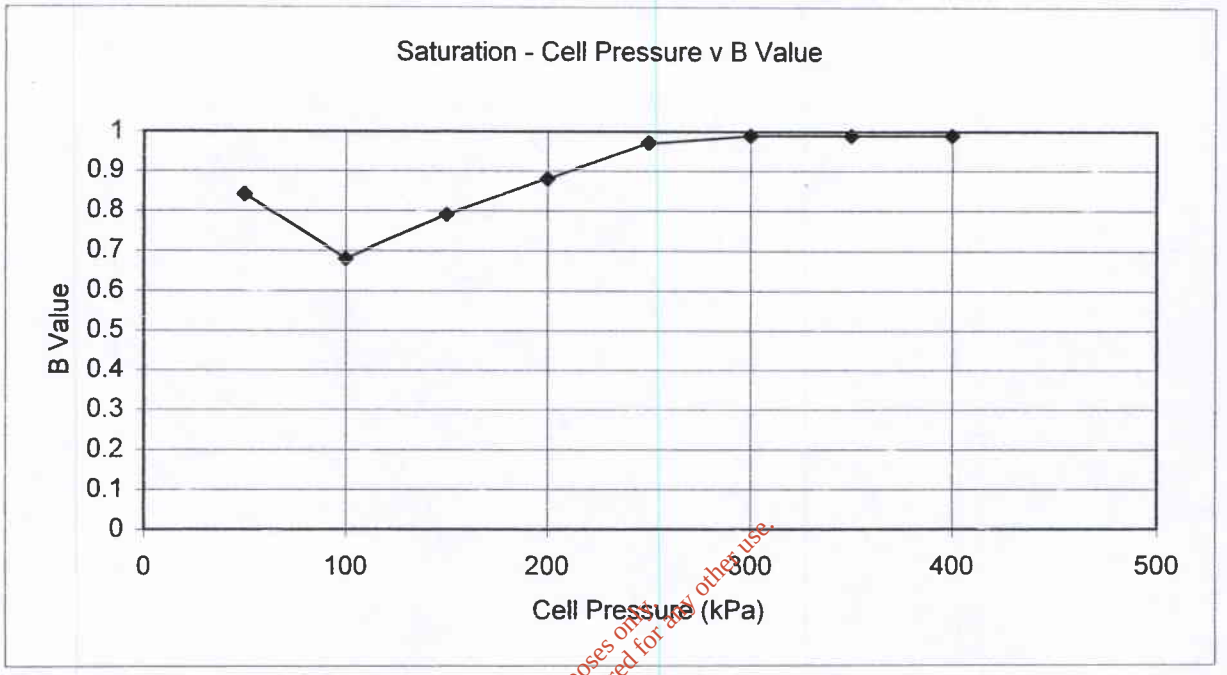
Total duration of test (days) 13

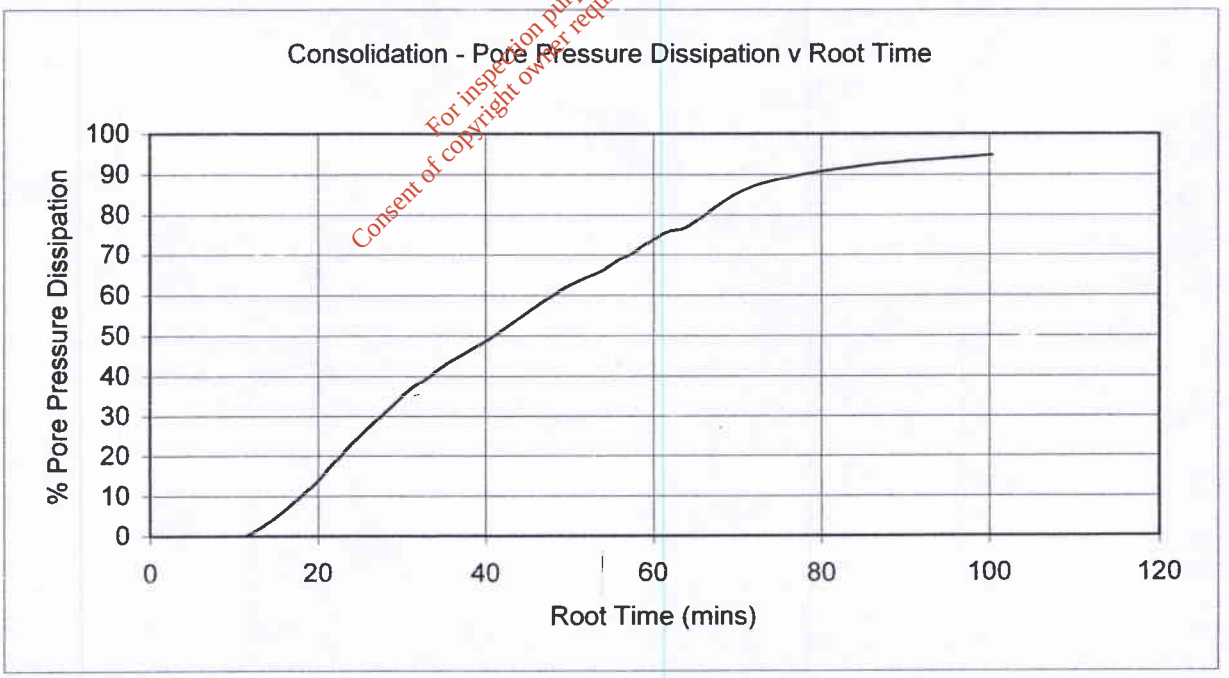
Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Location: Adjacent to river

Sample No. 2/9/RW1





Compiled by	Date	Checked by	Date	
J Barrett	22/09/05			Page 2 of 2

Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Contract: Glaslough — Contract No. 11093

Location: Wooded Area — Sample No. 2/9/RW2

Method of Preparation: Remoulded 2.5kg rammer at as received moisture content

Description: Dark brown slightly sandy slightly gravelly organic SILT with many roots

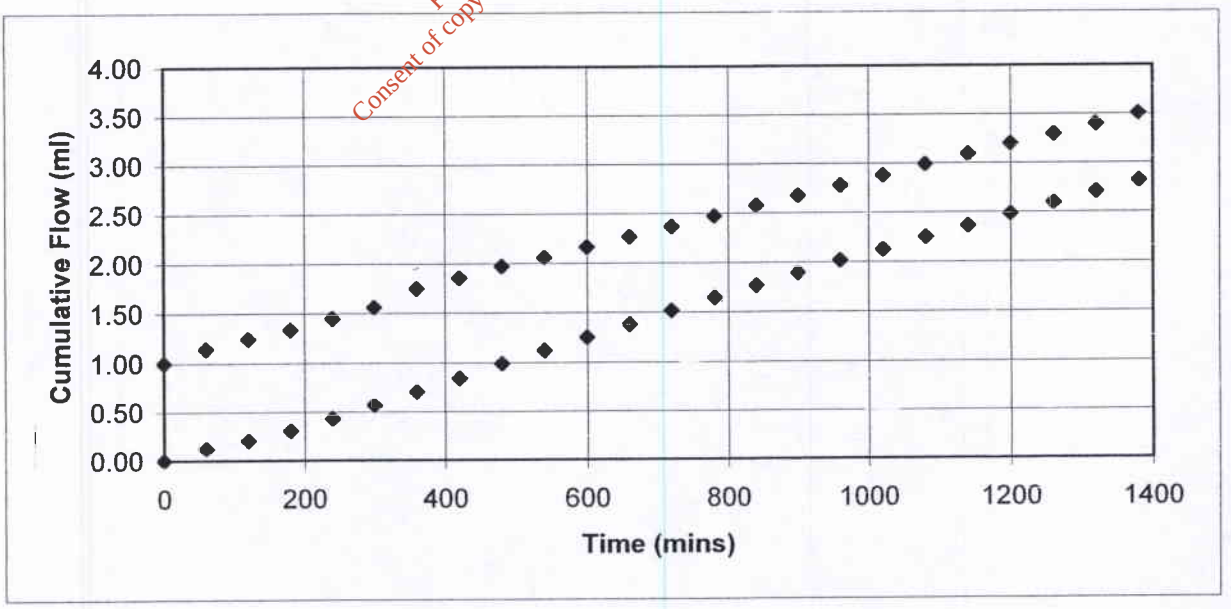
Specimen Dimensions: Height (mm) 104.1 Diameter (mm) 100.2

Specimen Conditions:	Initial	Final
Moisture Content (%)	196	170
Bulk Density (Mg/m^3)	1.38	1.34
Dry Density (Mg/m^3)	0.47	0.79

Saturation Stage
Method: Cell & back pressure stages — Final *B* Value: 0.99
Duration of Stage (days): 3

Consolidation Stage
Cell Pressure (kPa) 400 — Back Pressure (kPa) 300
Volume change (ml) 85.02 — Duration of Stage (days) 6

Permeability Stage
Mean Effective Stress 85 — Hydraulic gradient 29
Coefficient of Permeability (m/s) 1.41E-10 — Duration of Stage (days) 1



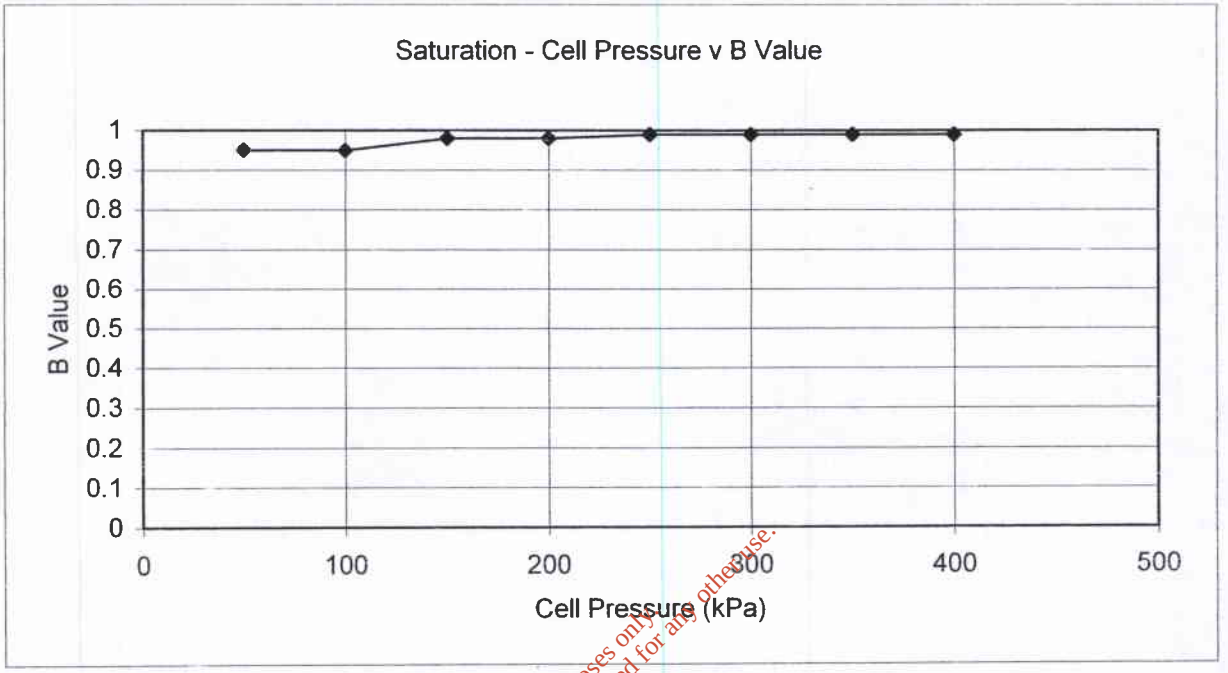
Total duration of test (days) 10

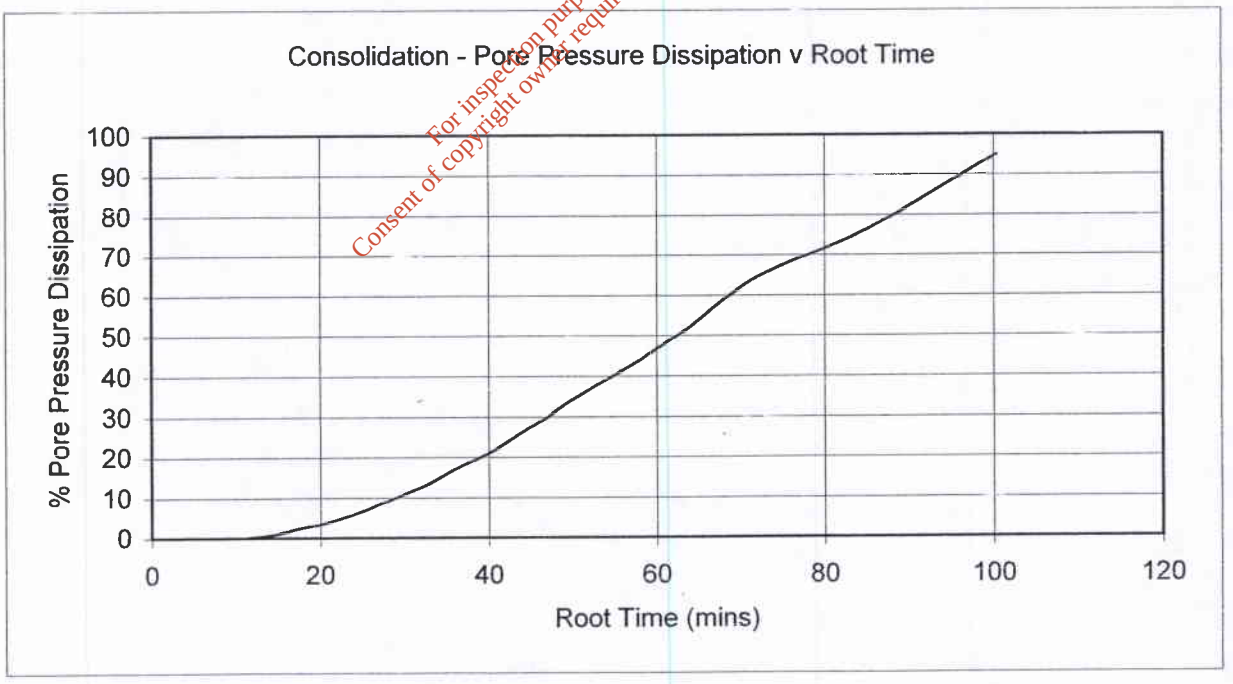
Determination of Permeability in a Triaxial Cell

BS1377:Part 6:1990, Clause 6

Location: Wooded Area

Sample No. 2/9/RW2



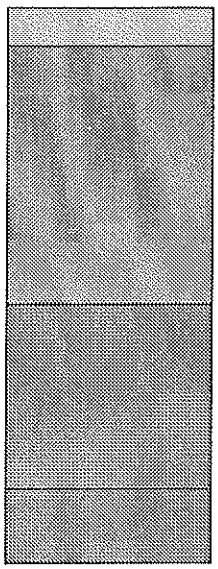


Compiled by	Date	Checked by	Date	
J Barrett	22/09/05			Page 2 of 2

GLASLOUGH SEWERAGE IMPROVEMENT SCHEME: PROPOSED SITE NO. 2 ON LESLIE ESTATE PROPERTY: EXAMINATION OF SITE NO 2:

TRIAL HOLES (20/10/98) :

TRIAL HOLE NO. 1: (see also photos attached).



200 mm VEGETATION / TREE STUMPS

FINE CLAY – TOPSOIL

1.6m

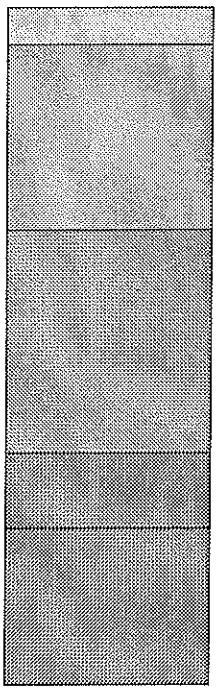
BLUE / GREY CLAY

2.5m WATER ENTERING PIT

2.8m TRENCH DEPTH

COMMENTS:
TRENCH DEPTH 2.8m
SIDES OF TRENCH BEGINNING TO SUBSIDE.
WATER ENTERING AT 2.5m.

TRIAL HOLE NO. 2: (see also photos attached).



200mm VEGETATION / TREE STUMPS

FINE CLAY – TOPSOIL

1.3m

BLUE / GREY CLAY

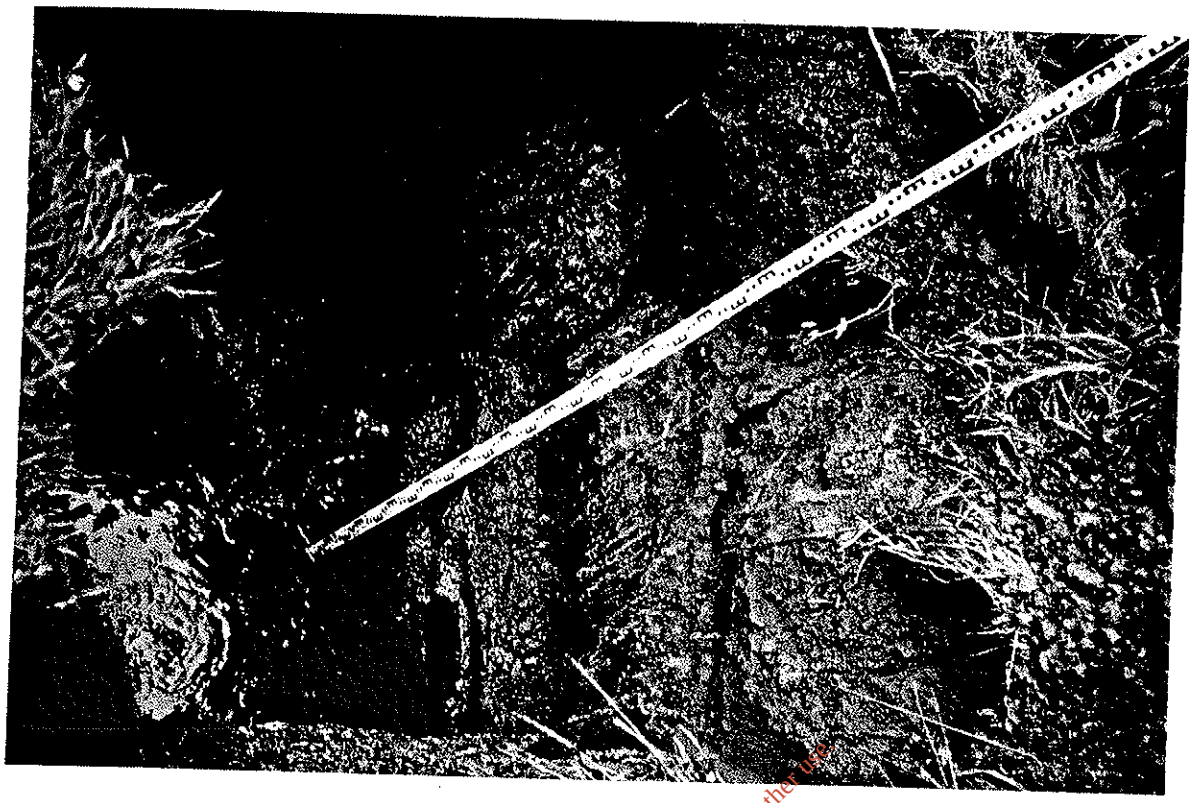
2.6m

2.9m WATER ENTERING PIT

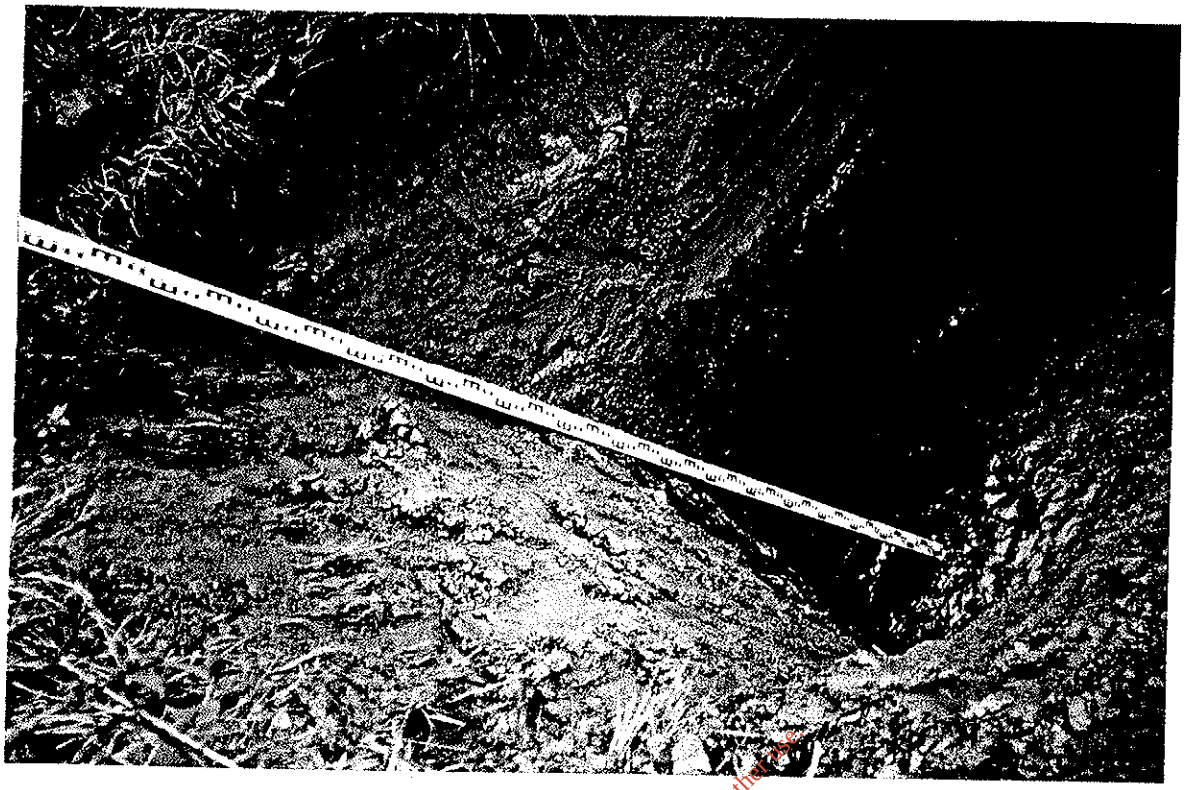
SHALE / GRAVEL LAYER STONES RANGING IN SIZES FROM 25mm - 100mm

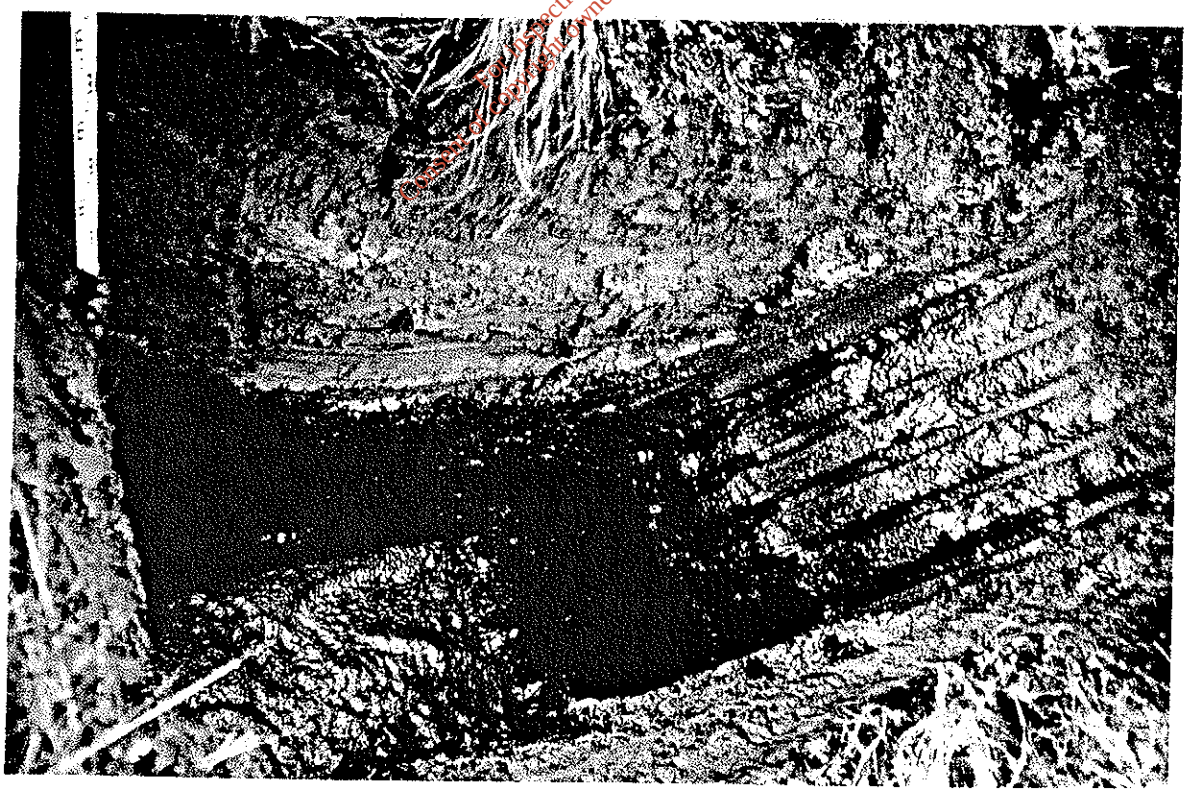
3.7m TRENCH DEPTH

COMMENTS:
TRENCH DEPTH 3.7m
TRENCH SUBSIDING
WATER ENTERING AT 2.6m



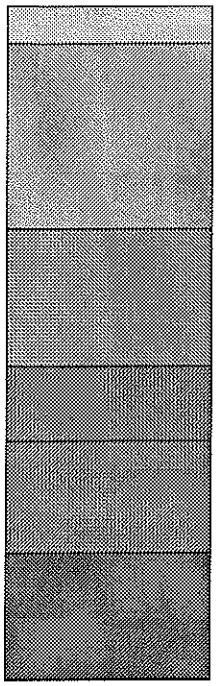
TRIAL HOLE NO. 1. (20/10/98)





TRIAL HOLE NO. 2. (20/10/98)

TRIAL HOLE NO. 3: (see also photos attached).



100mm VEGETATION / TREE STUMPS

FINE CLAY – TOPSOIL

1.2m

BLUE / GREY CLAY

1.8m

2.7m WATER ENTERING PIT

LAYER OF GRAVEL /SHALE RANGING IN SIZES FROM 25mm - 100mm

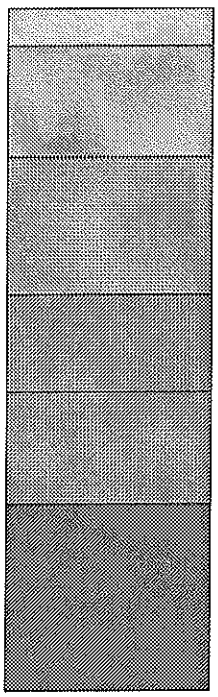
3.2m

LAYER OF BOULDER CLAY

3.5m TRENCH DEPTH

COMMENTS:
TRENCH DEPTH 3.5m
TRENCH SUBSIDING AT GRAVEL LAYER
WATER ENTERING AT 2.7m

TRIAL HOLE NO. 4: (see also photos attached).



200mm VEGETATION / TREE STUMPS

FINE CLAY – TOPSOIL

0.6m

BLUE / GREY CLAY

1.4m

2.6m WATER ENTERING PIT

LAYER OF GRAVEL /SHALE RANGING IN SIZES FROM 25mm - 100mm

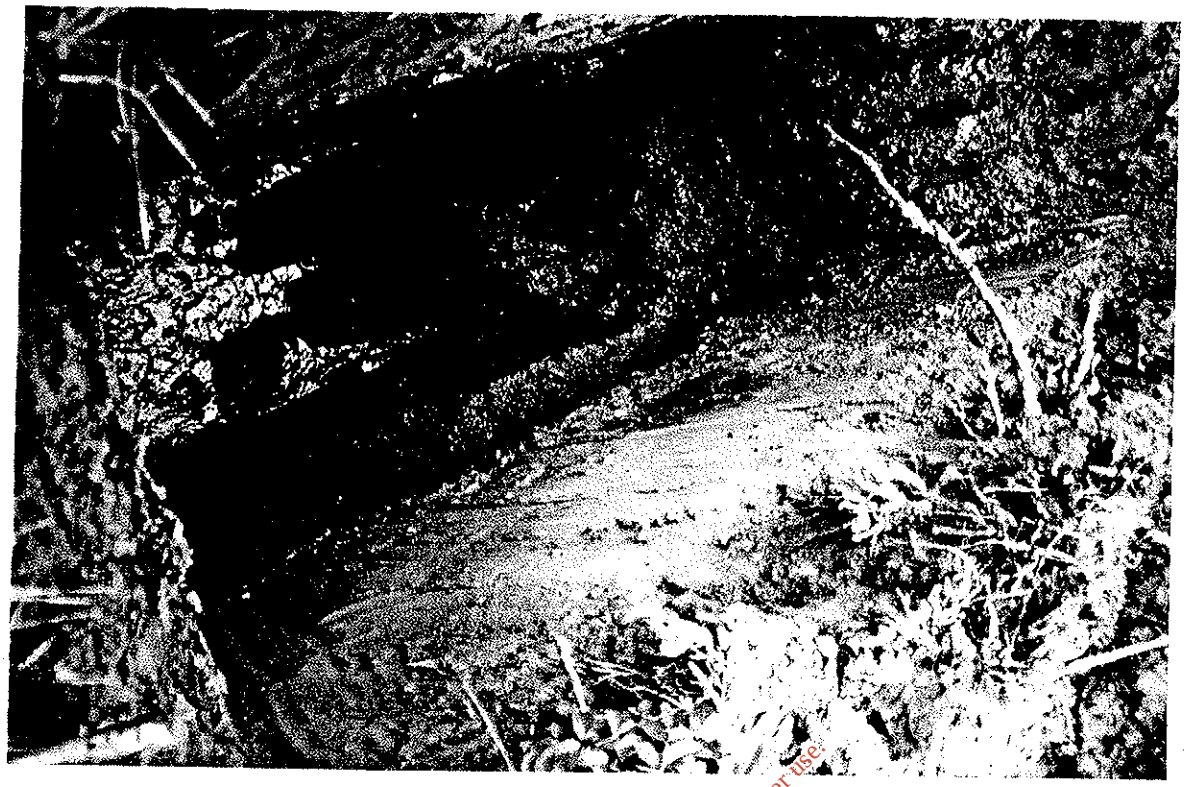
3.1m

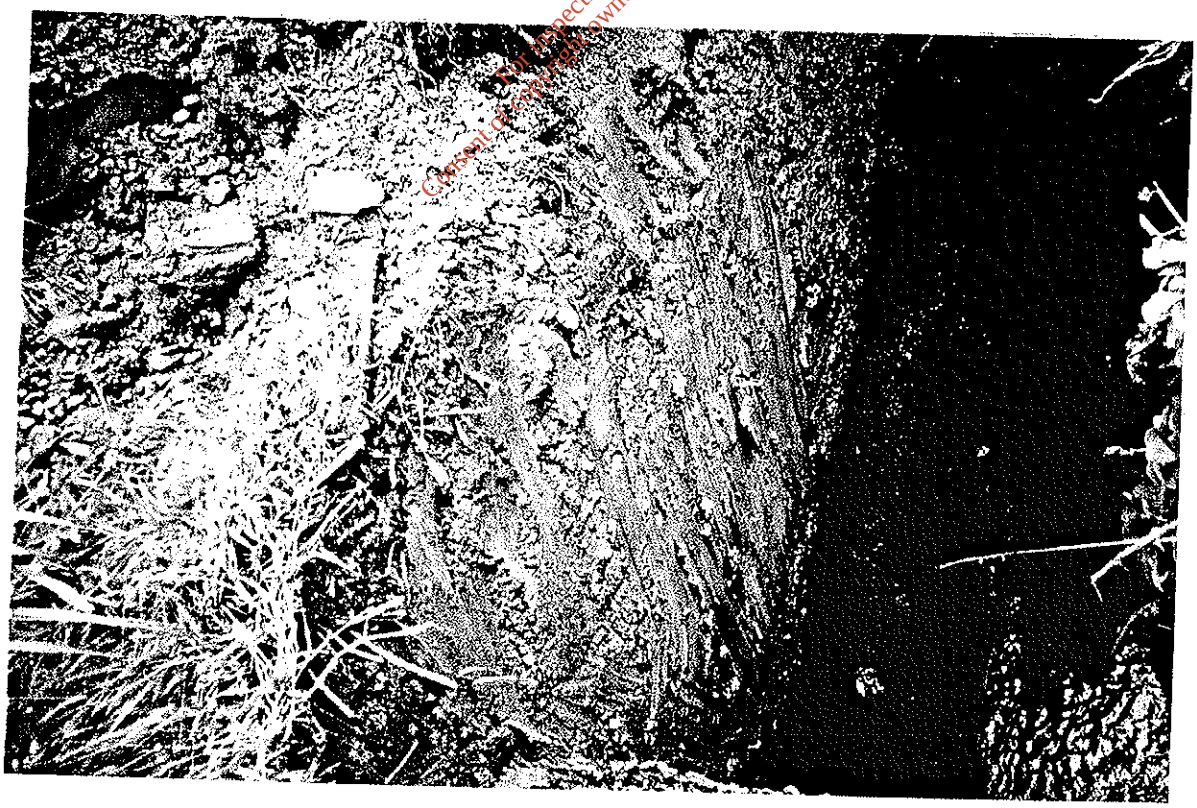
BLUE / GREY CLAY

4m TRENCH DEPTH

COMMENTS:
TRENCH DEPTH 4m
TRENCH SUBSIDING AT GRAVEL LAYER
WATER ENTERING AT 2.6m

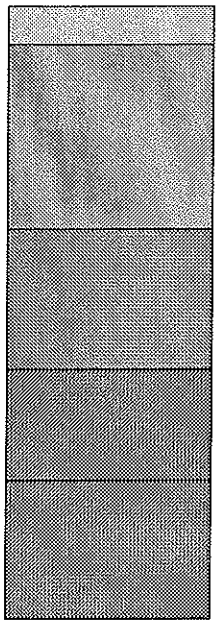
TRIAL HOLE NO. 3. (20/10/98)





TRIAL HOLE NO. 4. (20/10/98)

TRIAL HOLE NO. 5: (see also photos attached).



150mm VEGETATION / TREE STUMPS

FINE CLAY – TOPSOIL

1.3m

BOULDER CLAY

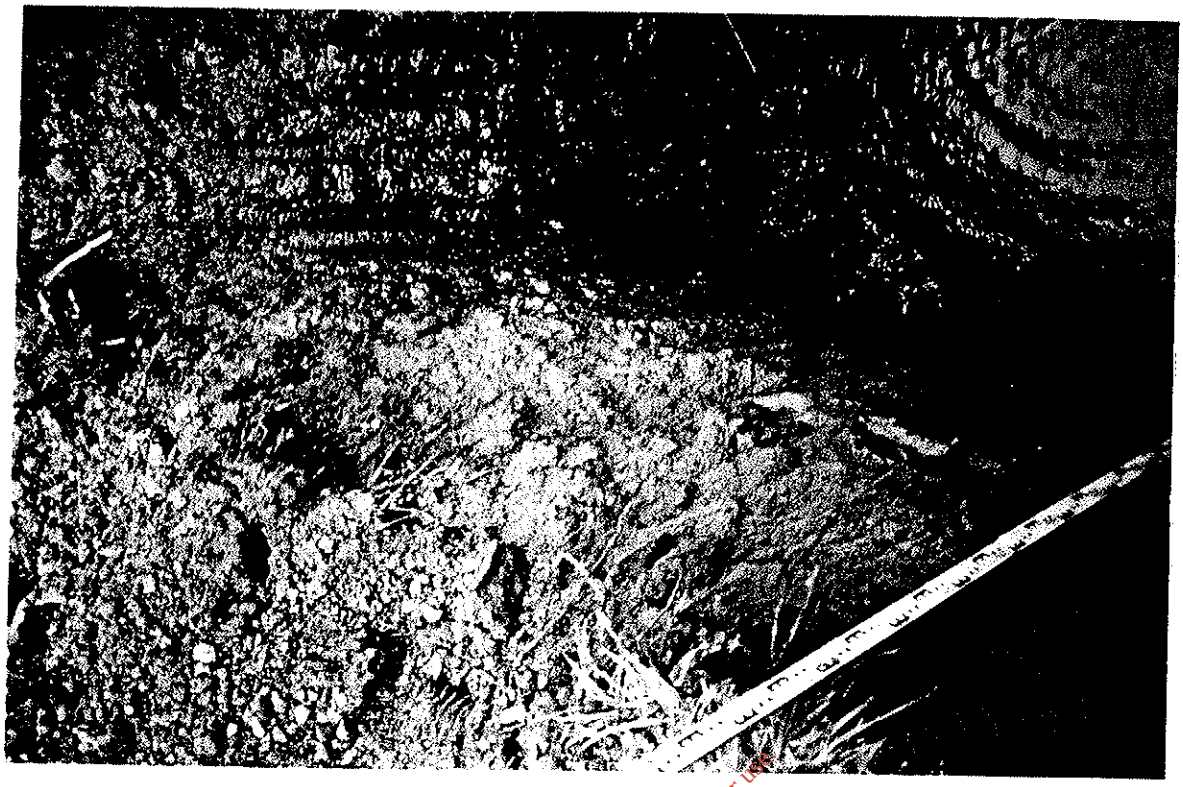
1.9m

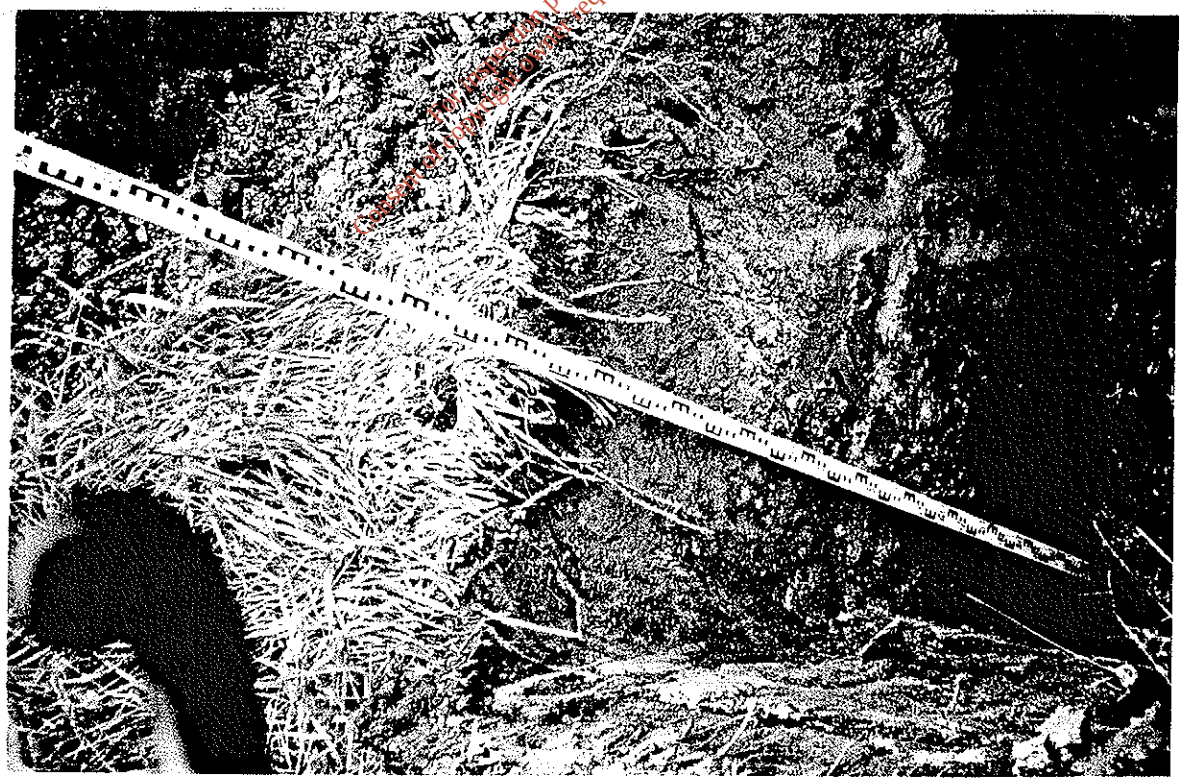
2.4m WATER ENTERING PIT

LAYER OF GRAVEL / SHALE RANGING IN SIZES FROM 25mm - 100mm

3.3m TRENCH DEPTH

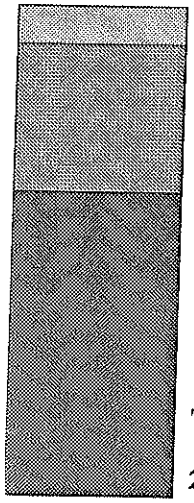
COMMENTS:
TRENCH DEPTH 3.3m
TRENCH SUBSIDING AT GRAVEL LAYER
WATER ENTERING AT 2.4m





TRIAL HOLE NO. 5. (20/10/98)

TRIAL HOLE NO. 6:



350 TOPSOIL

BOULDER CLAY

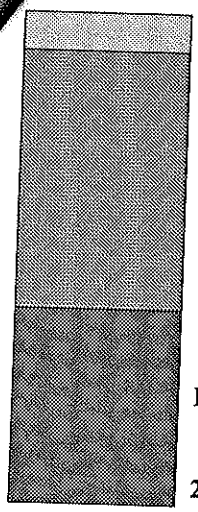
1.0m

GREY GRAVELLY SILTY CLAY / MIMIMUAL WATER ENTERING TRENCH

TRENCH STABLE AT 2.8m

2.8m

RIAL HOLE NO. 7:



350 TOPSOIL

BOULDER CLAY

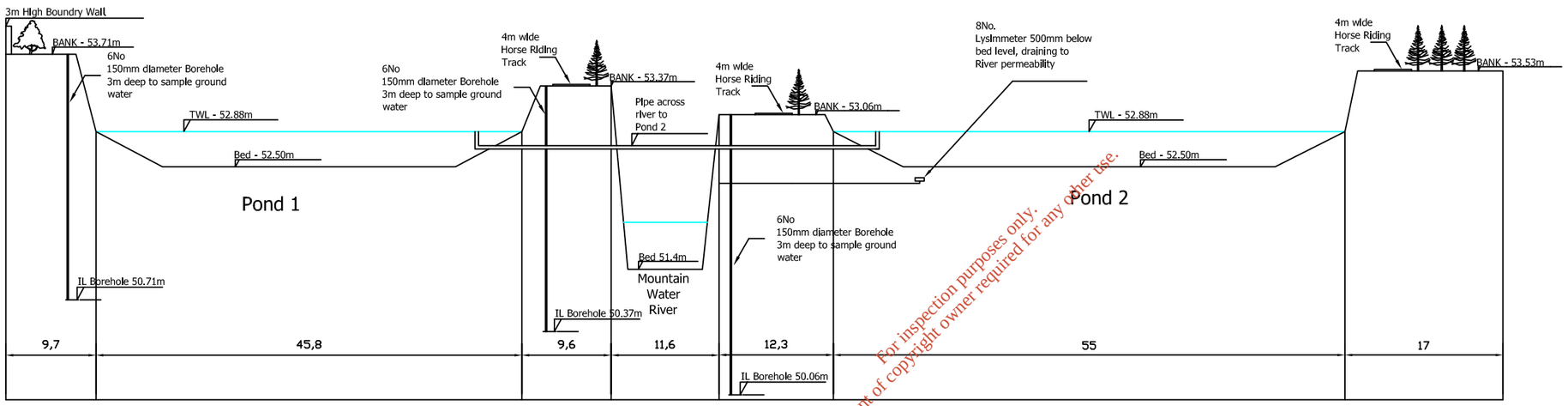
1.5m WATER ENTERING AT 1.5m

RUNNING SAND / TRENCH COLLAPSING

2.2m HARD GRAVEL AT 2.2m

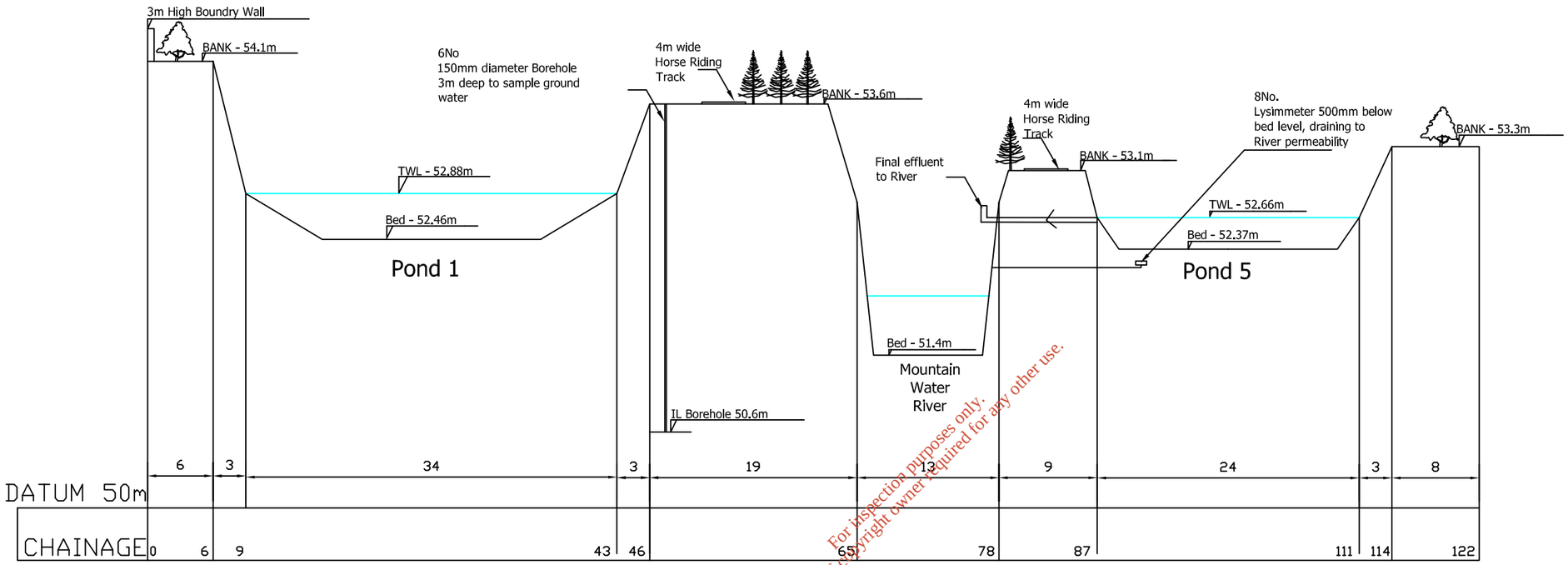
Appendix B

Site Cross Sections



Section through Ponds and River

Glaslough ICW



Section through Ponds and River

Glaslough ICW

GLASLOUGH WASTE WATER TREATMENT WORKS

WASTE WATER DISCHARGE LICENCE APPLICATION

Revised Non Technical Summary

Monaghan County Council
County Offices
The Glen
Co. Monaghan

JUNE 2010

REVISED NON TECHNCIAL SUMMARY

Monaghan County Council is applying to the Environmental Protection Agency for a waste water discharge licence for the Glaslough Wastewater Sewerage Scheme at Glaslough, Co. Monaghan.

The Glaslough Waste Water Treatment Works comprises a gravity sewer network, a pumping station and associated rising main and an Integrated Constructed Wetlands (ICW) for the treatment of municipal sewerage serving Glaslough Village.

The Glaslough pilot ICW (NGR 272027E, 342135N) is part of a unique initiative by the Department of Environment Heritage and Local Government (DoEHLG) in treating liquid waste streams in shallow vegetated ponds and to towards achieving effective social, economic and environmental water management. It is a co-operative undertaking by Monaghan County Council, Castle Leslie, DoEHLG and the University of Edinburgh.

The wetland, as noted above, treats sewage from the village of Glaslough and has a design capacity of 1,750 PE. The current load is approximately 700 PE (based on house counts and business capacity in 2008; some of which is seasonal) and provides tertiary treatment. No pre-treatment is carried out. The influent is pumped directly from the pumping station located on site (272019E, 342128N) to a receiving pond (Sludge Pond). Thereafter the liquid flows by gravity through 5 sequential vegetated ponds through connecting pipes after which the effluent discharges to the Mountain Water River at 272194E 342230N.

The Pumping Station is located adjacent to the Integrated Constructed Wetlands at National Grid Reference 272019E, 342128N. There is one emergency overflow located at the pumping station which is directed to discharge into Pond 2 (NGR 272054, 342128). This emergency overflow was originally designed to discharge to the Mountain Water River just upstream of the outfall locations at NGR 272029E, 342194N. There are no storm water overflows associated with the works.

The Mountain Water River is not a designated Salmonid Water (under the European Communities (Quality of Salmonid Waters) Regulations, 1988) nor is it identified as sensitive water in terms of the Urban Waste Water Treatment Regulations 2001. The river is not designated as an SPA, SAC or NHA. The River is a tributary of the Blackwater Monaghan which is designated as sensitive from the confluence of the River Shambles to Newmills Bridge under the Urban Waste Water Treatment Regulations 2001.

The overall status of the Mountain Water River is Poor and the date now set for this water body for achieving Good Ecological Status is 2021.

A Q value of 3 was recorded upstream of the discharge point (Nr of Glaslough Bridge Station No. 0650) in 2004. A previous Q value of 3 was also recorded at this location in 2001 and 1998.

The nearest flow monitoring data available for the Mountain Water River is at the Bridge North of Glaslough (NGR 271979; 342193) (OPW Station 03055). The 95-percentile flow (m^3/s) is given as 0.020, the average flow as 1.34 (m^3/s).

The treated effluent has an average BOD concentration of 5 mg/l and average suspended solids concentration of 8 mg/l. Average concentrations of nutrients are as follows; Molybdate Reactive Phosphate 0.09 mg/l (P), Total Phosphorus 0.15 mg/l (P), Total Nitrogen 2.07 mg/l (N) and Ammonia 0.82 mg N/l (Based on Monaghan County Council's 2009-2010 data).

At present the existing waste water treatment plant is meeting the required standards as set out in the Urban Waste Water Regulations 2001(S.I 254 of 2001) for the limits set on BOD, COD and suspended solids.

The upstream and downstream monitoring results for 2009-2010 are tabled below:

Parameter	Upstream				Downstream			
	Mean	Max	95%ile	n	Mean	Max	95%ile	n
COD (mg O_2/L)	35	101	84.00	121	34	101	74.05	120
BOD_5 (mg O_2/L)	3	30	8.00	114	3	12	6.08	114
TSS (mg/L)	10	96	61.50	115	8	90	19.50	115
Total Nitrogen (mg N/L)	1.99	11.2	3.24	94	1.94	6.1	3.61	94
Total Phosphorus (mg P/L)	0.14	0.76	0.27	120	0.13	0.56	0.28	119
Ammonia (mg N/L)	0.49	1.5	1.17	121	0.48	1.5	1.22	119
Nitrate (mg N/L)	0.94	2.2	1.80	111	0.94	2.1	1.65	111
Molybdate Reactive Phosphate (mg P/L)	0.08	0.3	0.18	116	0.08	0.3	0.16	115

Monaghan Co. Co. upstream and downstream monitoring results indicate that the Mountain Water River is not achieving the BOD, Ammonia or MRP standards stipulated for good status (mean or 95%ile) in the European Communities Objectives (Surface Water) Regulations, 2009 (S.I. No. 272 of 209). However the assimilative capacity results and monitoring results indicate that the effluent discharge from the Glaslough WWTW is not having a significant impact on the receiving waters and thereby is not contributing to the failure of this waterbody to comply with the European Communities Objectives (Surface Water) Regulations in terms of required parameters.