Appendix 2 Trial Pit records

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP1
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Ref. No.	Type	Depth (m)		
0.0	MADE GROUND consisting of red sand and cobbles.									
	MADE GROUND consisting of black sandy clay with plastic, glass and red brick.		0.40							
1.0					▽	T310	B	1.00		
	Stiff grey brown very sandy CLAY		1.30							
	Stiff becoming very stiff grey brown slightly sandy CLAY		1.90							
2.0										
						T311	B	2.50		
3.0										
	End of Trial Pit at 3.50 m		3.50			T312	B	3.50		
4.0										

Groundwater Conditions: Seepage @ 1.3m

Stability: Pit walls stable

Remarks:

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP2
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Ref. No.	Type	Depth (m)		
0.0	MADE GROUND consisting of black sandy clay with plastic, glass and red brick.									
	Stiff becoming very stiff grey brown sandy CLAY		0.80							
1.0						T313	B	1.50		
2.0						T314	B	2.50		
3.0										
	End of Trial Pit at 3.50 m		3.50			T315	B	3.50		
4.0										

Groundwater Conditions: No groundwater encountered

Stability: Pit walls stable

Remarks:

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP3
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Ref. No.	Type	Depth (m)		
0.0	MADE GROUND consisting of black sandy clay with plastic, glass and red brick.									
1.0	MADE GROUND consisting of black sandy clay with steel, glass and plastic.		1.00							
	Very stiff grey brown slightly sandy CLAY.		1.50		▽	T329	B	1.70		
2.0										
3.0						T330	B	3.00		
	End of Trial Pit at 3.50 m		3.50							
4.0										

Groundwater Conditions: Seepage @ 1.5m

Stability: Pit walls stable

Remarks:

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP4
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Ref. No.	Type	Depth (m)		
0.0	TOPSOIL		0.10							
	Firm becoming stiff grey brown very sandy CLAY									
1.0						T331	B	1.00		
	Light brown fine to coarse SAND		1.80		▽	T332	B	1.90		
2.0										
	End of Trial Pit at 2.30 m		2.30							
3.0										
4.0										

Groundwater Conditions: Rapid ingress @ 2.1m

Stability: Major pit wall collapse below 1.8m due to water ingress, forcing completion of pit

Remarks:

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP5
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Ref. No.	Type	Depth (m)		
0.0	MADE GROUND consisting of black sandy clay with plastic, glass and red brick.									
	Stiff becoming very stiff grey brown sandy CLAY		0.30							
1.0					▽	T316	B	1.50		
2.0						T317	B	2.50		
3.0										
	End of Trial Pit at 3.50 m		3.50			T318	B	3.50		
4.0										

Groundwater Conditions: Seepage @ 1.6m

Stability: Pit walls stable

Remarks:

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP6
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples Ref. No.	Samples Type	Samples Depth (m)	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	MADE GROUND consisting of black sandy clay with plastic, glass and red brick.									
	MADE GROUND consisting of black sandy clay with steel		0.70							
1.0	Light brown fine to medium SAND		1.10			T327	B	1.00		
						T328	B	1.50		
2.0										
3.0	End of Trial Pit at 3.00 m		3.00		▽					
4.0										

Groundwater Conditions: Medium ingress @ 3.0m

Stability: Major pit wall collapse due to water ingress, forcing completion of pit

Remarks:

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP7
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Ref. No.	Type	Depth (m)		
0.0	MADE GROUND consisting of black sandy clay with plastic, glass and red brick.									
	Stiff becoming very stiff grey brown slightly sandy CLAY		0.30							
1.0						T324	B	1.50		
2.0						T325	B	2.50		
3.0										
	End of Trial Pit at 3.30 m		3.30			T326	B	3.50		
4.0										

Groundwater Conditions: No groundwater encountered

Stability: Pit walls stable

Remarks:

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP8
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Ref. No.	Type	Depth (m)		
0.0	MADE GROUND consisting of black sandy clay with plastic, glass and red brick.									
	Stiff becoming very stiff grey brown slightly sandy CLAY		0.70							
1.0						T321	B	1.50		
2.0						T322	B	2.50		
3.0										
	End of Trial Pit at 3.50 m		3.50			T323	B	3.50		
4.0										

Groundwater Conditions: No groundwater encountered

Stability: Pit walls stable

Remarks:

REPORT NO. 11303	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Foxhole, Youghal	Trial Pit No.:	TP9
		Sheet:	Sheet 1 of 1
CLIENT:		Excavation Method:	14T Tracked Excavator
ENGINEER:	SWS Natural Resources Ltd	Date Started:	23/11/2005
		Date Completed:	23/11/2005
CO-ORDINATES:	E - N -	Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples: Ref. No.	Samples: Type	Samples: Depth (m)	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	TOPSOIL		0.10							
	Red brown gravelly fine to coarse SAND with many sub-rounded cobbles									
1.0						T319	B	1.00		
	Light brown slightly gravelly fine to coarse SAND		1.40							
2.0										
						T320	B	2.50		
3.0					▽					
	End of Trial Pit at 3.20 m		3.20							
4.0										

Groundwater Conditions: Medium ingress @ 3.2m

Stability: Major pit wall collapse due to water ingress, forcing completion of pit

Remarks:

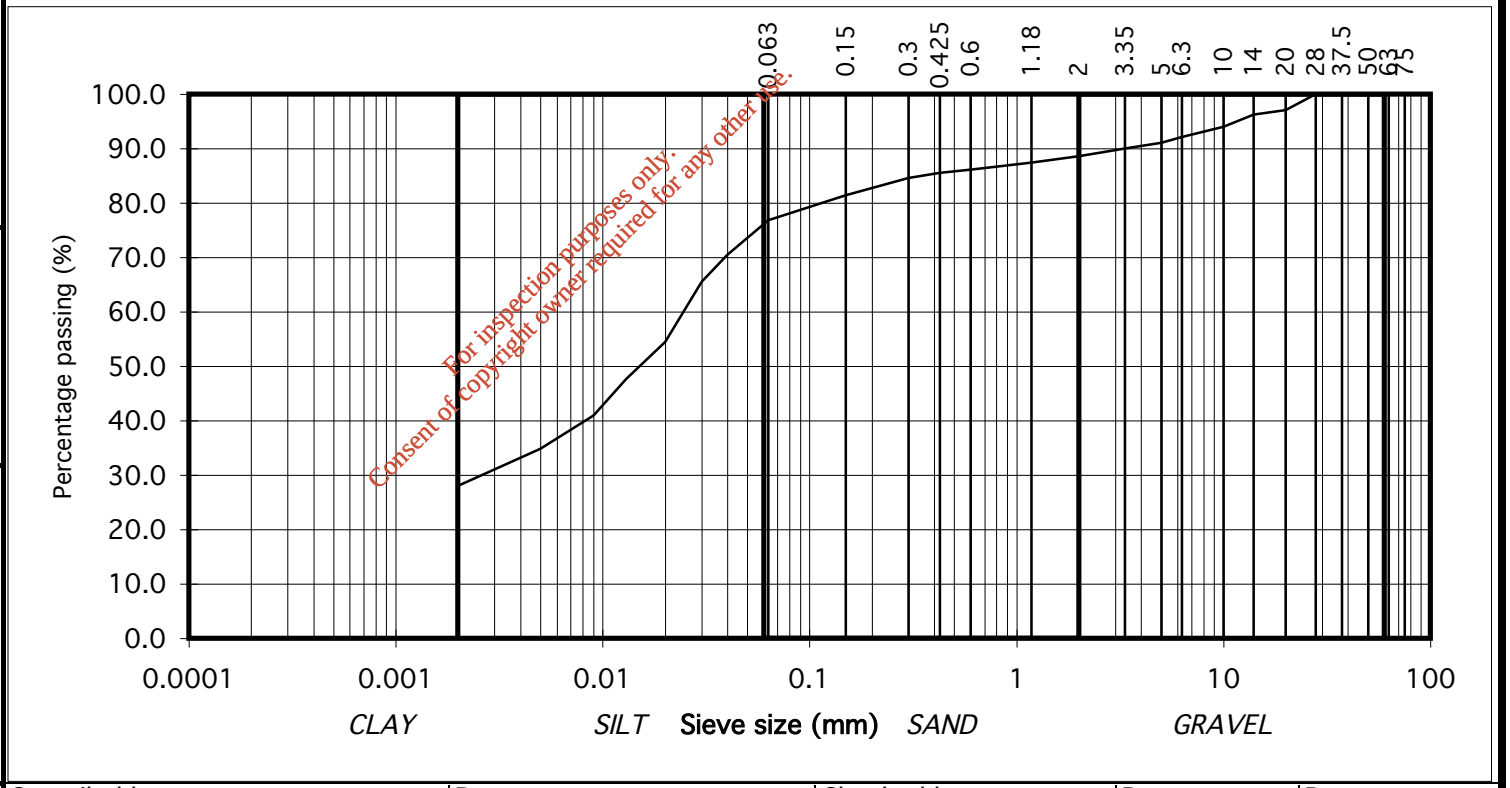
Appendix 3 Laboratory Test Results

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100.0	COBBLES
63	100.0	
50	100.0	
37.5	100.0	
28	100.0	
20	97.1	GRAVEL
14	96.2	
10	94.0	
6.3	92.1	
5	91.1	
3.35	90.0	
2	88.5	
1.18	87.4	
0.6	86.1	SAND
0.425	85.5	
0.3	84.5	
0.15	81.4	
0.063	76.8	
0.04	70.4	
0.03	65.5	
0.02	54.5	SILT/CLAY
0.013	47.7	
0.009	40.9	
0.005	34.8	
0.002	28.0	

Contract No: 11303
Contract: FOXHOLE YOUGHAL CO.CORK
BH/TP No: BH 7
SAMPLE No.: 3329
DEPTH (m): 12.00
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Brown slightly sandy, slightly gravelly, CLAY



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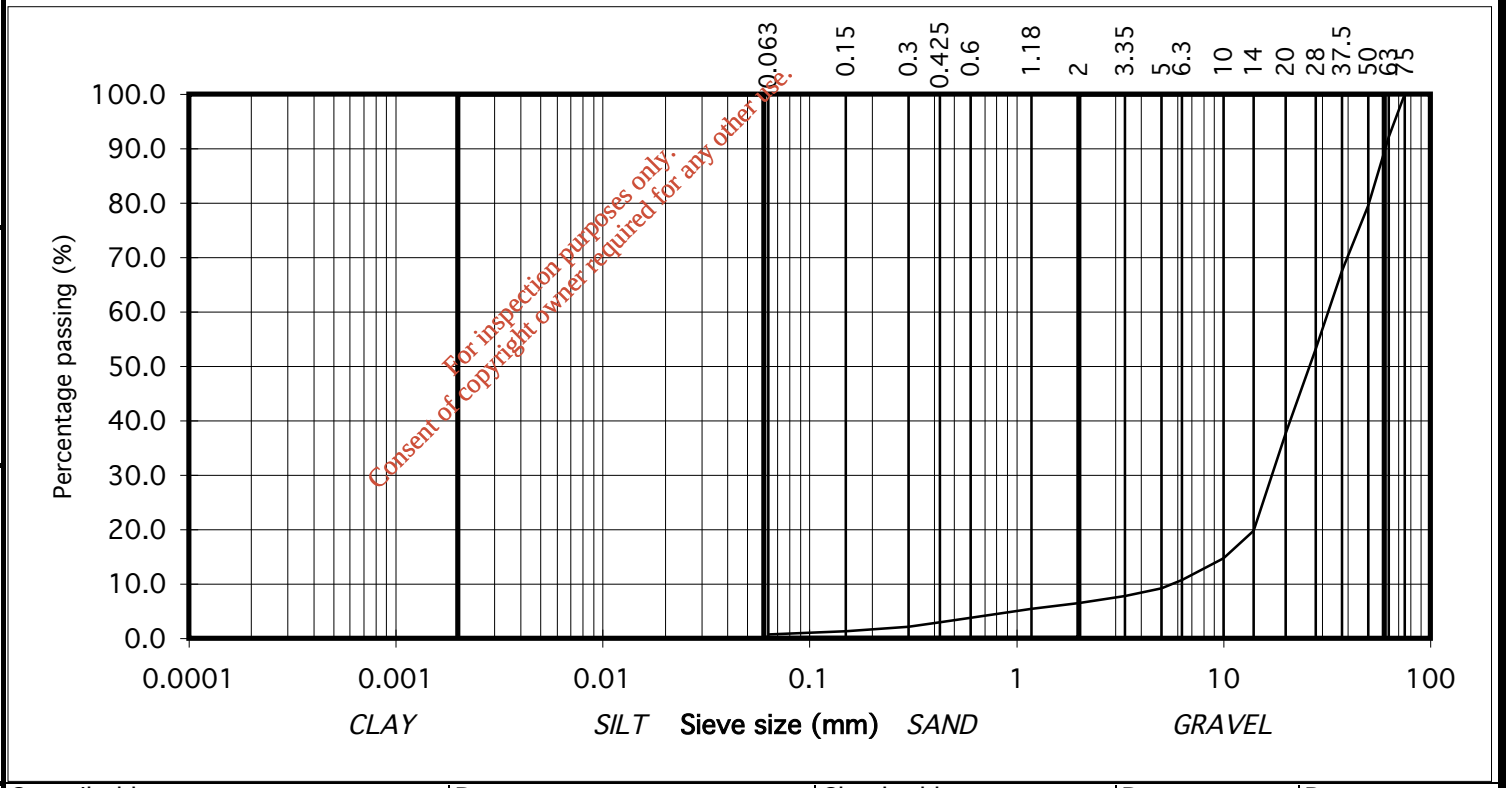
D CONNOLLY	21/12/05			

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100.0	COBBLES
63	92.1	GRAVEL
50	79.6	
37.5	67.5	
28	53.1	
20	37.7	
14	19.7	
10	14.7	
6.3	10.7	
5	9.2	
3.35	7.8	
2	6.5	SAND
1.18	5.4	
0.6	3.7	
0.425	2.9	
0.3	2.2	
0.15	1.3	
0.063	0.7	SILT/CLAY
0.04	#N/A	
0.03	#N/A	
0.02	#N/A	
0.013	#N/A	
0.009	#N/A	
0.005	#N/A	
0.002	#N/A	

Contract No: 11303
Contract: FOXHOLE YOUGHAL CO.CORK
BH/TP No: BH 6
SAMPLE No.: 3394
DEPTH (m): 7.00
TEST METHOD: Wet sieve
DESCRIPTION: Grey brown slightly clayey/silty, sandy, GRAVEL with some cobbles



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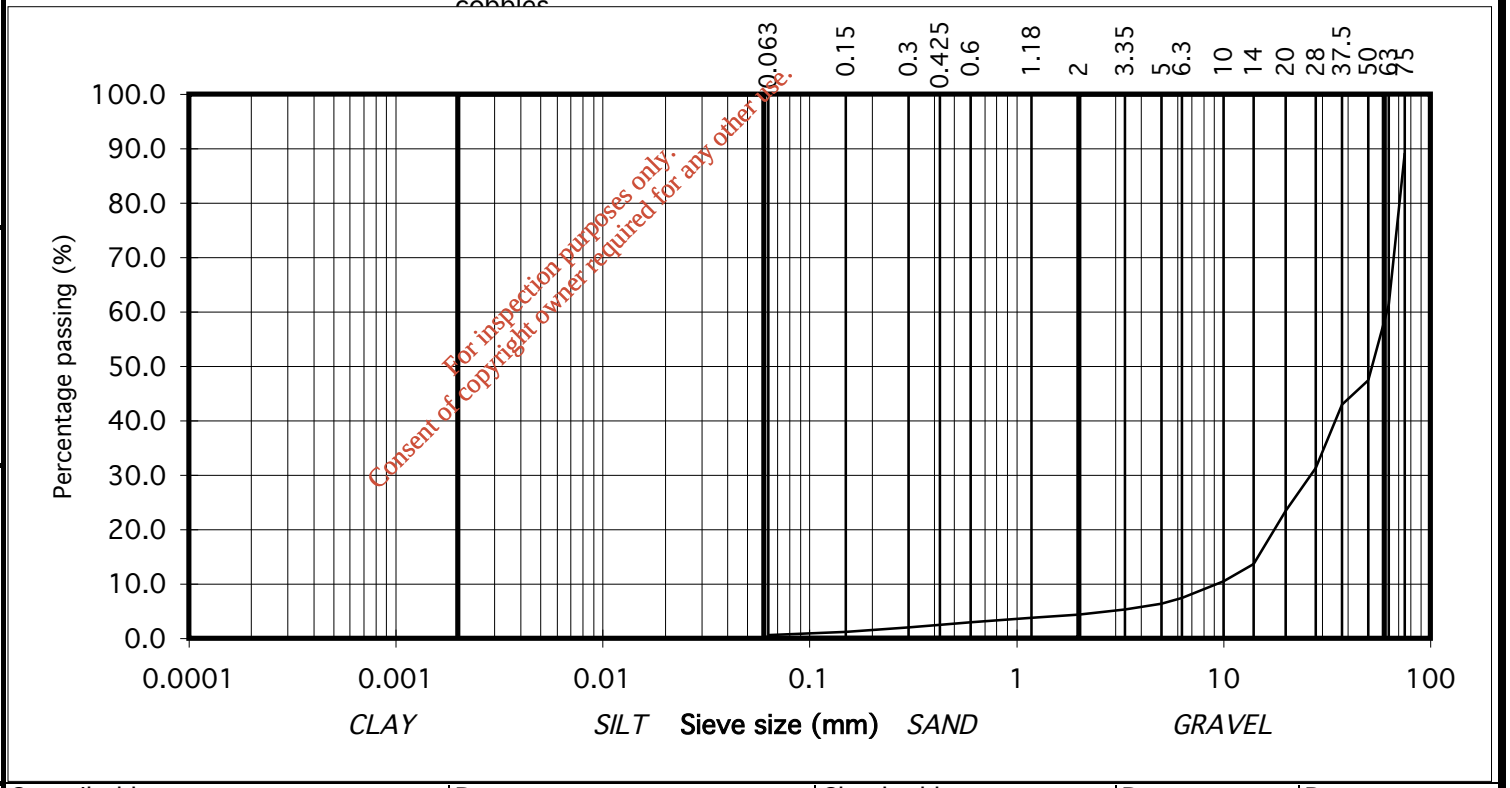
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	89.2	COBBLES
63	61.3	GRAVEL
50	47.4	
37.5	43.0	
28	31.3	
20	23.4	
14	13.7	
10	10.4	
6.3	7.4	
5	6.4	
3.35	5.3	
2	4.4	SAND
1.18	3.8	
0.6	2.9	
0.425	2.5	
0.3	2.0	
0.15	1.1	
0.063	0.6	SILT/CLAY
0.04	#N/A	
0.03	#N/A	
0.02	#N/A	
0.013	#N/A	
0.009	#N/A	
0.005	#N/A	
0.002	#N/A	

Contract No: 11303
Contract: FOXHOLE YOUGHAL CO.CORK
BH/TP No: BH 4
SAMPLE No.: 3382
DEPTH (m): 8.00
TEST METHOD: Wet sieve
DESCRIPTION: Grey brown slightly clayey/silty, slightly sandy, GRAVEL with many cobbles



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Compiled by:	Date:	Checked by:	Date:	Page no:
D CONNOLLY	21/12/05			

REPORT NO.

SULPHATE ANALYSIS

IGSL

CONTRACT: FOXHOLE YOUGHAL CO.CORK

CONTRACT NO 11303

BH/TP NO.	DEPTH (M)	SAMPLE NO.	SAMPLE TYPE	TEST CODE	% Passing 2mm	SULPHUR TRIOXIDE		(so3 X 1.2)	pH
						WATER SO3 g/L	TOTAL SOIL so3 %	TOTAL SOIL so 4 %	VALUE
BH 1	2.00	3333	D	S	98.6		0.038	0.046	8.1
BH 3	5.00	3365	D	S	96.7		0.045	0.054	7.7
BH 6	2.00	3389	D	S	77		0.016	0.019	6.4
BH 8	2.00	4203	D	S	94.2		0.038	0.046	8.0

TEST CODE: W = WATER S = SOIL A = AQUEOUS SOIL EXTRACT(2:1)

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
BH 1	3333	2.00	D	21.2	49	25	24	96.9	WS	Mottled brown slightly sandy CLAY with occasional fine gravel	C I
BH 1	3343	12.00	D	17.2	40	17	23	88.4	WS	Brown slightly sandy slightly gravelly CLAY	C I
BH 2	3350	4.00	D	23.2	47	20	27	98.0	WS	Mottled brown slightly sandy CLAY with occasional fine gravel	C I
BH 3	3365	5.00	D	23.2	38	19	19	91.1	WS	Mottled brown slightly sandy slightly gravelly CLAY	C I
BH 6	3389	2.00	D	20.9	48	20	28	93.2	WS	Mottled brown slightly sandy slightly gravelly CLAY	C I
BH 7	3323	6.00	D	48.5	40	19	21	98.4	WS	Mottled grey brown slightly sandy CLAY	C I
BH 7	3329	12.00	D	27.3	52	20	32	85.5	WS	Brown slightly sandy slightly gravelly CLAY	C H
BH 8	4203	2.00	D	21.8	44	19	25	95.2	WS	Mottled brown slightly sandy CLAY with occasional fine gravel	C I

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

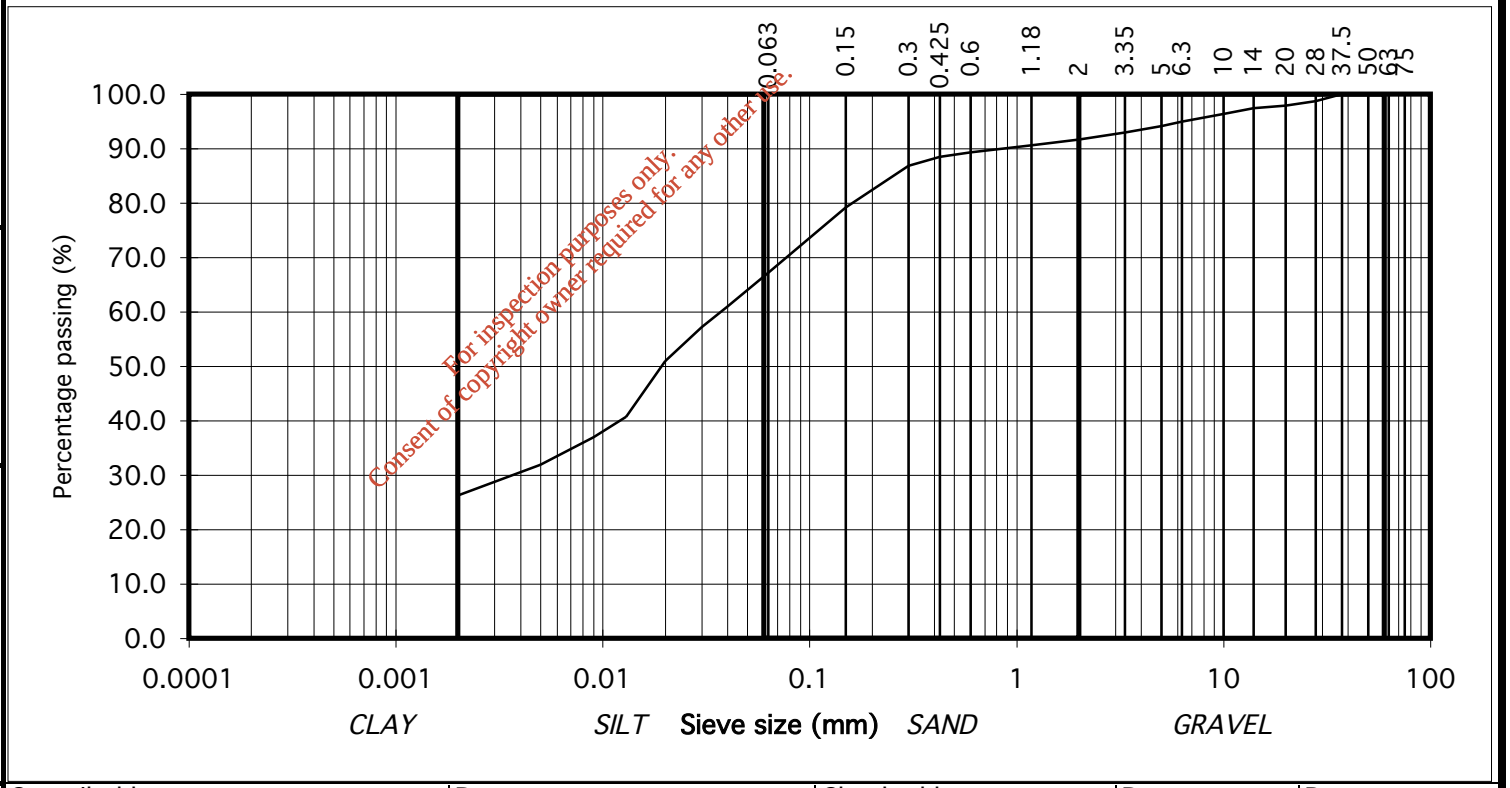
IGSL	Contract				Contract No.
	FOXHOLE YOUGHAL CO.CORK				11303
	Compiled By	Date	Checked By	Date	Page
	D CONNOLLY	21/12/05			of

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100.0	COBBLES
63	100.0	GRAVEL
50	100.0	
37.5	100.0	
28	98.7	
20	97.9	
14	97.4	
10	96.4	
6.3	95.0	
5	94.1	
3.35	92.9	
2	91.7	SAND
1.18	90.6	
0.6	89.3	
0.425	88.4	
0.3	86.8	
0.15	79.2	
0.063	67.1	SILT/CLAY
0.04	60.9	
0.03	57.1	
0.02	51.0	
0.013	40.7	
0.009	37.0	
0.005	31.8	
0.002	26.2	

Contract No:	11303
Contract:	FOXHOLE YOUGHAL CO.CORK
BH/TP No:	BH 1
SAMPLE No.:	3343
DEPTH (m):	12.00
TEST METHOD:	Wet sieve and hydrometer
DESCRIPTION:	Brown slightly sandy, slightly gravelly, CLAY



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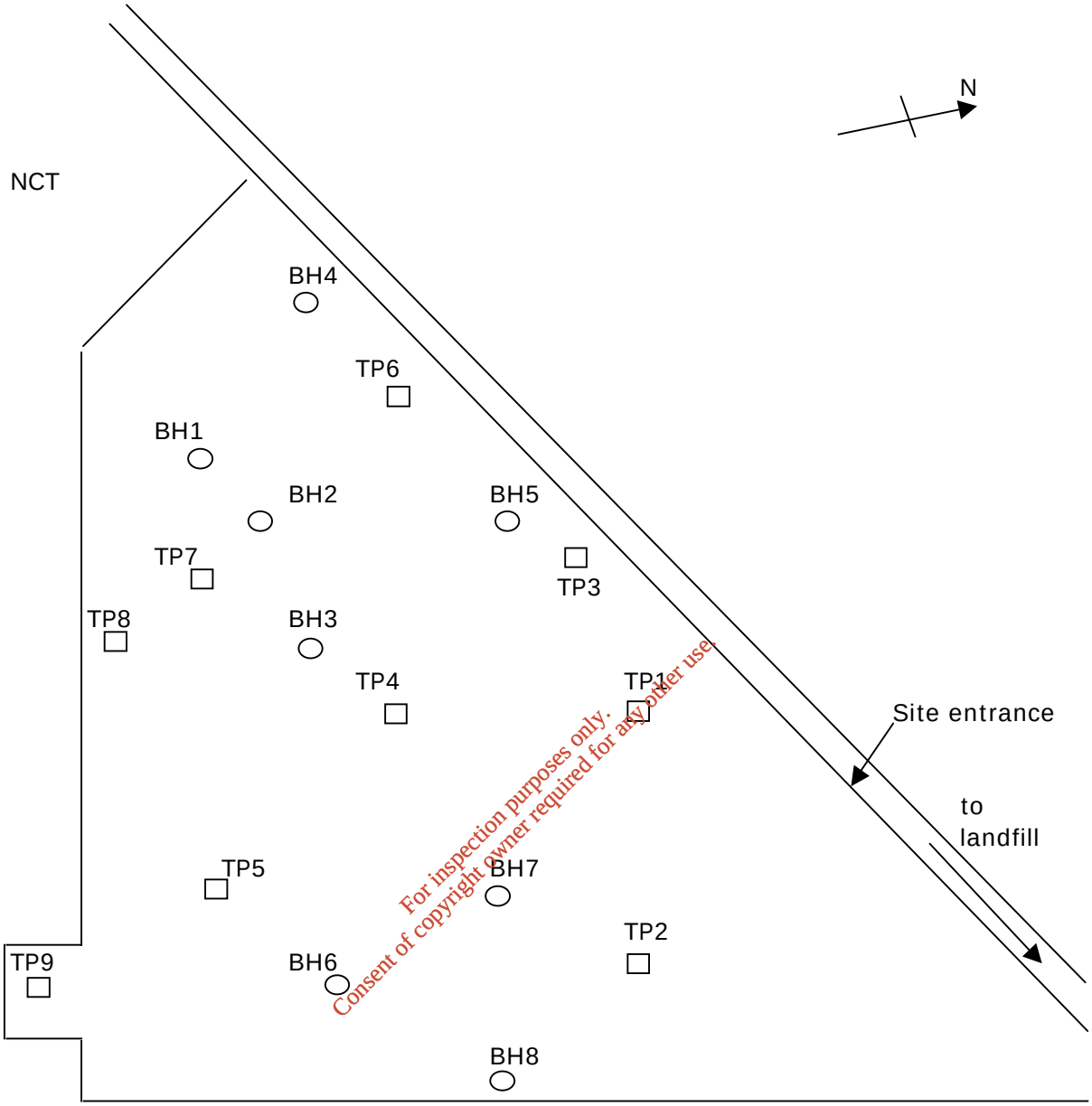
Compiled by:	Date:	Checked by:	Date:	Page no:
D CONNOLLY	21/12/05			

Appendix 4 Site Plan



Youghal - Foxhole

11303

Fig.4

Appendix 3

SWS Group Limited
Compliance with Waste Licence W0211-01
Site Investigatory Work

Report on site investigation at the Foxhole waste facility, Youghal, Co. Cork

MEL Work Item A1
MEL Doc. Ref: 1906-068 (Final)
Date: Wednesday, April 18, 2007

Report by :
Minerex Environmental Limited
Hydrogeological, Environmental and
Geophysical Services
Taney Hall, Dundrum, Dublin 14, Ireland
Dublin 14, Ireland
Tel.: +353-(0)1-2964435
Fax.: +353-(0)1-2964436
Email: enquiries@minerex.ie
Website: www.minerex.ie

Report To:
Sinead Hickey
SWS Group Limited
Shinagh House
Bandon
Co. Cork

Prepared by :

Jenny Rush M.Sc.
Project Manager

Reviewed by :

EurGeol **Cecil Shine** M.Sc. PGeo
Project Director

Minerex
Environmental Limited

Contents

Appendices

Appendix	Title	Pages	Minerex Reference
Appendix A	Site location map	1 x A3	1906-008.cdr
Appendix B	Borehole logs	4 x A4	1906-024.ppt
Appendix C	Analytical results	1 x A3	1906-010.xls
Appendix D	Water level map	1 x A3	1906-008.cdr
Appendix E	Photos	2 x A4	1906-009.ppt

1. Introduction

1.1 Background and purpose

1.1.1 Minerex Environmental Limited were commissioned by the SWS Group to carry out an investigation into the potential for soil and groundwater contamination at a site adjacent to Youghal Landfill (Appendix A) in accordance with Condition 6.18 of Waste Licence W0211-01 as follows:

'6.18.1 Groundwater shall be sampled and analysed in accordance with Schedule C.6: Groundwater Monitoring, of this licence. A report of the results of monitoring shall be submitted annually as part of the AER.

6.18.2 The licensee shall, within six months of the date of grant of this licence, submit a comprehensive proposal for the monitoring and remediation of hydrocarbon contamination in soil and groundwater at the site. The proposal shall have particular regard to the ground in, around, under and hydraulically down-gradient of the area historically used for diesel storage; as well as to the three dimensional configuration of any plume that may extend from the source area. The scope, detail and reporting of the monitoring shall be agreed by the Agency prior to implementation. Due regard shall be given to the findings of any previous reports that may be relevant. Any recommendations arising from a report on the monitoring results shall be implemented within a timeframe to be specified by the Agency.'

1.1.2 Condition 3.23 of the waste licence details recommendations for a monitoring infrastructure, as follows:

'3.23 Monitoring Infrastructure
(i) Within three months of the date of commencement of the licensed activities, the licensee shall install three monitoring points at MW1, MW2 and MW3 in accordance with Schedule C.6 Groundwater Monitoring, of this licence to allow for the sampling and analyses of groundwater.
(ii) Groundwater monitoring wells shall be constructed having regard to the guidance given in the Agency's landfill manual "Landfill Monitoring" and shall be adequately protected to prevent contamination or physical damage.'

1.1.3 The site historically comprised part of the neighbouring landfill and housed a diesel storage area near the current site entrance (Appendix A). Previous site investigations have been carried out by Geotech Specialists Limited in June 2004 and IGSL in November 2005. No chemical analysis was carried out on the soils during these investigations but a hydrocarbon smell was recorded in an area of the site which historically housed over ground diesel storage tanks.

1.1.4 The results of the soil investigation carried out by Minerex and the proposal for dealing with any contamination were reported on 19th January 2007 (Ref. 1). Low concentrations of Diesel Range Organics are present in the stockpiled material from the area of concern. However no hydrocarbons were observed in the material nor were any PID values above background recorded.

1.2 Objective

The objective for installing and sampling groundwater monitoring points was to determine if there is any contamination in the groundwater underlying the area in which the diesel storage tanks were housed and to determine if any contamination has migrated from this area.

1.3 Schedule of works

In order to address the potential for groundwater contamination, Minerex were commissioned by the SWS Group to install and sample three groundwater monitoring points across the site. Minerex staff were onsite to install and monitor the boreholes on 19/02/07, 08/03/07, 14/03/07 and 15/03/07.

2. Methods, equipment and materials

2.1 Health and safety

MEL employed their standard health and safety procedures in all aspects of the work. There were no near misses or accidents during project.

2.2 Borehole locations

The proposed locations for the groundwater monitoring points were specified in the waste licence as follows:

- MW1 at E209704, N079731 (along the south-eastern boundary of site);
- MW2 at E209589, N079778 (along the western boundary of site);
- MW3 in the area which housed the diesel storage unit.

These locations were identified using a hand-held GPS unit. The groundwater monitoring points were installed as close as possible to these locations, with the exception of MW1 (Appendix D). The grid co-ordinates for MW1 placed the monitoring point in the centre of an area to be used by onsite traffic. Minerex submitted a request to the EPA on 15th February 2007 that the location be changed to an area at the south-eastern edge of the site where there would be less traffic (Ref. 2). The revised location was approved by the EPA on 16th February 2007 (Ref. 3).

2.3 Shell & Auger drilling

Glover Site Investigation were commissioned by Minerex to undertake the drilling using a shell and auger rig, which allows for efficient drilling through sands and gravels. The boreholes were drilled to various depths from 5-14m depending on the water strikes to an 8" diameter. During drilling, the overburden geology was logged by Minerex staff every 1m. The geological logging of borehole samples was carried out in accordance with industry standard BS 5930:1999, which is the geotechnical engineering approach to identifying and describing subsoils, and using a flowchart for geological description based on BS5930:1999 formulated by the Geological Survey of Ireland (Ref. 4), and modified by Minerex as appropriate in the interest of the requirements of the project. When drilling was complete, the monitoring points were installed by Minerex staff.

2.4 Groundwater sampling

2.4.1 Methodology

Sampling methodology followed standards and protocols based on ISO 5667 standard methods, EPA guidelines and Minerex best practice, whereby every practical effort was made to purge each monitoring borehole of three borehole volumes prior to a sample being taken. Individual bailers were used to sample the boreholes after purging. Field testing for pH, conductivity and temperature was undertaken at all boreholes.

2.4.2 Laboratory analysis

The samples were dispatched to Alcontrol Laboratories for analysis of the following parameters in accordance with the requirements of the waste licence and additional parameters considered appropriate to the nature of the site: cadmium, cobalt, iron, manganese, arsenic, sodium, chloride, fluoride, nitrate, phosphate, sulphate, diesel range organics, mineral oil, petrol range organics, BTEX parameters – benzene, ethylbenzene, toluene and xylene, volatile organic compounds (VOC's) and semi-volatile organic compounds (SVOC's).

2.4.3 Standards, guidance and legislation used to compare results

The analytical results of the groundwater sampling were compared to the limits set by the following guidance and legislation: -

Standards, guidance & legislation	***Minerex Doc. Ref.***
S.I. No. 106 (2007) Drinking Water Regulations	E-nonCD329
S.I. No. 439 (2000) Drinking Water Standard	F215
S.I. No. 12 (2001) Dangerous Substances Regulations	F279
EPA (2006) Towards Setting Guideline Values For The Protection Of Groundwater In Ireland (Interim Report)	F827
Dutch guidelines for groundwater chemistry (2000) In Ministry of Housing, Spatial Planning and Environment, Rijnstraat 8, 2515 XP The Hague, Internal Post Code 625, Department of Soil Protection	F221

2.5 Levelling & water levels

2.5.1 An elevation survey of the monitoring points MW2 and MW3 was undertaken on 08/03/07. The elevations of ground level, top of steel casing, and top of piezometers were surveyed as appropriate using a benchmark of known elevation above Ordnance Datum as indicated by SWS staff. These levels have been added to the site database maintained by Minerex. The ground level at MW1 was estimated from a previous site survey.

2.5.2 Static water levels were recorded at MW1, MW2 and MW3 prior to sampling using an electronic dip meter ('dipper'). All water levels were recorded from a reference point marked on the top of steel casing and have been reduced to metres above Ordnance Datum as standard.

3. Results & interpretation

3.1 Geology

The results of drilling indicate that the depth of made ground varies considerably across the site, with 2m of made ground at MW1, 1m at MW2 and 3m at MW3 (Appendix B). The made ground generally consists of gravelly clay with fragments of glass, ceramics, plastic, wood and metal. The underlying subsoil generally consists of gravelly clay with cobbles or sandy gravels with cobbles (Appendix B). Bedrock was not reached in any of the boreholes

3.2 Groundwater

Water strikes were recorded in sandy gravels at a depth of 4m in MW1, in compact gravelly clay at 6m in MW2 and in loose sandy gravel at 13.8m in MW3. Damp patches were recorded within the made ground at 0.5m below the surface across the site.

3.3 Borehole installations

3.3.1 MW1 was drilled to a depth of 5m through made ground and then through natural clay with cobbles into sandy gravel with cobbles (Appendix B). Two piezometers were installed opposite areas where a water strike was recorded. The lower piezometer (P1) consists of 2m of 2" uPVC screen and 3m of casing was installed to the base of the borehole around which a washed 5-10mm gravel pack was placed up to 2.5m from the ground surface. Above the gravel pack, a seal of bentonite of approximately 0.5m was installed to prevent the downward migration of water along the annulus of the piezometer. The upper piezometer (P2) consists of 1m of 2" uPVC screen and 1m of casing was installed to the base of the borehole around which a washed 5-10mm gravel pack was placed up to 0.5m from the ground surface. Above the gravel pack, a seal of bentonite of approximately 0.3m was installed followed by 0.1m of hardcore and 0.1m of gravel.

3.3.2 MW2 was drilled to a depth of 7.3m through made ground and then through natural gravelly clay (Appendix B). Two piezometers were installed opposite areas where a water strike was recorded. The lower piezometer (P1) consists of 1m of 2" uPVC screen and 6.5m of casing was installed to the base of the borehole around which a washed 5-10mm gravel pack was placed up to 5.8m from the ground surface. Above the gravel pack, a seal of bentonite of approximately 1.5m was installed to prevent the downward migration of water along the annulus of the piezometer. The upper piezometer (P2) consists of 1m of 2" uPVC screen and 0.5m of casing was installed to the base of the borehole around which a washed 5-10mm gravel pack was placed.

3.3.3 MW3 was drilled to a depth of 14m through made ground and then through gravelly clay into sandy gravel (Appendix B). Two piezometers were installed opposite areas where a water strike was recorded. The lower piezometer (P1) consists of 1m of 2" uPVC screen and 13m of casing was installed to the base of the borehole around which a washed 5-10mm gravel pack was placed up to 12m from the ground surface. Above the gravel pack, a seal of bentonite of approximately 2m was installed to prevent the downward migration of water along the annulus of the piezometer. Above the bentonite seal, the borehole was backfilled with subsoil from the hole up to 3m below the ground surface. The upper piezometer (P2) consists of 1m of 2" uPVC screen and 1m of casing was installed to the base of the borehole around which a washed 5-10mm gravel pack was placed up to 0.6m from the ground surface. Above the gravel pack, a seal of bentonite of approximately 0.2m was installed followed by 0.2m of hardcore and asphalt.

3.4 Borehole completions

3.4.1 The monitoring point at MW1 was completed with a steel well cover installed into the top layer of gravel (Appendix B). The well cover extends to approximately 0.2m above the original ground surface. The piezometers are covered with caps and marked with the piezometer reference, i.e. MW1-P1 (Appendix E).

3.4.2 At MW2, Minerex were requested by SWS site staff to place a steel well cover over the hole as a temporary protective measure, until the area is surfaced during site works (Appendix B). It is understood that SWS will install the steel well cover as necessary. The piezometers are covered with caps and marked with the piezometer reference.

3.4.3 The monitoring point at MW3 was completed with a steel well cover installed into a layer of asphalt (Appendix B). The well cover is level with the surrounding asphalt surface (Appendix E). The piezometers are covered with caps and marked with the piezometer reference.

3.5 Water levels

3.5.1 Static water levels were recorded prior to sampling on 08/03/07 at MW2 and at MW3 and on 15/03/07 at MW1 (Appendix D). The water levels are referenced to metres below the reference point and also to metres above Ordnance Datum at Malin Head. The shallow piezometer in MW1 (P2) remained dry during sampling.

Monitoring point ID	*Date*	*Horizon*	*Installation depth (mbgl)*	*Water level (mbRef)*	*Reduced water level (maOD)*
MW1-P1	15/03/07	Sandy gravel with cobbles	3-5	4.04	1.16
MW1-P2	15/03/07	Made ground	0.9-1.9	-	-
MW2-P1	08/03/07	Loose gravelly clay	6.3-7.3	0.51	5.47
MW2-P2	08/03/07	Made ground	0.3-1.3	0.77	5.20
MW3-P1	08/03/07	Loose sandy gravel	13-14	0.9	5.21
MW3-P2	08/03/07	Made ground	0.8-1.8	0.91	5.20

3.5.2 The recording of two water strikes during drilling suggests there to be two groundwater systems onsite; a perched water table within the made ground and, in places, a piezometric surface within the underlying natural subsoil.

3.5.3 The occurrence of a water table within the made ground is not continuous across the site, as MW1-P2 is recorded to be dry, suggesting that its occurrence is dependent on the permeability of the made ground material.

3.5.4 Piezometric levels recorded in MW2-P1 and MW3-P1 are shallow and relatively similar to the level of the water table, suggesting that the horizon into which these piezometers are installed is confined and that groundwater here is under pressure driving it up the piezometer. This horizon is recorded as loose gravelly clay at MW2 and loose sandy gravel at MW3 and is confined beneath 6m of clay at MW2 and 10.5m of clay at MW3.

3.5.5 The water level recorded at MW1 is relatively deep, suggesting that the gravelly horizon here is unconfined.

3.6 Aquifer vulnerability

3.6.1 Vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities (Ref.5). The vulnerability of groundwater depends the connectivity between the land surface and the aquifer, therefore it is a function of subsoil permeability, subsoil depth

and recharge type (diffuse or point). The following table details the vulnerability classification used by the Geological Survey of Ireland.

Hydrogeological Conditions			
Vulnerability rating	***Subsoil type & thickness***		
	High permeability (sand/ gravel)	*Moderate permeability (sandy subsoil)*	*Low permeability (clayey subsoil, clay, peat)*
Extreme (E)	0-3m	0-3m	0-3m
High (H)	>3m	3-10m	3-5m
Moderate (M)	N/A	>10m	5-10m
Low (L)	N/A	N/A	>10m

3.6.2 The depth and permeability of the confining clay horizon, as discussed in Section 3.3, ensure that the underlying gravelly horizon is protected from groundwater contamination and can be classified as having moderate vulnerability.

3.7 Results of groundwater sampling

3.7.1 The results of field testing for pH, conductivity and temperature are detailed in the table below.

Monitoring point ID	***pH***	***Conductivity (uS/cm)***	***Temperature (°C)***
MW1-P1	5.64	452	10.08
MW1-P2	-	-	-
MW2-P1	6.81	842	10.8
MW2-P2	7.48	853	11.0
MW3-P1	7.2	550	10.5
MW3-P2	6.88	644	9.2

3.7.2 The analytical results of sampling are detailed in Appendix C. The results for diesel range organics, mineral oil, petrol range organics and BTEX parameters are below the minimum detection limit of 10ug/l used by the laboratory. Also the results for VOC's and SVOC's are below the minimum detection limit of 1ug/l. All of the results for arsenic, cadmium, chloride and sodium remain below the relevant legislative and guidance limits.

3.7.3 All of the results for cobalt remain below the Dutch target value of 20ug/l, with the exception of the result of 71ug/l at MW1-P1. The result for iron at MW1-P1 of 7.456mg/l is the only result to exceed the IGV limit of 0.2mg/l. All of the results for manganese exceed the IGV of 0.05mg/l.

3.7.4 All of the results for chloride exceed the interim guideline value (IGV) of 30mg/l set by the EPA but remain below the limit of 250mg/l set by S.I. No. 439 and S.I. No. 12. All of the results for orthophosphate exceed the IGV of 0.03mg/l. All of the results for sulphate are below the limit of 200mg/l set by S.I. No. 294 and by the IGV's, with the exception of the result of 248mg/l at MW2-P2 (shallow piezometer). All of the results for nitrate remain below the IGV of 25mg/l, with the exception of the result of 28.3mg/l at MW1-P1 and of 25.6mg/l at MW3-P1.

4. Conclusions

4.1 The results of drilling indicate that the **depth of made ground varies** considerably across the site and is underlain generally by gravelly clay with cobbles or sandy gravels with cobbles. A **perched water table** occurs within the made ground but is discontinuous across the site and appears to be dependent on the permeability of the material. A water table, or in places, a **piezometric surface**, occurs within the gravelly clay horizon where uncompact and loose or in the sandy gravel horizon.

4.2 Three monitoring points have been drilled onsite at agreed locations, into which **coupled piezometers** are installed, one into the made ground and one into the gravelly horizon.

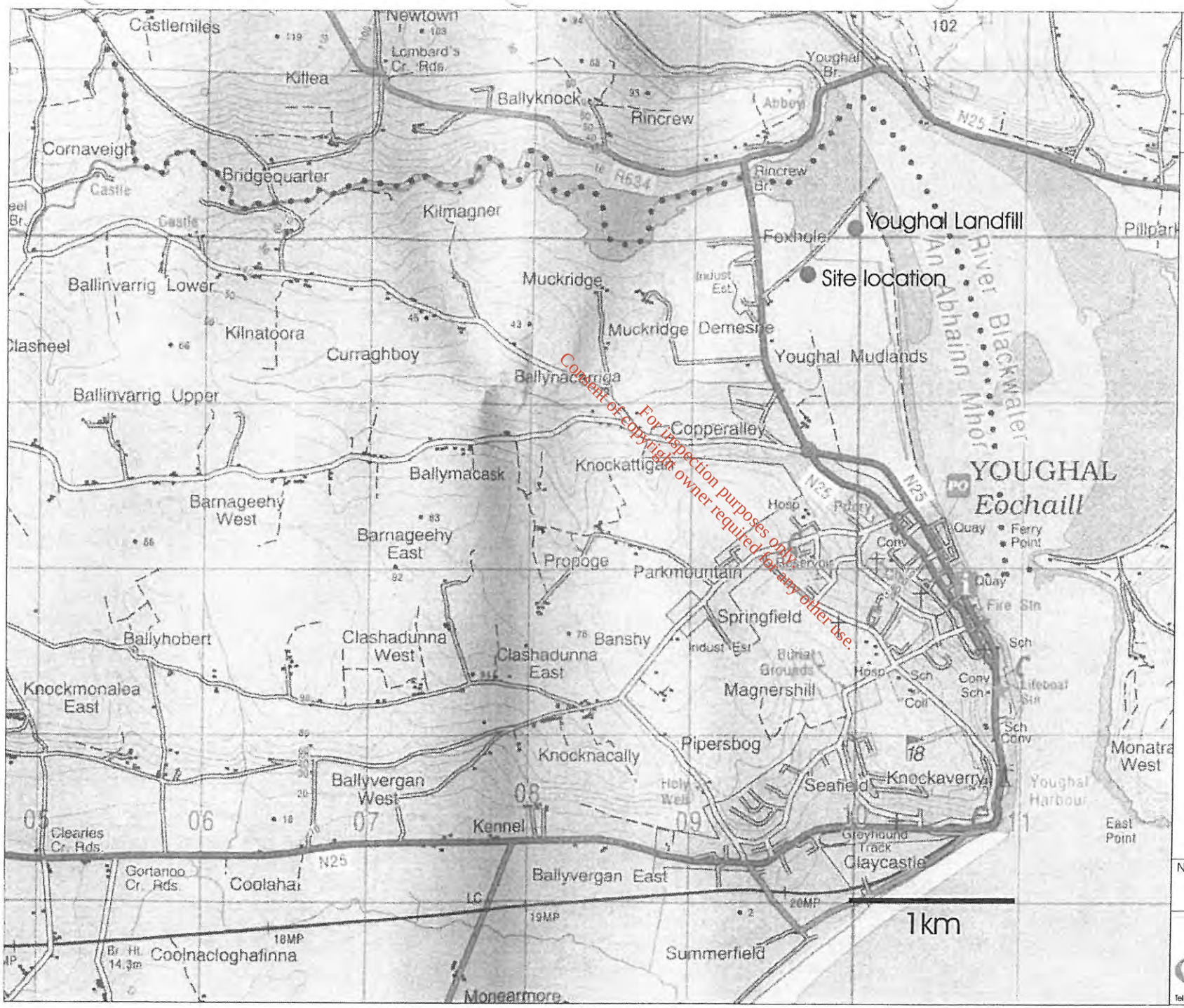
4.3 The results of sampling and analysis show there to be **no recorded hydrocarbon contamination present** in the groundwater. The results of sampling show there to be high levels of iron and manganese, characteristic of groundwater in impure limestone bedrock. High values of phosphate suggest that the recharge area of the underlying aquifer, outside of the site, is subject to agricultural contamination. Slightly elevated conductivity at MW2 indicates an elevated amount of dissolved material in the water, most likely as a result of the proximity of the site to the sea.

4.4 The results of levelling and of recording water levels at the monitoring points suggest that **groundwater flow is towards the southeastern corner** of the site under low tide conditions. However the direction of flow may change under high tide conditions.

5. References

No.	Description	Minerex Doc. Ref.
1.	Minerex (2007) Proposal for the remediation of soil and groundwater contamination	1906-045 (Proposal – Second Draft).pdf
2.	Minerex correspondence with EPA on 15th March 2007	1906-068.msg
3.	EPA correspondence to Minerex dated 16th March 2007	1906-070.msg
4.	Geological Survey of Ireland (2001) Flow chart to aid in the classification of subsoil in Ireland.	F702
5.	www.gsi.ie	

Appendix A



Appendix A
Site location map

AVR Environmental Solutions
Foxhole, Youghal

Drawing Ref. 1906-008 (MASTER)
Date: 12/04/07

Common legend

- Foxhole Site
- Youghal Landfill

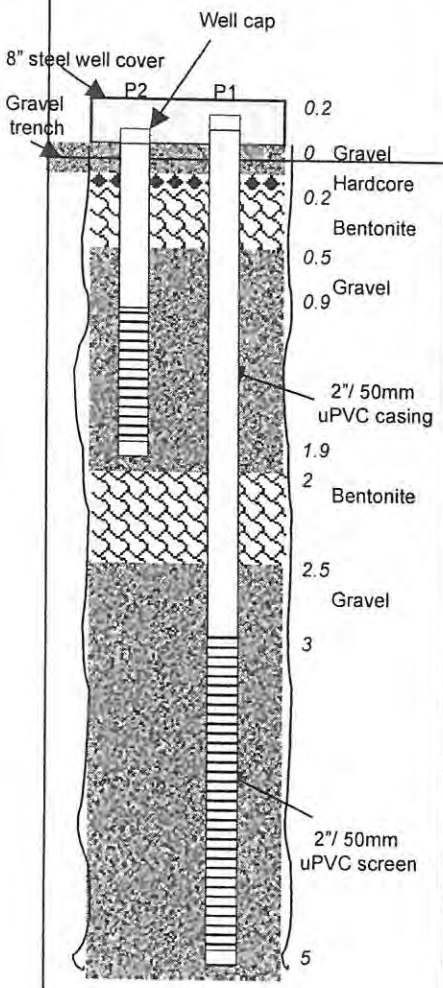
NOTES

Minerex
Environmental Limited
Tel 01-2964435, Fax 01-2964436, Email: Enquiries@minerex.ie

Appendix B

FINAL

Borehole Design & Completion



BOREHOLE LOG	MW1
Client	SWS
MEL work item	1906 A2
Page No.	1 of 1
Date drilled:	15/03/07
Logged by:	J. O'Keeffe
Equipment used	Shell & Auger
MEL Doc. Ref.	1906-024
National grid co-ordinates	E 209683 N 79705

Groundwater occurrence	Depth (mbGL)	Description	Interpretation
Damp	1	Light brown/ grey gravelly **CLAY** with 2% glass, 4%plastic, 2%ceramic, 1%wood & 2%metal	Made Ground
Slightly damp @ 1.5m	2	Medium dense dark brown gravelly **CLAY** with grey/ white ash banding with 2%glass & 2%plastic	Made Ground
Dry	3	Red/ brown **CLAY** with cobbles	Natural Subsoil
Dry	4	Red/ brown gravelly **CLAY** with cobbles	Natural Subsoil
Wet @4m	5	Sandy **GRAVEL** with cobbles	Natural Subsoil
Wet	6	END OF BOREHOLE@5.15M	
	7		
	8		

Notes:

- Geological interfaces recorded to the nearest 0.2m.

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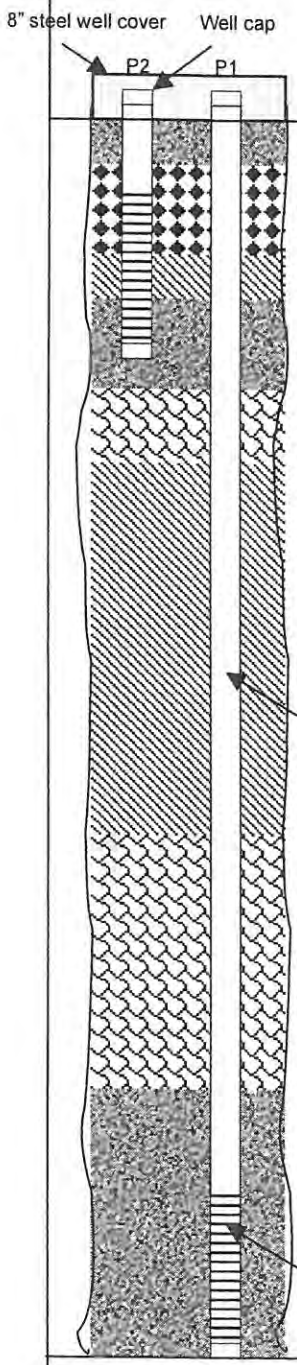
FINAL

Borehole Design & Completion



BOREHOLE LOG MW2

Client	SWS
MEL work item	1906 A2
Page No.	1 of 1
Date drilled:	19/02/07
Logged by:	S. Starr
Equipment used	Shell & Auger
MEL Doc. Ref.	1906-024
National grid co-ordinates	E209589 N079778

Groundwater occurrence	Depth (mbGL)	Description	Interpretation
Damp	1	Uncompact medium brown gravelly **CLAY** with 5 %plastic, 3 %ceramic & 5%wood	Made Ground
Dry	2	Compact dark brown gravelly **CLAY** Light grey silt bands ~2mm thick encountered at 1.85m.	Natural Subsoil
Damp	3	Firm light brown gravelly **CLAY**	Natural Subsoil
Dry	4	Firm dark brown **SILT/ CLAY** with cobbles	Natural Subsoil
Dry	5	Very compact dark brown/ grey gravelly **CLAY**	Natural Subsoil
Wet @6m	6		
Wet	7	Uncompact dark brown/ grey gravelly **CLAY**	Natural Subsoil
		END OF BOREHOLE @7.3M	

Notes:

- Geological interfaces recorded to the nearest 0.2m.

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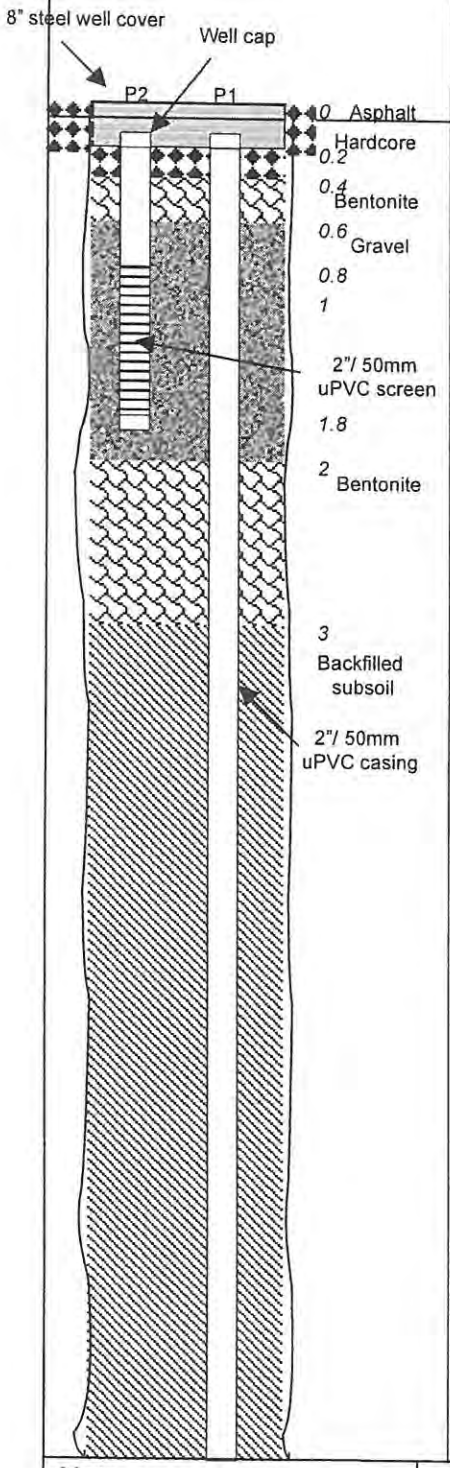
FINAL

Borehole Design & Completion



BOREHOLE LOG	MW3
Client	SWS
MEL work item	1906 A2
Page No.	1 of 2
Date drilled:	14-15/02/07
Logged by:	S. Starr
Equipment used	Shell & Auger
MEL Doc. Ref.	1906-024
National grid co-ordinates	E209643 N 79809

Groundwater occurrence	Depth (mbGL)	Description	Interpretation
	0.5	Hardcore & cement	Made Ground
Damp @ 0.5m	1	Brown to black peaty gravelly CLAY with 2% plastic, 2%glass, 1%wood & 1% steel.	Made Ground
Damp	2		
Damp	3	Stiff grey/brown **CLAY**	Natural Subsoil
Dry	4		
Dry	5		
Dry	6		
Dry	7		

Notes:

- Geological interfaces recorded to the nearest 0.2m.

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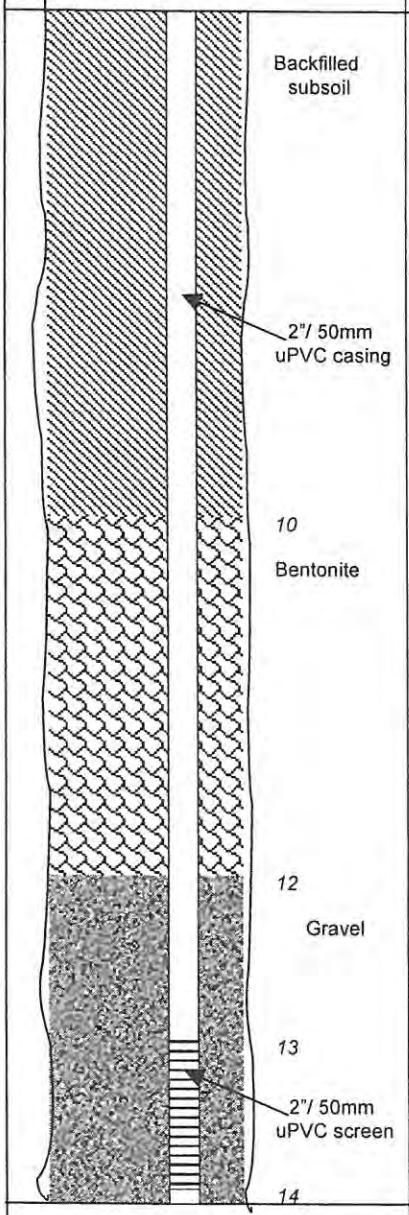
FINAL

BOREHOLE LOG MW3

Client	SWS
MEL work item	1906 A2
Page No.	2 of 2
Date drilled:	14-15/02/07
Logged by:	S. Starr
Equipment used	Shell & Auger
MEL Doc. Ref.	1906-024
National grid co-ordinates	E209643 N 79809



Groundwater occurrence	Depth (mbGL)	Description	Interpretation
Dry	8	Stiff grey/ brown **CLAY** with gravels at depth	Natural Subsoil
Dry	9		
Dry	10		
	10.5	Stiff grey/ brown gravelly **CLAY** with layers of green & red medium to coarse-grained **SAND**	Natural Subsoil
Dry	11	Stiff grey/ brown **CLAY** with gravels at depth	Natural Subsoil
Dry	12		
Dry	13		
Damp			
Wet @13.8m	13.6	Loose clayey sandy **GRAVEL**	Natural Subsoil
	14	END OF BOREHOLE@14M	

Notes:

- Geological interfaces recorded to the nearest 0.2m.

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GENERAL LEGEND, ABBREVIATIONS AND INSTALLATION DETAILS

BEDROCK

Metamorphic bedrock
Igneous bedrock
Mudstone bedrock
Siltstone bedrock
Limestone bedrock

COLOUR

Light Grey	Gy_l
Medium Grey	Gy_m
Dark Grey	Gy_d
Blue/grey	Bl-Gy
Orange/Brown	Or-Bn
Black	Bk

GRAIN SIZE (Soil)

Clay (% of)	C(20)
Silt (% of)	St(20)
Sand (% of)	Sd(20)
Gravel (% of)	G(20)
Sand (Fine to Medium)	Sd_{F-M}
Gravel (Fine to Coarse Subangular to angular)	$G_{F-C\ SA-A}$

MONITORING POINT COMPLETIONS

TS/C1/PH1	Terminal Site/Couple no./Phreatic no.
PR/C2/P2	Peat Repository/Couple no./Piezometer no.
H7	Von Post humification scale
	Push-on cap
	Screen
	Casing
	Porous tip
	Drive cone
P2_PH1	Piezometer no. and Phreatic tube no.
	Bentonite pellets
	Cement-Bentonite grout
	Gravel pack, nominal 2-5mm in diameter
	Damp, wet and water strike respectively
1/2/03	Static water table (with date or time since installation)

PLAN SKETCHES

PWS1	Percussion Window Sampler (PWS) boreholes
TP1	Hand dug trial pits / Shallow pit excavations (JCB)
100 BG	FID/PID in ppm Hydrocarbons with BG = background
99.791	Reduced levels - maOD Malin
	Oil pipeline
	Storage tanks (Overground and underground)

OVERBURDEN (Description uses BS 5930 and GSI guidelines)

BOULDER(S) (>200mm)

COBBLES (60 to 200mm)

GRAVEL (Homogeneous larger sized particles from 2 to 60 mm)

SAND (General, if without grain size description) Particle sizes: 2 to 0.06mm. Three sub-categories distinguishable to the eye)

Coarse **SAND** (2-0.6mm)

Medium **SAND** (0.6-0.2mm)

Fine **SAND** (0.2-0.06mm)

SILT (0.06 - 0.002mm)

CLAYS (<0.002mm)

CONCRETE

CRUSHED STONE or AGGREGATE or TARMACADAM

LANDFILL (eg plastic, glass, wood, domestic waste, concrete etc.)

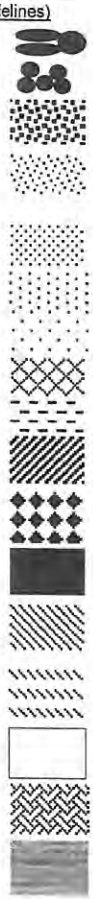
FILL OR BACKFILLED GROUND (unspecified)

COLLAPSED FORMATION (with possible voids) or **DRILL CHIPPINGS / MATERIAL RETURNED BY AIR FLUSH DRILLING**

LOSS (Blank - white)

TOP SOIL

PEAT (General) (with descriptions such as colour, plant remains evident, distinct H_2S smell etc) (H (Von Post) value associated commonly)



MONITORING POINT DESIGN FOR PEAT SUBSOILS

Push-on, female cap

The cap is loosely fitted to allow easy removal. The piezometer is labelled using indellible ink inside and outside the cap. A small hole is drilled in the side to enable air movement in and out of the piezometer.

Casing up-stand

The upstand is the height of the casing above ground level in meters. The height depends on local groundwater and surface water circumstances. The piezometer number is scrapped onto the side of the casing near the cap as with time the writing on the cap wears off. Upstands vary from 0.3 to 1.0m in height. The convention is allow a higher upstand for those piezometers positioned at a higher level.

Casing

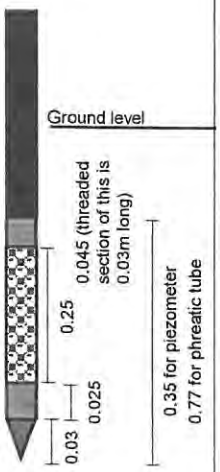
The casing is black or dark grey coloured, flush-threaded, uPVC. The OD is 26.80mm and the ID is 18.40. The casing is flush-threaded to the piezometer tip.

Tube or Piezometer tip

This section is installed opposite the required formation. There are two sections to the piezometer tip. The inner tube section is 18.40mm ID, white in colour and involves extruded microporous polyethylene. The outer comprises grey or black coloured uPVC with 10 x 0.013m diameter holes per 0.10m of piezometer tip. Therefore the surface area exposed to the formation (peat) is small. The piezometer tube tip is flush-threaded, either male or female, to the piezometer casing. Threaded part is 0.03m long. The phreatic tube tip is longer than the piezometer tube tip to allow for greater water level fluctuations.

Drive cone

This is grey coloured, solid, uPVC, pushed or screwed into the tube or piezometer tip. No glue has been used. If the ground is soft, a push-in button cap may be used instead of a drive cone.



NOTES:-

The phreatic tubes are pushed by hand into the peat. The piezometers are pushed or driven into the peat and mineral soil after a narrow diameter hole has been formed using overburden drilling (Cobra or Percussion Window Sampler) / coring equipment (Gouge corer). The tubes and piezometers have three main functions: water table measurements, water sampling, permeability measurements.

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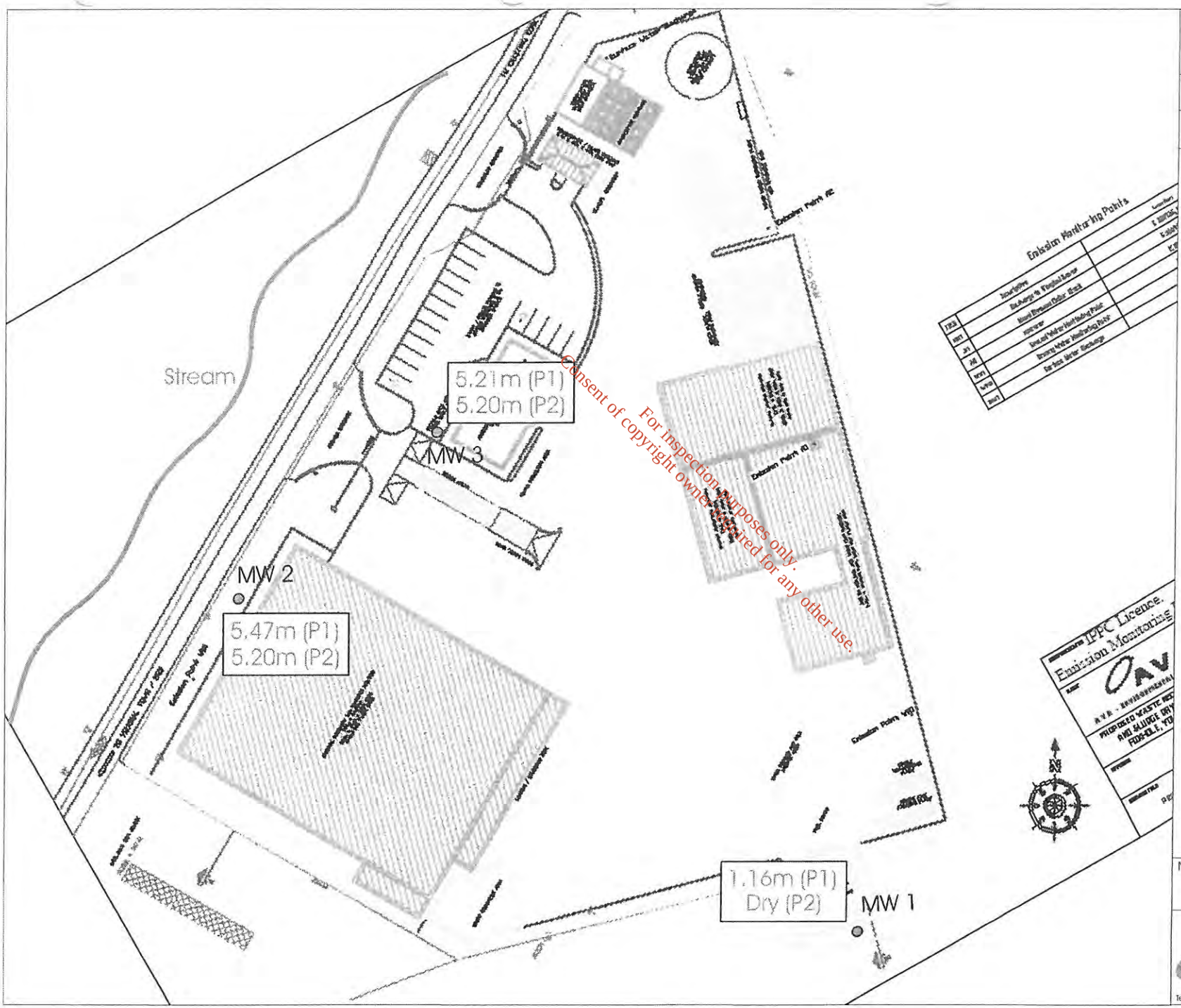
Appendix C

PARAMETER / SUBSTANCE	Expression Results	EU Directives & SI's										Dutch 2000 Levels		Results				
		Drinking Waters						Surface water				The Ministry of Housing, Spatial Planning and Environment Directorate-General for Environmental Protection Rijnstraat 8, P.O.Box 30945, 2500 GX, the Hague., The Netherlands		Minerex Environmental Limited				
		DRINKING WATER REGULATIONS						Water Quality (Dangerous Substances) Regulations 2001 (applies to all waters other than groundwaters)		Guidance from Waterford County Council on acceptable nitrate concentrations in groundwater (1874-002.xls)	Interim Guideline Values (IGV's) - EPA, 2004							
		SI no. 439 of 2000			SI no. 106 of 2007			S.I. No. 12 of 2001										
Medium analysed		Drinking Water Standard			Drinking Water Standard			Schedule Standards				WATER Shallow Ground Water (<10m) / Deep Ground Water (>10m)						
- water - soil - gas	Units	Parameter No	Parameter category	Parametric Value	Parameter No	Parameter category	Parametric Value	Standard (ug/l) for fresh water <100 hardness / >100 hardness	Standard (ug/l) for Tidal Waters			Target Levels (optimum)	Intervention (action)	MW1-P1	MW2-P1	MW2-P2	MW3-P1	MW3-P2
Arsenic (dissolved)	water	ug/l	5	B	10.00	5	B	10.00	25/25	20		10.00	10 / 7.2	60	5	5	4	4	4
Benzene	water	ug/l	6	B	1.00	6	B	1.00				1	0.20	30	<10	<10	<10	<10	<10
Cadmium - Dissolved	water	ug/l				10	B	5				5.00	0.4 / 0.06	6.00	1.7	0.6	<0.4	<0.4	<0.4
Chloride - total	water	mg/l	31	C	250	31	C	250					100mg/l	-	78	182	137	43	57
Cobalt	water	ug/l											20 / 0.70	100	71	2	1	<1	<1
DRO (Diesel range organics)	water	ug/l													<10	<10	<10	<10	<10
Ethylbenzene	water	ug/l										10.00	4	150	<10	<10	<10	<10	<10
Fluoride - total	water	ug/l	16	B	1000	16	B	1500	500/500	1500			0.5mg/l	-	<0.1	0.3	0.7	<0.1	0.3
Iron - Dissolved	water	mg/l				36	C	0.2				0.20			7.465	<0.002	<0.002	<0.002	<0.002
Manganese - Dissolved	water	mg/l	37	C	0.05	37	C	0.05				0.05			2.779	2.344	0.164	0.048	0.151
Mineral Oil (9)	water	ug/l											50	600	<10	<10	<10	<10	<10
Nitrate	water	mg/l	20	B	50.00	20	B	50.00			25.00	25.00			28.3	1.6	11.5	25.6	23.1
Phosphate (assume Ortho phosphate)	water	mg/l										0.03			0.05	0.12	0.11	0.08	0.08
PRO (Petroleum range organics)	water	ug/l													<10	<10	<10	<10	<10
Sodium	water	mg/l	41	C	200	41	C	200				150.00			43	120	120	28.5	41
Sulphate	water	mg/l	40	C	250	40	C	250				200.00			37	69	248	22	40
SVOC - USEPA 8260 inc TICs	water	ug/l													<1	<1	<1	<1	<1
Toluene	water	ug/l							10.0	10.0		10	7	1000	<10	<10	<10	<10	<10
Volatile organic compounds (VOC)	water	ug/l											0.10	25	<1	<1	<1	<1	<1
Xylenes (3 isomers)	water	ug/l							10.0	10.0		10	0.2	70	<10	<10	<10	<10	<10

Appendix D



Appendix D
Water level map

AVR Environmental Solutions
Foxhole, Youghal

Drawing Ref. 1906-008 (MASTER)
Date: 17/04/07

Common legend

- Borehole location
- Water level (mOD)

NOTES

Minerex
Environmental Limited

Tel 01-2964435, Fax 01-2964436, Email: Enquiries@minerex.ie

Appendix E

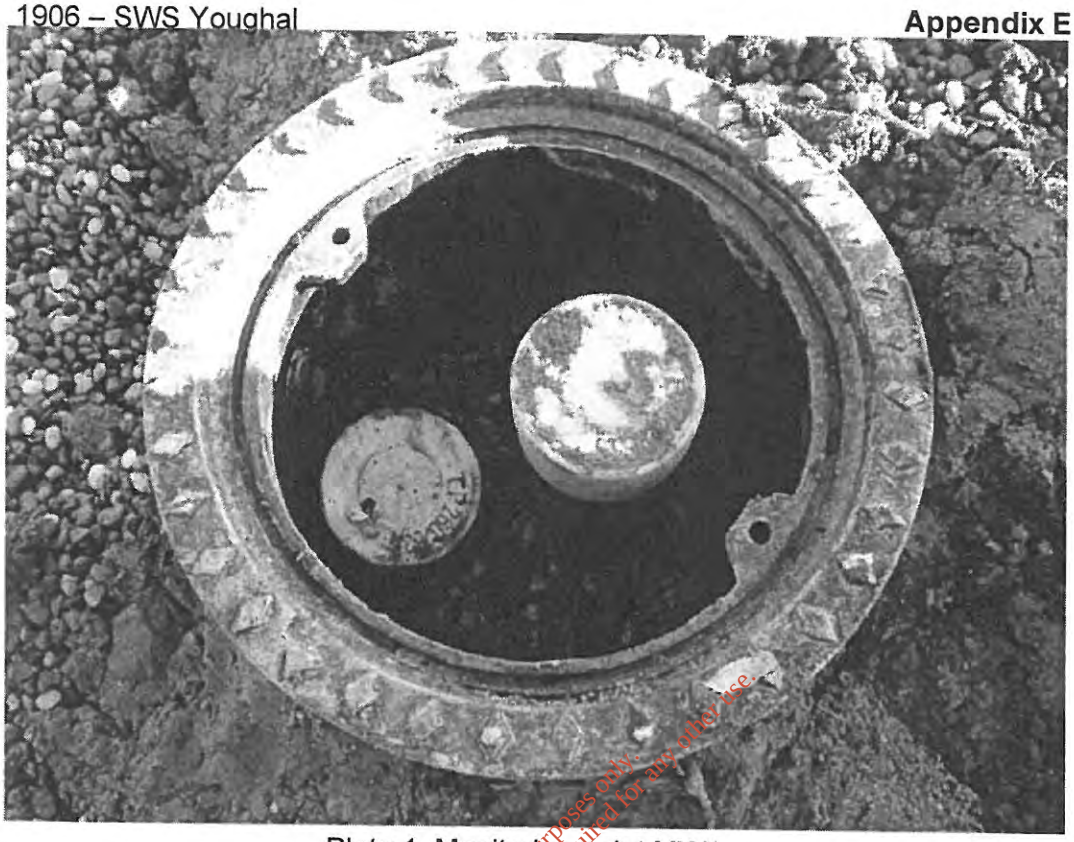


Plate 1. Monitoring point MW1

Plate 2. Monitoring point MW3

Appendix 4

6.0 SOILS & GEOLOGY

6.1 INTRODUCTION

6.1.1 Background & Objectives

Hydro-Environmental Services (HES) was engaged by ERAS Eco. Ltd to carry out an assessment of the potential impact of a proposed upgrade to an existing waste recovery / transfer facility at Foxhall, Youghal Co. Cork on the soil and geological environment.

This report provides a baseline assessment of the environmental setting of the site in terms of soil & geology and discusses the potential impacts of the construction and operation of the proposed development may have on them. Where required appropriate mitigation measures to limit any identified significant impacts to soils and geology are recommended.

6.1.2 Existing and Proposed Developments

The existing development has planning permission (Ref: 04/7531) for the recovery/transfer of waste and a sludge drying facility. The development comprises of:

- Waste Recovery & transfer building;
- Sludge dry facility;
- Wastewater treatment and balance tanks;
- Stormwater tanks, wheel wash & bunded storage areas;
- Ancillary building and facilities; and,
- Outputs which include dry sludge and wastewater.

The proposed development which is the subject of this EIS comprises:

- Hazardous waste treatment facility using Aqua Citrox^{R} Technology;
- Handling / storage area for solvents;
- Lime stabilisation unit;
- Anaerobic digestion unit; and,
- Outputs which will include inert solids, water and gases.

6.1.3 Relevant Legislation

The EIS is carried out in accordance with the follow legislation:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations and subsequent Amendments (S.I. No. 84 of 1995, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000, S.I. No. 538 of 2001), S.I. No. 30 of 2000 the Planning and Development Act, 2000 and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments, on the assessment of the effects of certain public and private projects on the environment; and,
- S.I. No. 4 of 1995: The Heritage Act 1995.

6.1.4 Relevant Guidance

The soils and geology section of the EIS is carried out in accordance with guidance contained in the following documents:

- Environmental Protection Agency (2003): Advise Notes on Current Practice (in the Preparation of Environmental Impact Statements);
- Environmental Protection Agency (2002): Guidelines on the Information to be Contained in Environmental Impact Statements;

- Institute of Geologists Ireland (2002): Geology in Environmental Impact Statements – A Guide;
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes; and,
- County Cork Development Plan (2003);

6.2 SCHEDULE OF WORKS

6.2.1 Desk Study

A desk study of the site and the surrounding area was largely completed in advance of undertaking the walkover survey and site investigation. This involved collecting all relevant geological data for the site and surrounding area. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 25 (Geology of South Cork). Geological Survey of Ireland (GSI, 2004);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets;
- The Department of Communications Marine and Natural Resources - Exploration and Mining Division website (www.minex.ie);
- General Soil Map of Ireland 2nd edition (www.epa.ie);
- Ordinance Survey of Ireland – Discovery Series and 1:50,000 maps;
- Geotechnical Site Investigation Report by Geotech Specialists Ltd (August, 2004);
- Letter to EPA Inspector from Minerex Ltd dated 19th January, 2007; and,
- Report on Site Investigation by Minerex Ltd (April, 2007).

6.2.2 Walkover survey

A walkover survey of the site was undertaken by Hydro Environmental Services on 5thAugust 2010. A visual inspection of the site was carried out whereby all potential sources of contamination including chemical and waste storage areas were checked for signs of leakages such as discolouration and smell. Groundwater levels were recorded in the 3 no. on-site monitoring wells.

6.2.3 Impact Assessment Methodology

Using information from the desk study and data from the previous site investigations an estimation of the importance of the soil and geological environment within the study area is assessed using the criteria set out in Table 6.1 (NRA, 2005).

The evaluation criteria (EPA, 2002 and EPA, 2003) for the assessment of impacts require that likely impacts are described with respect to their extent, magnitude, complexity, probability, duration, frequency, reversibility and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in EPA (2002) Glossary of Impacts and are as follows in Table 6.2. In addition the two impact characteristics proximity and probability are described for each impact and these are defined in Table 6.3.

In order to provide an understanding of this descriptive system in terms of the geological /hydrolological environment, elements of this system of description of impacts are related to examples of potential impacts on the hydrology and morphology of the existing environment, as shown in Table 6.4

Table 6.1: Estimation of Importance of Soil and Geology Criteria (NRA, 2005)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site). Well drained and/or highly fertility soils. Moderately sized existing quarry or pit Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed Wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

Table 6.2. Impact Descriptors as per EPA, 2003

Impact Characteristic	Degree/Nature	Description
Quality	Positive	A change which improves the quality of the Environment.
	Neutral	A change which does not affect the quality of the Environment.
	Negative	A change which reduces the quality of the environment.
Significance	Imperceptible	An impact capable of measurement but without noticeable consequences.
	Slight	An impact which causes noticeable changes in the character of the environment without affecting its' sensitivities.
	Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends.
	Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Profound	An impact which obliterates sensitive characteristics.
Duration	Temporary	Impact lasting for one year or less.
	Short-term	Impact lasting one to seven years.
	Medium-term	Impact lasting seven to fifteen years.
	Long-term	Impact lasting fifteen to sixty years.
	Permanent	Impact lasting over sixty years.
Type	Do Nothing	The environment as it would be in the future should no development of any kind be carried out.
	Cumulative	The addition of many small impacts to create one larger, more significant impact.
	Indeterminable	When the full consequences of a change in the environment cannot be described.
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost.
	Synergistic	Where the resultant impact is of greater significance than the sum of its constituents.
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Worst Case	The impacts arising from a development in the case where mitigation measures substantially fail.

Table 6.3. Additional Impact Characteristics

Impact Characteristic	Degree/Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Low	A low likelihood of occurrence of the impact.
	Medium	A medium likelihood of occurrence of the impact.
	High	A high likelihood of occurrence of the impact.

Table 6.4. Impact Descriptors Related to the Receiving Environment

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
Negative only	Profound	• Widespread permanent impact on: - The extent or morphology of a cSAC. - Regionally important aquifers. - Extents of floodplains. • Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	• Local or widespread time dependent impacts on: -The extent or morphology of a cSAC / ecologically important area. -A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). -Extent of floodplains. • Widespread permanent impacts on the extent or morphology of an NHA/ecologically important area, • Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	• Local time dependent impacts on: - The extent or morphology of a cSAC / NHA / ecologically important area. - A minor hydrogeological feature. - Extent of floodplains. • Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	• Local perceptible time dependent impacts not requiring mitigation.
Neutral	Imperceptible	• No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

6.3 THE EXISTING ENVIRONMENT

6.3.1 Site Location and Description

The site is located off Regional Road R634 (former N25 Waterford – Cork National Road) adjacent to Youghal Landfill and Civic Amenity Centre. The site itself and the surrounding area are situated on low-lying land (approximately 5m OD Malin Head) reclaimed from the Blackwater Estuary which is known locally as Youghal Mudlands. The northern and western boundaries of the site are defined by a public access road and an adjacent development respectively. The southern and western boundaries overlook undeveloped reclaimed land.

The site which has an approximate area of 2.32Ha currently operates as a non-hazardous waste recovery /transfer facility. The existing development which is completely constructed on concrete hardstanding comprises three main buildings. These include a waste recovery/transfer building, a dry sludge building and an administration block. Wastewater treatment (domestic and process water) and stormwater attenuation facilities are situated on the northeast corner of the site. This area also acts as a chemical store for the wastewater treatment works (i.e. NaOCl, $Al_2(SO_4)_3$ and NaOH). All chemical storage containers, which are located outside, are bunded by plastic spill trays. Located on the

southern part of the site is a bunded hydrocarbon storage area and an outside waste storage area which is surrounding by concrete walls. Youghal Landfill facility is located approximately 300m to the northeast of the site. The Foxhall waste management site historically comprised part of the neighbouring landfill facility and housed a diesel storage area near the current site entrance (i.e. east of the administration block). Historical site soil contamination is discussed below in Section 6.3.4.

6.3.2 Soils and Subsoils

The published soils map (www.epa.ie) for the area is shown as Figure 6.1. Soils mapped in the vicinity of the site include deep mineral (AminDW) and marine which are associated with the estuary of the Blackwater River (Estuary) to the east of the site. Deep well drained mineral soil is mapped to the west of the site. The published subsoils map of the area (www.gsi.ie) shows the site to be underlain by made ground which is consistent with the historical background of the area which involved reclamation of land within the area known locally as the Youghal Mudlands. Natural mapped subsoils in this area include marine sands in the vicinity of the estuary and sandstone tills further west of the site (refer to Figure 6.2).

Site specific information on the superficial geology of the site was initially obtained by Geotech Ltd in August 2004 during site investigation work for the exsting development. A summary of the stratum encountered is shown in Table 6.5. No bedrock was encountered at a maximum depth of 12m below ground level (mbgl).

Table: 6.5 Summary of Strata Encountered (Geotech Ltd, 2004)

Stratum Encountered	Proven Thickness (m)
MADE GROUND – Gravelly sandy clay with building and household rubbish	0.3 – 2.3
GLACIAL TILL – Stiff gravelly clay with occasional cobbles	≤ 11.6
FLUVIO-GLACIAL DEPOSITS – Loose clayey slightly gravelly SAND	≤ 1.8

A summary of stratum encountered by Minerex Environmental Ltd during the installation of groundwater monitoring wells (MW1, MW2 & MW3) in April, 2007 is shown in Table 6.6. The made ground was reported to comprise predominately of gravelly clay with fragments of plastic (4-5%), wood (1%), glass (2%) and ceramics (2-3%). The underlying natural subsoils generally consisted of stiff grey/brown CLAY or red/brown gravelly CLAY with cobbles which were underlain by loose clayey sandy GRAVEL. No bedrock was encountered at a maximum depth of 14m bgl.

Table 6.6: Summary of Strata Encountered (Minerex Ltd, 2004)

Stratum Encountered	Proven Thickness (m)
Concrete	
MADE GROUND – clay with plastic, Wood, metals & ceramics	0 – 3.0
Firm-stiff red/brown gravelly CLAY with cobbles	2 – 10.6
Loose clayey sandy GRAVEL	0.3 – 2.0

6.3.3 Bedrock Geology

Based on the mapped geology of the area (www.gsi.ie) the bedrock underlying the site consists mainly of the Waulsortian Limestones. The formation consists of massive, unbedded mounds of calcareous deposits in the form of mudstones, wackestones and packstones. Devonian rocks which are situated to the north and south of the site include the Ballysteen and Gyleen Formations, part of which is referred to as the Old Red Sandstone. Synclinal folding associated with the Variscan orogeny means that these limestones are surrounded on all sides by progressively older rocks. The bedrock map is shown as Figure 6.3.

6.3.4 Historical Site Contamination Sources

Historical reclamation work in this area has resulted in made ground with a proven thickness of up to 3m (Minerex, 2007) being present in the area of the site. Site investigation work as described in Section 6.3.2 identified the made ground to be predominately clay with small portion of construction and demolition waste. The site was then was used by the neighbouring landfill and housed a diesel storage area in the vicinity of the current site entrance (located to the east of the administration building). The area measured approximately 7m x 6.5m. Results of soil analysis undertaken by Minerex (2007) in this area were below the limit of detection (for hydrocarbons) used by the laboratory. PID readings for the samples taken were 0ppm and no odour of hydrocarbons was detected. It was concluded in the report (Minerex, 2007) that Diesel Range Organics (DRO's) were likely to be present in very minute concentrations above background levels.

6.3.5 Resource Importance

Using the criteria set out in Table 6.1 (NRA, 2005) the economic importance of the soils and geology underlying the site is "Low". This is based on criteria - "recent landfill site for construction and demolition wastes", which is within the lowest importance category.

6.4 CHARACTERISTICS OF THE DEVELOPMENT

The existing concrete yard is to be retained and used as a base for a new fibre mesh reinforced concrete slab. The new concrete will be laid to fall to a new grit trap and collection chamber located in the northern part of the site. A transfrontier shipment (TFS) compound will be constructed on the proposed newly constructed slab. The TFS will be bunded and the construction of this bund will consist of a 2m high reinforced concrete wall and a 450mm high reinforced concrete raised traffic bump. Runoff from the bunded area will be diverted to a grit trap/ collection manhole which will then drain to existing surface water drainage system via an automated butterfly valve. Stringent testing will be undertaken before runoff is allowed enter the existing surface water system. Due to the potentially hazardous and corrosive characteristics of the proposed waste it is proposed that pipework between the collection and discharge manholes are fabricated using stainless steel.

6.5 POTENTIAL IMPACTS OF DEVELOPMENT

6.5.1 Do Nothing Scenario

The site would remain as a waste recovery/transfer facility for non-hazardous waste.

6.5.2 Worst Case Scenario

Contamination of soils/subsoil due to leaks and cracks in the bunded area and leaks from the surface water drainage system.

6.5.3 Likely impacts and Mitigation measures

The likely impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are shown in Table 6.7.

6.6 RESIDUAL IMPACTS

No residual impacts are anticipated on the soil and geological environment.

6.7 Non-Technical Summary

The natural geology underlying the site includes gravelly clay with cobbles and limestone bedrock at depth. Overlying the natural soils in the vicinity of the site is a layer of made ground which was imported to reclaim the area from the estuary. The made ground comprises construction and demolition waste. The existing site which was constructed over this material is completely underlain by concrete hardstanding.

The proposed development which will be constructed on the existing hardstanding will have no physical impacts on the underlying soils and geology whatsoever. It is proposed that a reinforced concrete slab will be poured over the existing concrete hardstanding area. This will rule out any potential leakages that may have occurred from cracks within the existing hardstanding concrete.

Due to the hazardous and corrosive characteristics of the waste it is proposed that pipework between the collection chamber and the discharge manhole is fabricated using stainless steel. This will prevent corrosion and leakage of pipes into the future. Only non-hazardous runoff will be allowed continue into the existing surface water drainage system.

It is proposed that twice yearly inspections be carried out by suitably qualified engineers and written certification be recorded of these inspections to ensure the bunded area remains fit for purpose. Regular monitoring of groundwater quality up-gradient and down-gradient of the hazardous waste operation will indicate if leakages into the underlying soils are occurring.

No impacts on the soil and geological environmental are anticipated.

6.8 REFERENCES

Environmental Protection Agency (2003): Advice Notes on Current Practice (in the preparation on Environmental Impact Statements).

Environmental Protection Agency (2002): Guidelines on the Information to be contained in Environmental Impact Statements.

Geotech Ltd (2004): Geotechnical Site Investigation Report at Youghal, Co. Cork.

Institute of Geologists Ireland (2002): Geology in Environmental Impact Statements – A Guide.

Minerex Ltd (2007): Report on Site Investigation at Foxhall Waste Facility, Youghal, Co. Cork.

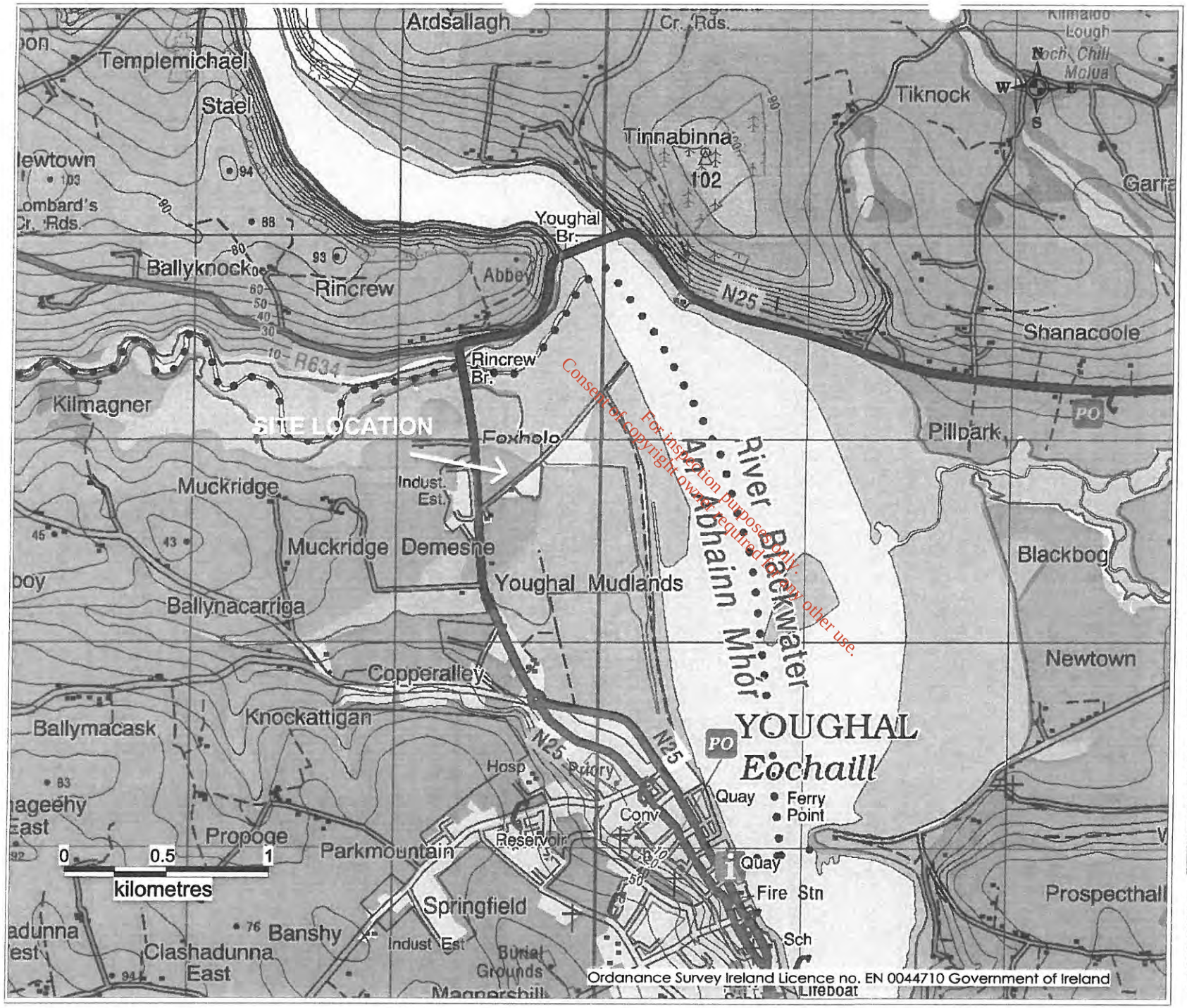
Minerex Ltd (2007): Letter to the EPA Inspector dated 19th January 2007.

National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

Table 6.7 Impacts Table Construction

	Hazard / Source and character of potential impact	Pathway	Receptor	Potential impact on soils and geology(refer to Table 6.2 to 6.4 for definition of impact descriptors and classification).	Proposed Mitigation Measures	Residual impact
SG1	Excavation of soil and bedrock during construction works It is proposed that the new waste storage and treatment area be constructed on the existing site hardstanding area. Therefore, there will be no physical changes made to the soil and geology of the site as no excavation will be required.				None required	
SG2	Contamination of soils/subsoils underlying the site due to leakages from bunded areas and surface water drainage water drainage systems. Runoff from waste storage areas.	Cracks in existing hardstanding areas and surface water drainage routes.	Soil/subsoil	Negative, significant, direct, low probability impact on soils and geology	Design measures to prevent accidental leaks of waste include: To contain spillages within the bunded area it is proposed that a reinforced concrete slab will be poured over the existing concrete hardstanding area. This will rule out any potential leakages that may have occurred from cracks within the existing hardstanding concrete. Runoff from the TRS will be prevented by the construction of a 2m high concrete wall. Access to the bunded will be guarded by a 450mm concrete ramp which will also prevent runoff leaving the bunded area. Due to the hazardous and corrosive characteristics of the waste it is proposed that pipework between the collection chamber and the discharge manhole is fabricated using stainless steel. This will prevent corrosion and leakage of pipes into the future. Only non-hazardous runoff will be allowed continue into the existing surface water drainage system. This will be determined by analysis. Monitoring and maintenance measure: It is proposed that twice yearly inspections be carried out by suitably qualified engineers and written certification be recorded of these inspections to ensure the bunded area remains fit for purpose. Maintenance of the TOC and butterfly valve should conform to their respective manufacturers' specifications. The TOC sensor contains perishable material that will need to be changed at regular intervals in addition to general maintenance as required. Regular monitoring of groundwater quality up-gradient and down-gradient of the hazardous waste operation which will indicate if leakages into the underlying soils are occurring.	Neutral, imperceptible, low probability, long term impact on soils/subsoils

FIGURES



Legend:

- Site Boundary
- Deep Mineral Soil (AminDW)
- Marine Sands
- Made Ground
- Alluvium
- Rock at Surface
- Poorly Drained Mineral (AminPD)

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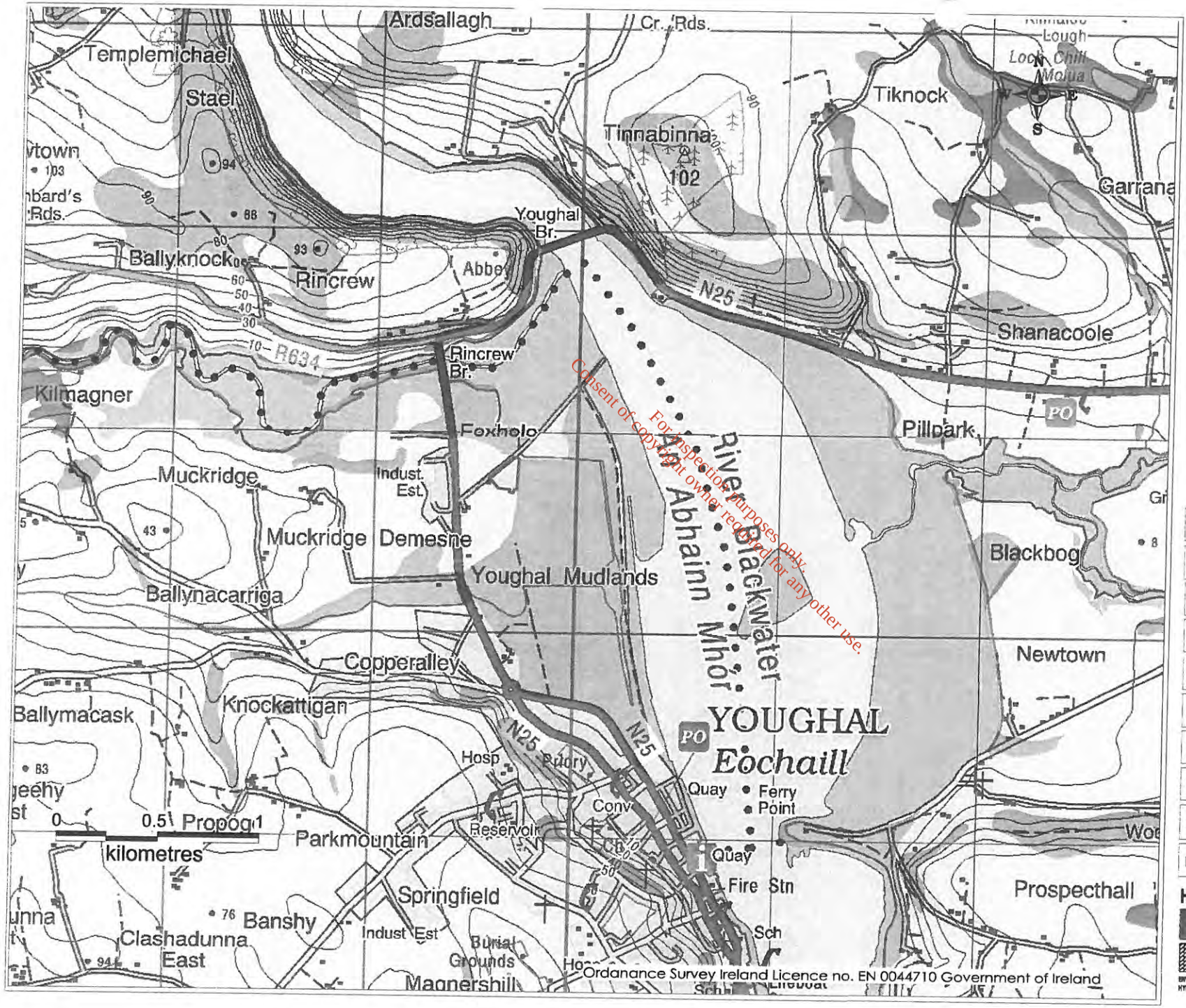
Job: Foxhall Waste Facility	
Project No. P1165	
Figure No. 6.1	
Sheet Size: A4	
Drawing No. P1165-1110-A4-601-00A	
Date: 08/11/2010	
Scale: 1:25,000	
Drawn by:DB	Checked by: MG

HYDRO-ENVIRONMENTAL SERVICES
22 Lower Main Street
Dungarvan, Co. Waterford
ENVIRONMENTAL ENGINEERING HYDROLOGY HYDROGEOLOGY
Tel: +353-58-44 122
Fax: +353-58-44 244
E-mail: mgill@cablesurf.com



Legend:

- Site Boundary
- Sandstone Tills
- Marine Sands
- Made Ground
- Rock at Surface
- Sandstone/shale Tills
- Alluvium

Title: Local Subsoils Map	
Client: Eras Eco Ltd	
Job: Foxhall Waste Facility	
Project No. P1165	
Figure No. 6.2	
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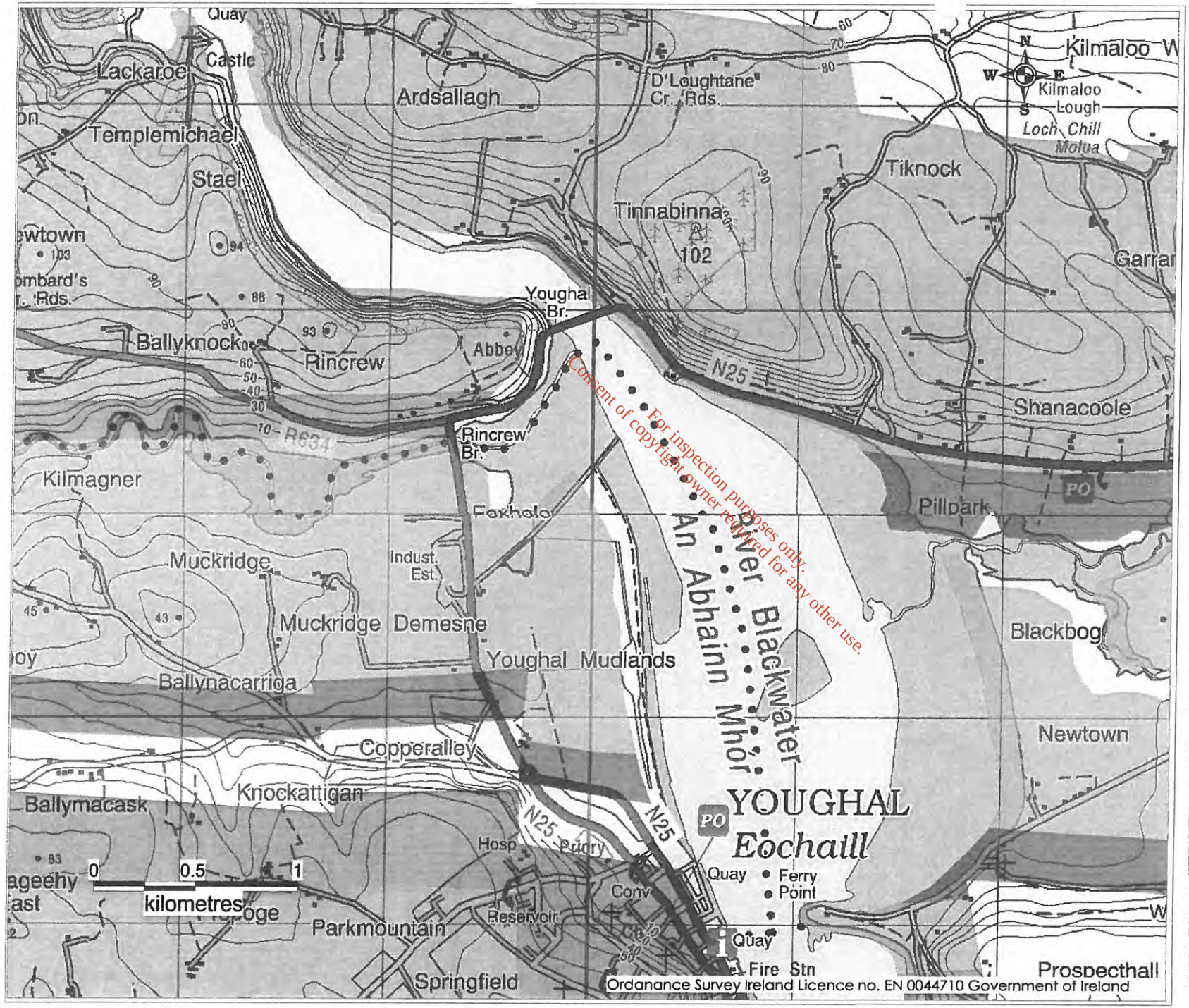
HYDRO-ENVIRONMENTAL SERVICES
22 Lower Main Street
Dungarvan, Co. Waterford
ENVIRONMENTAL ENGINEERING HYDROLOGY HYDROGEOLOGY
Tel: +353-58-44 122
Fax: +353-58-44 244
E-mail: mgill@cablesurf.com



Legend:

- Site Boundary
- Waulsortian Limestones
- Ballysteen Formation
- Ballytrasna Formation
- Gyleen Formation
- Crows Point Formation

Title: Local Bedrock Geology	
Client: Eras Eco Ltd	
Job: Foxhall Waste Facility	
Project No. P1165	
Figure No. 6.3	
Sheet Size: A4	
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Date: 08/11/2010	
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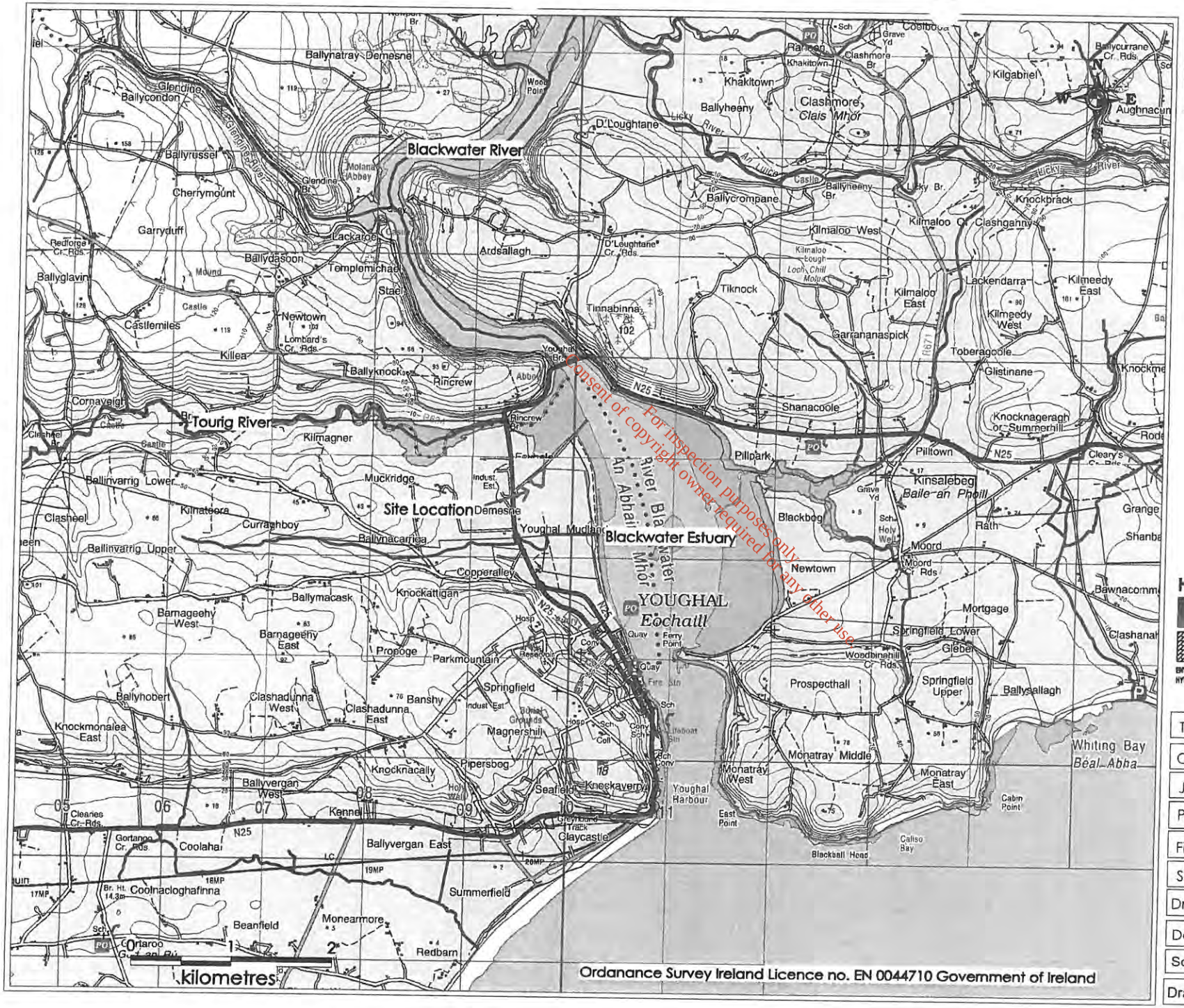
HYDRO-ENVIRONMENTAL SERVICES
22 Lower Main Street
Dungarvan, Co. Waterford
ENVIRONMENTAL ENGINEERING HYDROLOGY HYDROGEOLOGY
Tel: +353-58-44 122
Fax: +353-58-44 244
E-mail: mgill@cablesurf.com



HYDRO-ENVIRONMENTAL SERVICES
22 Lower Main Street
Dungarvan, Co. Waterford
ENVIRONMENTAL ENGINEERING HYDROLOGY HYDROGEOLOGY
Tel: +353-58-44 122
Fax: +353-58-44 244
E-mail: maill@cablesurf.com

Title: Regional Hydrology Map	
Client: Eras Eco Ltd	
Job: Foxhall, Youghal	
Project No: P1165	
Figure No: 7.1	
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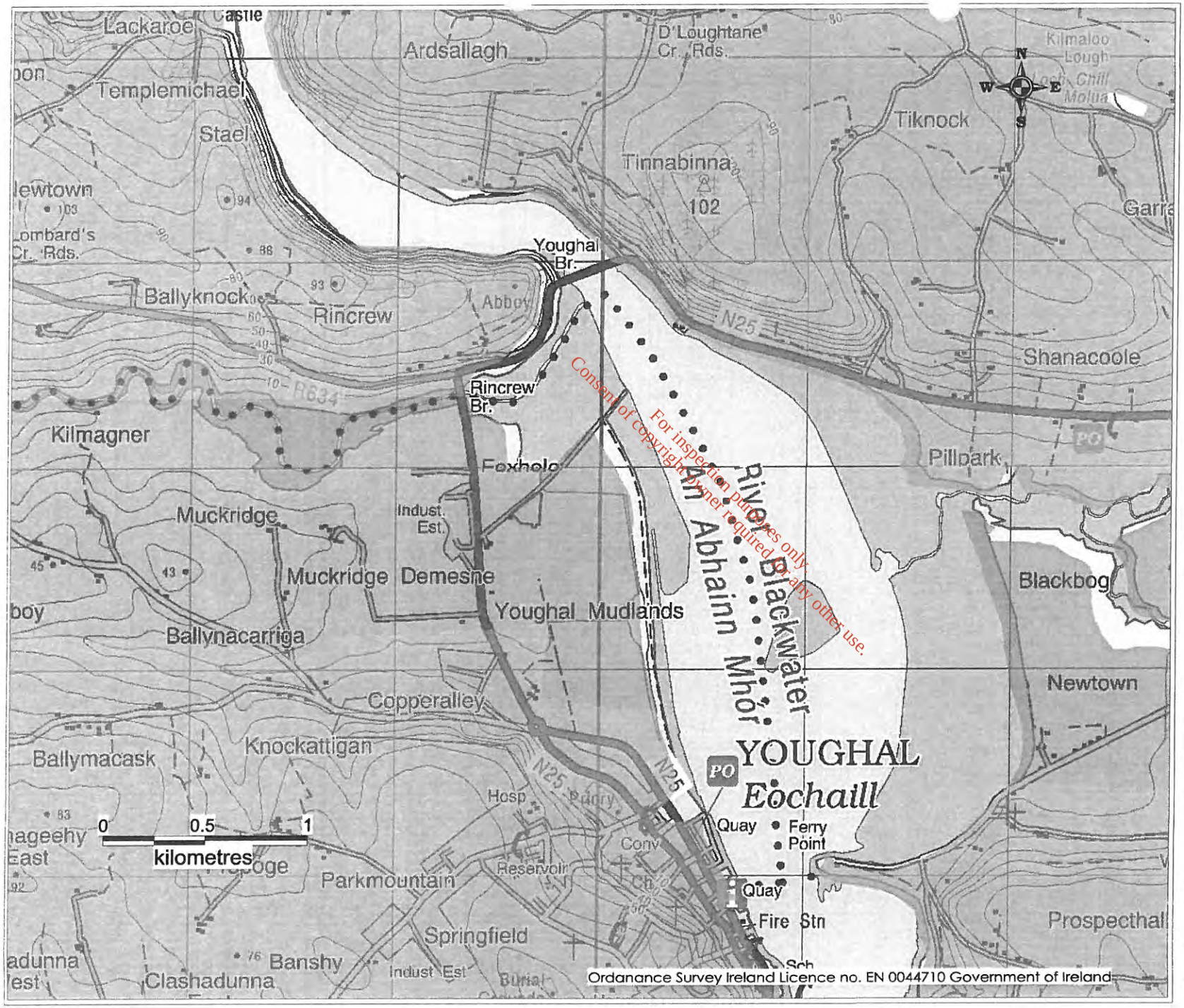
Scale: - 1:50000	
Drawn By: DB	Checked By: MG



Legend:

- Site Boundary
- Poorly Productive Aquifer
- Karstified Aquifer

Title: Aquifer Map	
Client: Eras Eco Ltd	
Job: Foxhall Waste Facility	
Project No. P1165	
Figure No. 7.2	
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Date: 08/11/2010	
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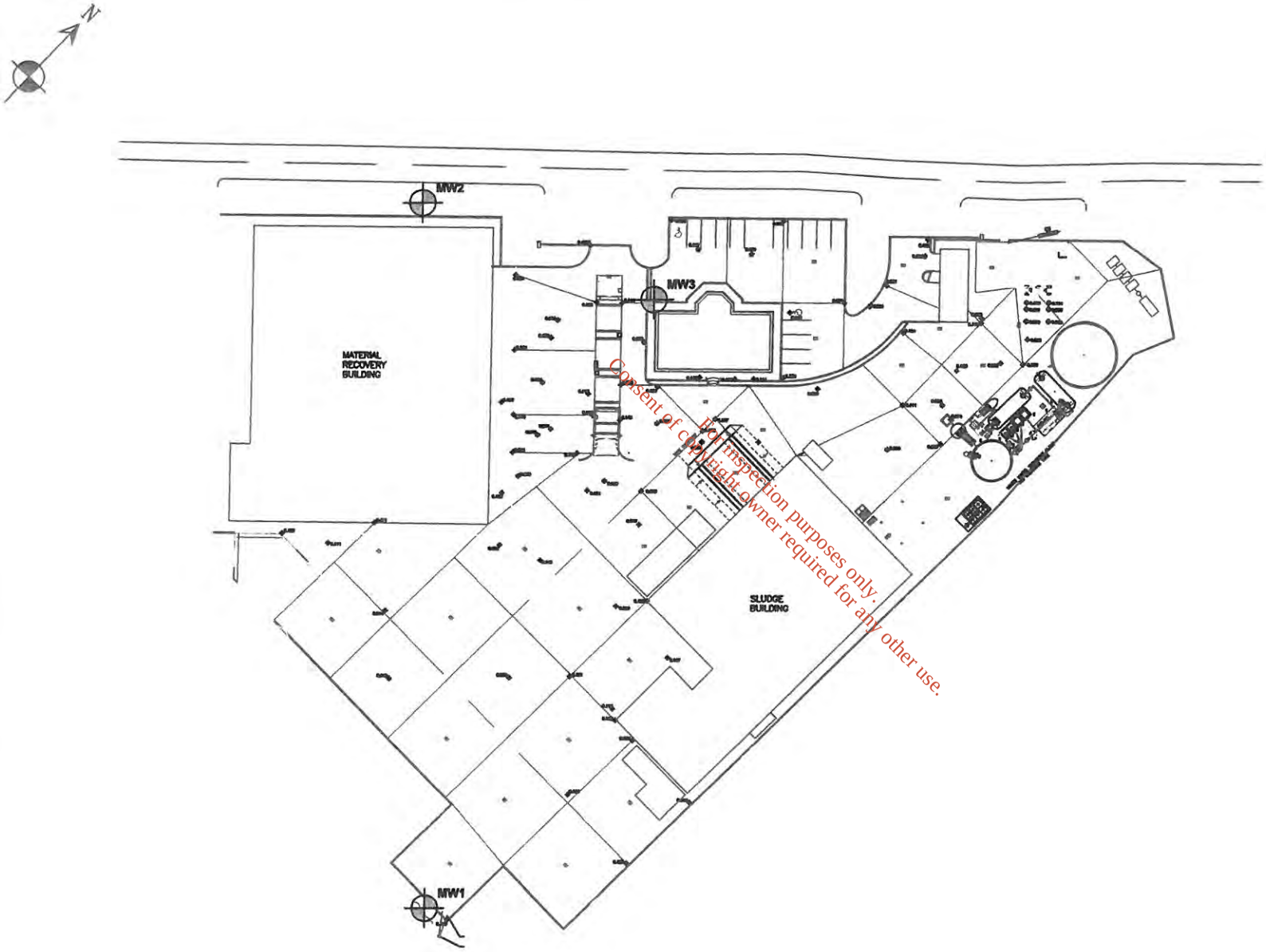
Drawn by:DB	Checked by: MG

HYDRO-ENVIRONMENTAL SERVICES
22 Lower Main Street
Dungarvan, Co. Waterford
ENVIRONMENTAL ENGINEERING
HYDROLOGY HYDROGEOLOGY
Tel: +353-58-44 122
Fax: +353-58-44 244
E-mail: mgill@cablesurf.com



LEGEND:

MW1 BOREHOLE LOCATIONS

Date	Description	Chkd	Signed

Revisions

22 Lower Main Street
Dungarvan, Co. Waterford

Tel: +353-58-44 122
Fax: +353-58-44 244
E-mail: mgill@cablesurf.com

Client:	ERAS ECO Ltd
Job:	Foxhole, Youghal, Co. Cork
Title:	Borehole Locations
Figure No:	7.3
Drawing No:	P1165-1110-A4-703-00A
Sheet Size: A4	Project No.: P1165
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Date: 08/11/2010	Checked By: MG