Comhairle Contae Chorcaí
Cork County Council

Environmental Department,
Inniscarra, Co. Cork.
Tel: (021) 4532700 • Fax (021) 4532727
Web: www.corkcoco.ie
An Rannóg Comhshaoil,
Inis Cara, Co. Chorcaí.
Fón: (021) 4532700 • Faics (021) 4532727
Suíomh Gréasáin: www.corkcoco.ie

08 May 2009

Mr Brian Meaney
Office of Licencing and Resources
Environmental Protection Agency
PO Box 3000
Johnstown Castle
Co. Wexford

Re: Application for the Certification of an Unregulated Landfill Site (namely Newmarket Landfill) as per S.I. No. 524 of 2008 Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008

Dear Sir,

Cork County Council would like to apply to have Newmarket landfill site Certified as per the Waste Management Regulations 2008.

A Tier I study was completed on this site in August 2007 as part of Cork County Councils statutory obligation under Section 22 of the Waste Management Act to investigate all old landfill sites in the county.

In March of 2008 O'Callaghan Moran and Associates Consultants were appointed to complete a Tier II Site Investigation and Report on the site following a competitive Tendering Process in March 2008. The investigation was completed between June and July of 2008 and a Tier II report was prepared in August 2008 showing that this site has reduced from a Moderate to Low Risk site.

Please find a copy of the Tier I and Tier II reports attached along with a cheque for the amount of €5,000. We request that the Agency consider refunding or waiving all or part of the fee as per section (3) of the Regulations.

If you have any queries please do not hesitate to contact me.

Yours faithfully,

Kieran Coffey
A/Senior Executive Engineer
Environment Directorate
Cork County Council

Granary House
Rutland Street
Cork

Tel. [021]4321521
Fax. [021]4321522

TIER 2 AND 3

ENVIRONMENTAL RISK ASSESSMENT

OF A

FORMER MUNICIPAL LANDFILL

NEWMARKET,

COUNTY CORK

Prepared For: -

Environmental Directorate,
Cork County Council,
Inniscarra,
Co. Cork

Prepared By: -

O' Callaghan Moran & Associates,
Granary House,
Rutland Street,
Cork

August 2008

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LIST OF APPENDICES

1. INTRODUCTION

Cork County Council (Environment Directorate) completed an inventory and conducted preliminary risk assessments of unregulated waste disposal sites in County Cork in accordance with the requirements of Section 22 of the Waste Management Act, 1996 to 2007.

The preliminary, or Tier 1 Assessments, followed the guidance in the Environmental Protection Agency (Agency) guidance document "Code of Practice Environmental risk Assessment for Unregulated Waste Disposal Sites (CoP)",which was published in April 2007.

The Council completed the Tier I Assessment of the Newmarket Landfill in August 2007, which ranked it as being of Moderate Risk. A copy of the assessment is included in Appendix 1. In May 2008 the Council appointed O' Callaghan Moran & Associates (OCM) to undertake a Tier 2 & 3 Environmental Risk Assessment of the site. The objective of the assessments was to establish the final environmental risk rating for the site.

1.1 Methodology

The Tier 2 assessment, which was carried out in accordance with the guidance in the COP, included a an initial review of the Tier 1 Report; review of original data sources; and a site inspection to get an understanding of historical landuse; establish the local and regional hydrological and hydrogeological conditions; confirm the presence of potentially sensitive off site receptor; and identify suitable locations for the intrusive investigation programme.

OCM subsequently designed and implemented a site investigation programme that included:-

- Geophysical survey
- Trial pit survey,
- Collection and analyses of waste and sub-soil samples,
- Installation of landfill gas/leachate monitoring wells,
- Installation of groundwater monitoring wells,
- Collection and analyses of groundwater samples,
- Collection and analysis of surface water samples
- Landfill gas monitoring.
- Topographic Survey

OCM carried out the intrusive investigation in accordance with BS 10175:2001 Investigation of Potentially Contaminated Sites-Code of Practice. The intrusive works were supervised by experienced OCM Environmental Scientist who was also responsible for all field monitoring and the collection of the waste, soil, surface water and groundwater samples. The leachate and groundwater monitoring wells were installed by Glovers Site Investigations under OCM supervision.

The testing laboratory used has UKAS certification for the majority of the analytical procedures. The laboratory methodologies were all ISO approved or equivalent.

A topographic survey was carried out by Focus Surveys and the geophysical survey was conducted by Apex Geoservices Ltd.

2. SITE DESCRIPTION

2.1 Site Location

The site is located approximately 1km to the southwest of Newmarket, as shown on Figure 2.1. The National Grid Reference is 131030: 106760. It is accessed off a national tertiary road, which runs between Newmarket and Boherboy.

2.2 Site Layout

The site occupies an area of 0.29 ha, as shown on Figure 2.2. It is bordered to the north by a drainage ditch, which separates it from the Cork County Council wastewater treatment plant (WTP) serving the town of Newmarket. The WTP is directly north of this drainage ditch. The site is bounded to the west by the River Dalua. To the east and south the site is bounded by steeply sloping wooded lands.

Prior to the site investigations much of the landfill area was covered with grass and large hedging plants (poplars), with trees (sycamores) along the southern margins. There is a gravel access road to the WTP in the west of the site, running parallel with the river.

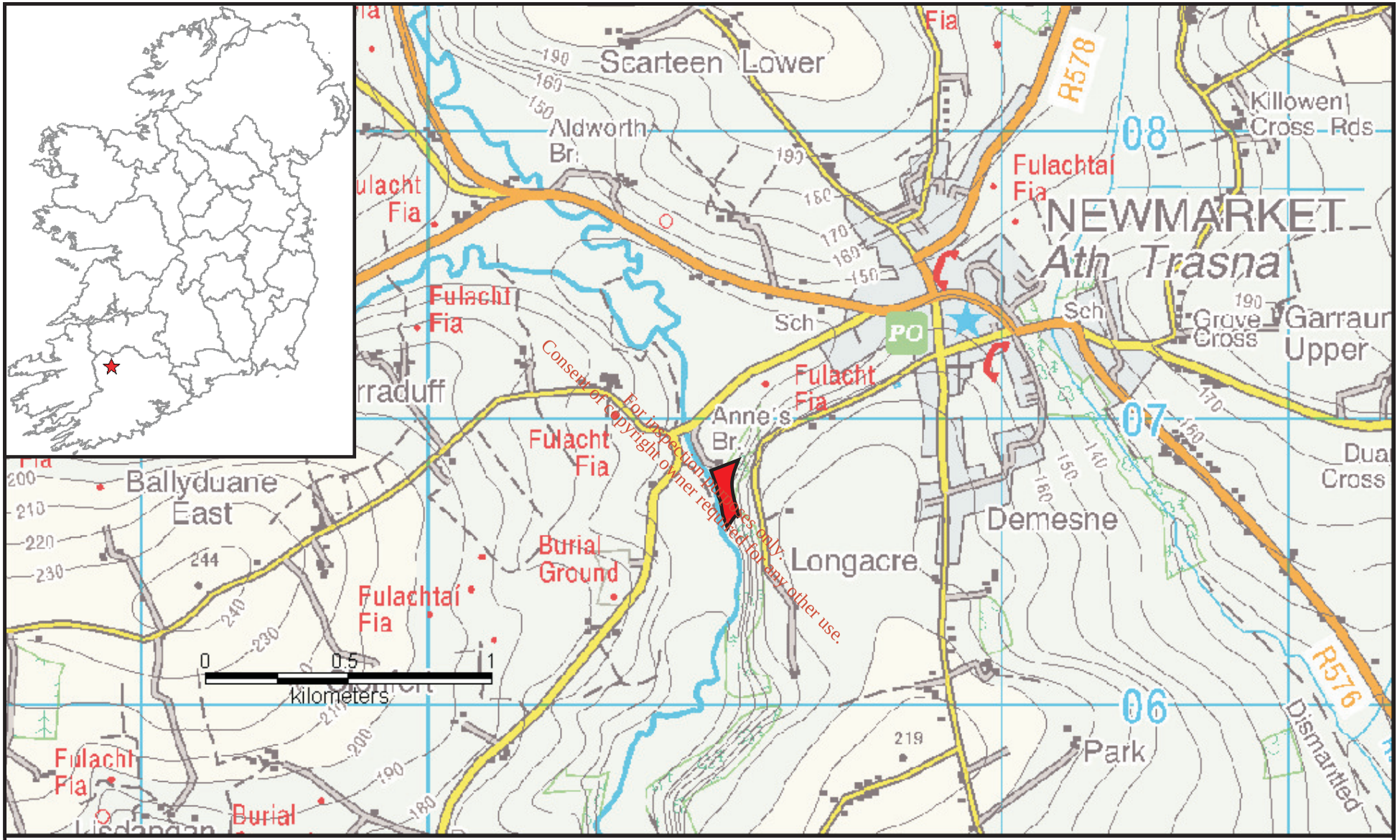
2.3 Surrounding Landuse

The surrounding land use is predominantly agricultural. The nearest residential dwelling is located more than 200m to the south east of the site.

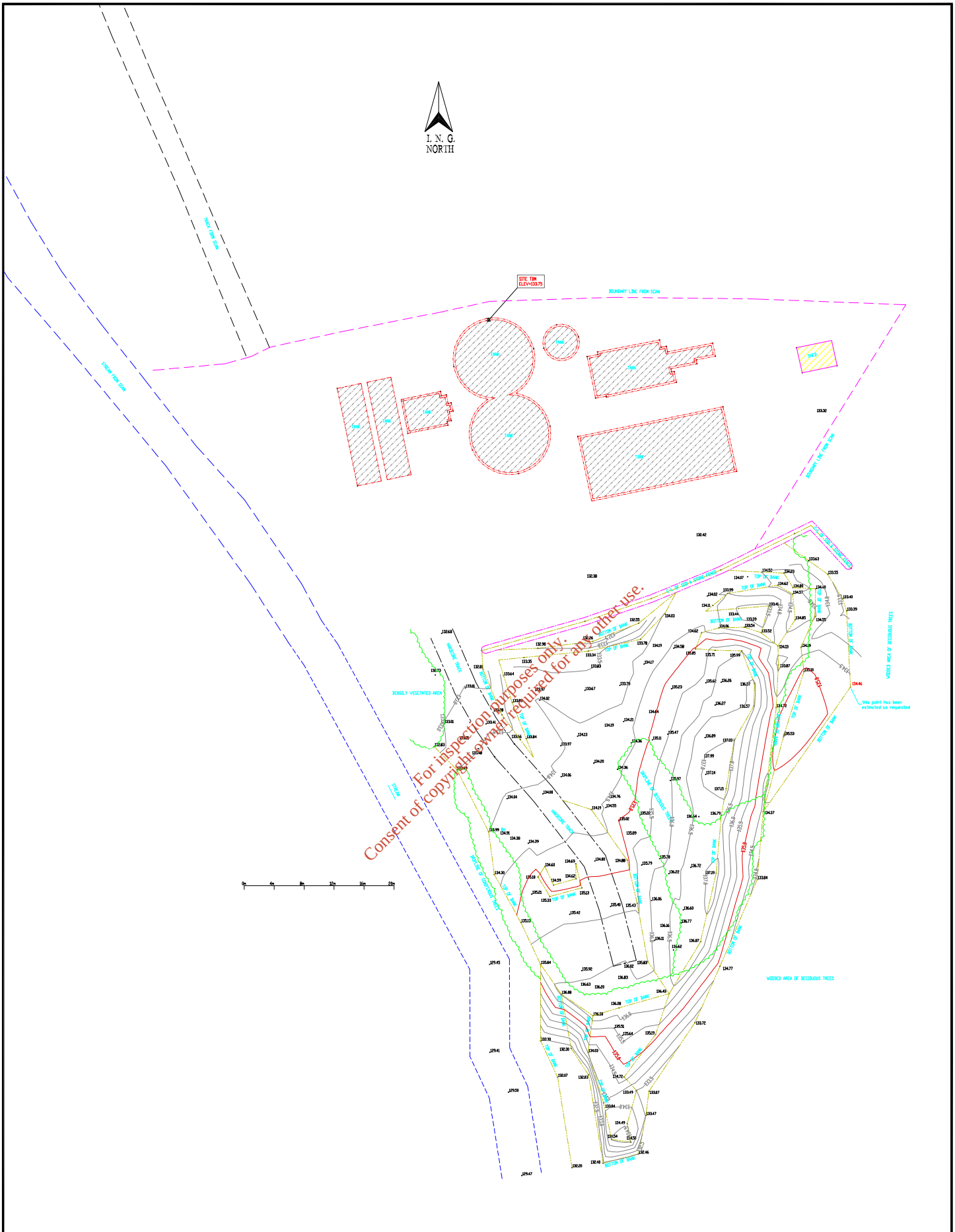
2.4 Site History

It is understood that waste disposal began at the site in the 1950s. A variety of wastes may have been deposited, including Municipal Solid Waste (MSW) and Construction and Demolition (C&D) wastes. It is also suspected that wastewater sludges from the WTP and oil/barrels may have been disposed here. Local Council staff report fires occurring, which was common at town dumps sites in the 1950s -1970s.

The site was not regularly used by the Council for the disposal of waste, because of access difficulties (but was used in emergencies). The site was open to the public between 2pm and 4pm on Fridays. It is estimated that site closed in 1984.



O' Callaghan Moran & Associates. Granary House, Rutland Street, Cork Ireland. Tel. (021) 4321521 Fax. (021) 4321522 email : info@ocallaghanmoran.com	CLIENT: Cork County Council	Details: Site Location	FIGURE NUMBER: 2.1
This drawing is the property of O'Callaghan Moran & Associates and shall not be used, reproduced or disclosed to anyone without the prior written permission of O'Callaghan Moran & Associates and shall be returned upon request.	TITLE: Site Location		Scale: Not To Scale; Job Number: 08-039-03



O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork, Ireland.
Tel. (021) 321521 Fax. (021) 321522
email : info@ocallaghanmoran.com
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CLIENT
CORK COUNTY COUNCIL

TITLE
SITE LAYOUT

DETAILS

DRG. No.
2.2

SCALE
1: 375

REV.
A

2.5 Hydrology

The fill area is dome shaped and slopes from the centre to the north, east, west and south. There is a drain which separates the landfill area from the high ground to the south. This drain may have been formed as a result of the placement of waste which prevented rainfall run-off from flowing north and west toward the River Dalua.

There is a stream which rises in the high ground to the south and flows along the eastern and northern side of the landfill. Both of these surface water features discharge into the River Dalua which flows in a southerly direction along the western site boundary. Each of these surface water drainage features receive run-off from the fill area.

The water level in the stream is approximately 3.8m below the site ground level at the north western site boundary close to the wastewater treatment plant but as the ground rises to the south the river is 7m below the ground level at the south western site boundary of the landfill.

2.6 Geology & Hydrogeology

OCM established the local geological and hydrogeological conditions from a review of databases maintained by the Geological Survey of Ireland (GSI), Teagasc and the site investigation findings. The latter are discussed in more detail in Section 3.

2.6.1 Soils and Subsoils

The GSI and Teagasc data bases indicate that the soil across the site ranges from mineral alluvium (AlluvMin) to shallow well draining acid mineral (AminSW). The subsoils range from alluvium to non carbonate rock close to the surface (RckNCa). The trial pits and boreholes revealed that the natural subsoils over the majority of the site comprise firm grey CLAY underlain by orange/brown sandy gravelly CLAY, with a proven minimum thickness of 1m.

Water was encountered in the subsoils underlying the waste, at a depth of 1.1m below what is believed to be original ground level.

2.6.2 Bedrock

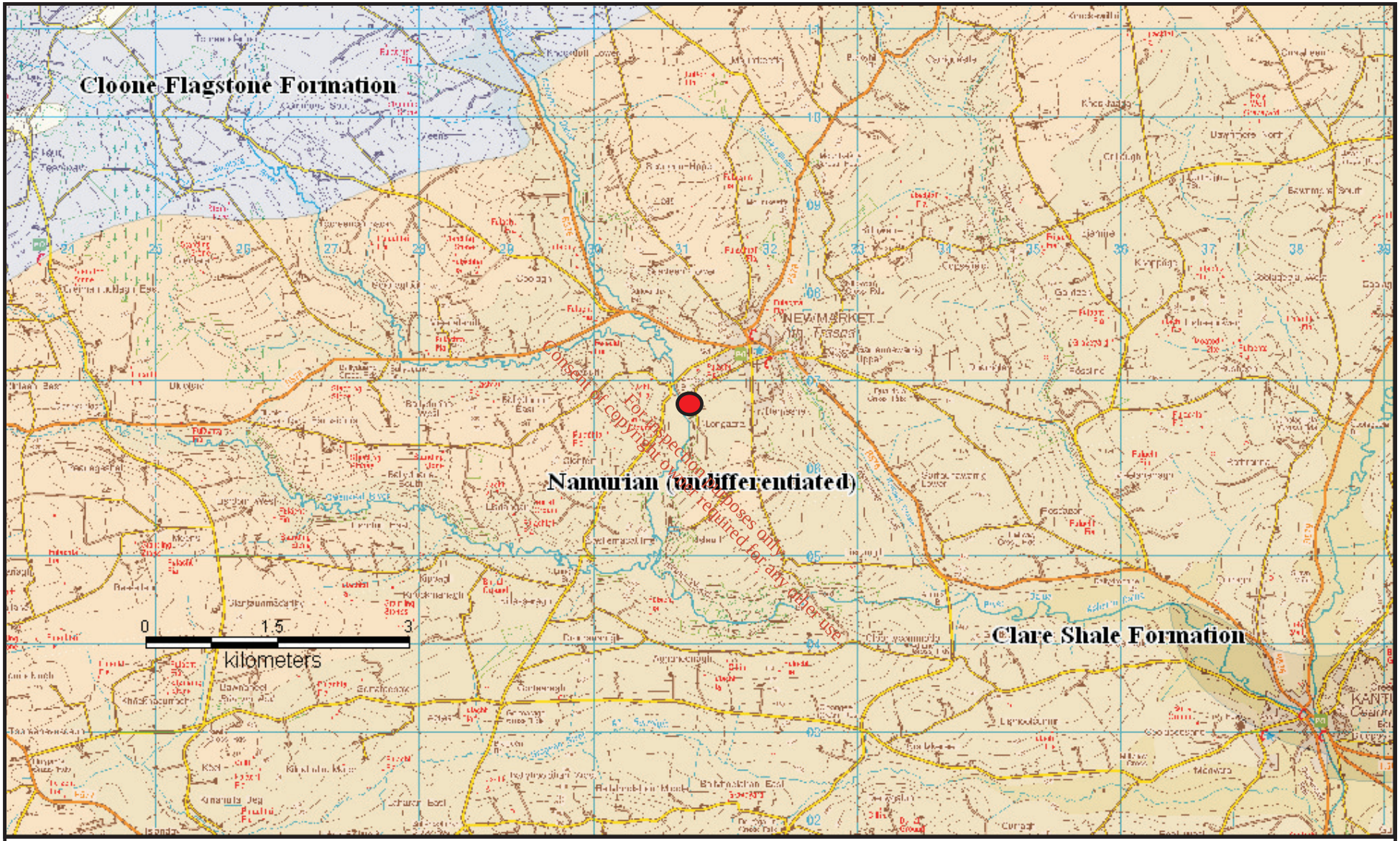
The regional bedrock geology is shown on Figure 2.3. The site is underlain by the Namurian deposits which comprise sandstone and shale. The bedrock is classified by the GSI as a locally important aquifer (**Ll**), being moderately productive only in local zones. The aquifer vulnerability is classified by the GSI as Extreme (**E**) to Extreme with rock close to the surface (Figure 2.4).

The borehole installation programme on site confirmed this vulnerability rating with depth to bedrock levels recorded at 1m below ground level (mbgl) in BH-4, 1.1mbgl in BH-5 and 1.8mbgl in BH-6.

The groundwater levels recorded on site indicates that groundwater flow is from north east to southwest towards the River Dalua. The groundwater level across the site ranges from 131.8mOD in the northeast of the site to 130mOD in the south west. The groundwater flow regime is presented in Figure 2.5.

2.7 Potential Receptors

The site is located on the western outskirts of the town of Newmarket. The nearest house is within 200m from the southeastern site boundary. The River Dalua, which runs along the western boundary, is a tributary of the Allow River which confluences with the Blackwater. The Dalua and the lands directly to the west of the site are within an Area of Special Conservation (SAC). The underlying bedrock is categorised a locally important aquifer. A search of the available records did not identify any private or public wells within 1km of the site. The location of these receptors is presented in Figure 2.6.



O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com

CLIENT
Cork County Council

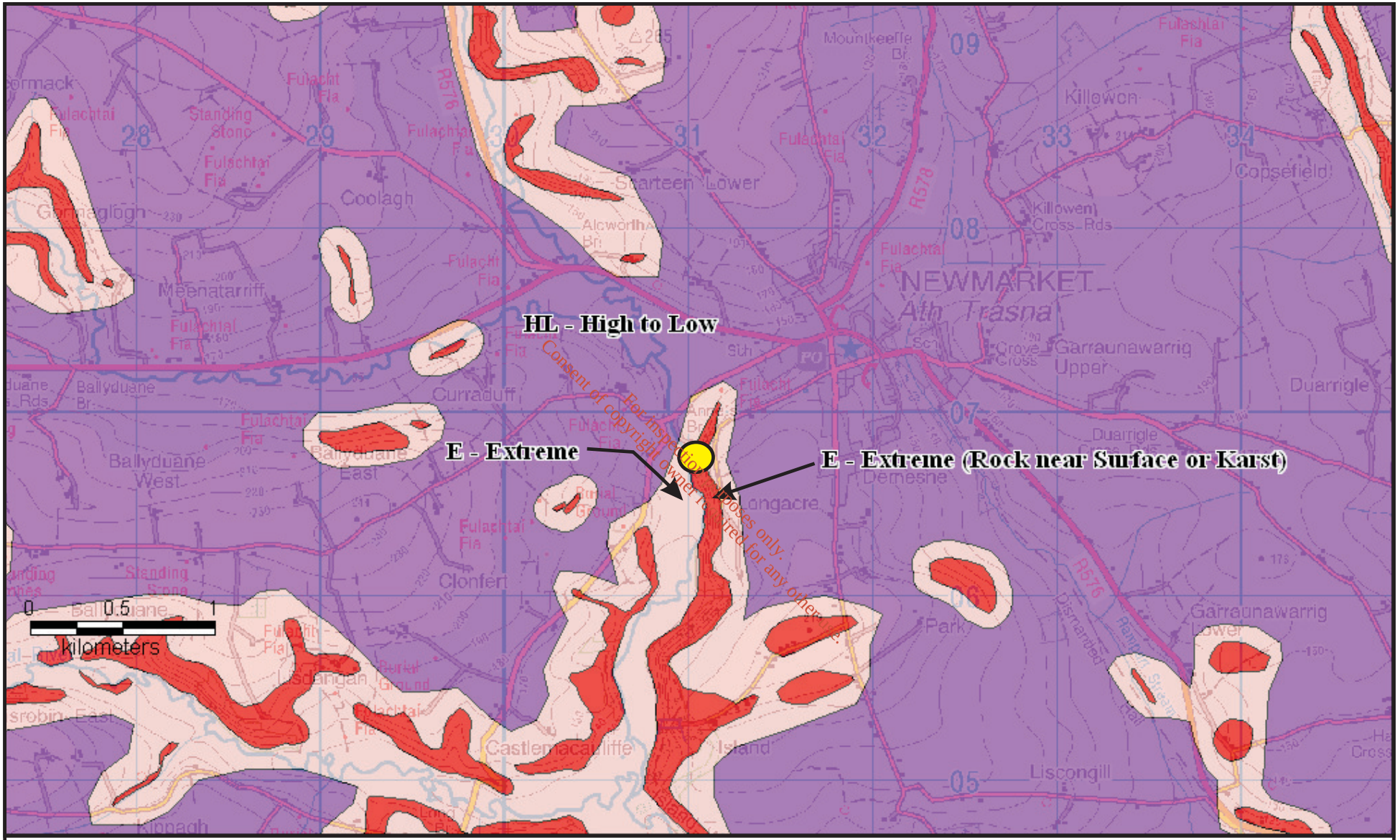
TITLE
Local Bedrock Geology

Details
Site Location

FIGURE NUMBER
2.3

Scale
Not To Scale

Job Number:
08-039-03



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Granary House, Rutland Street,
Cork Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com

CLIENT
Cork County Council

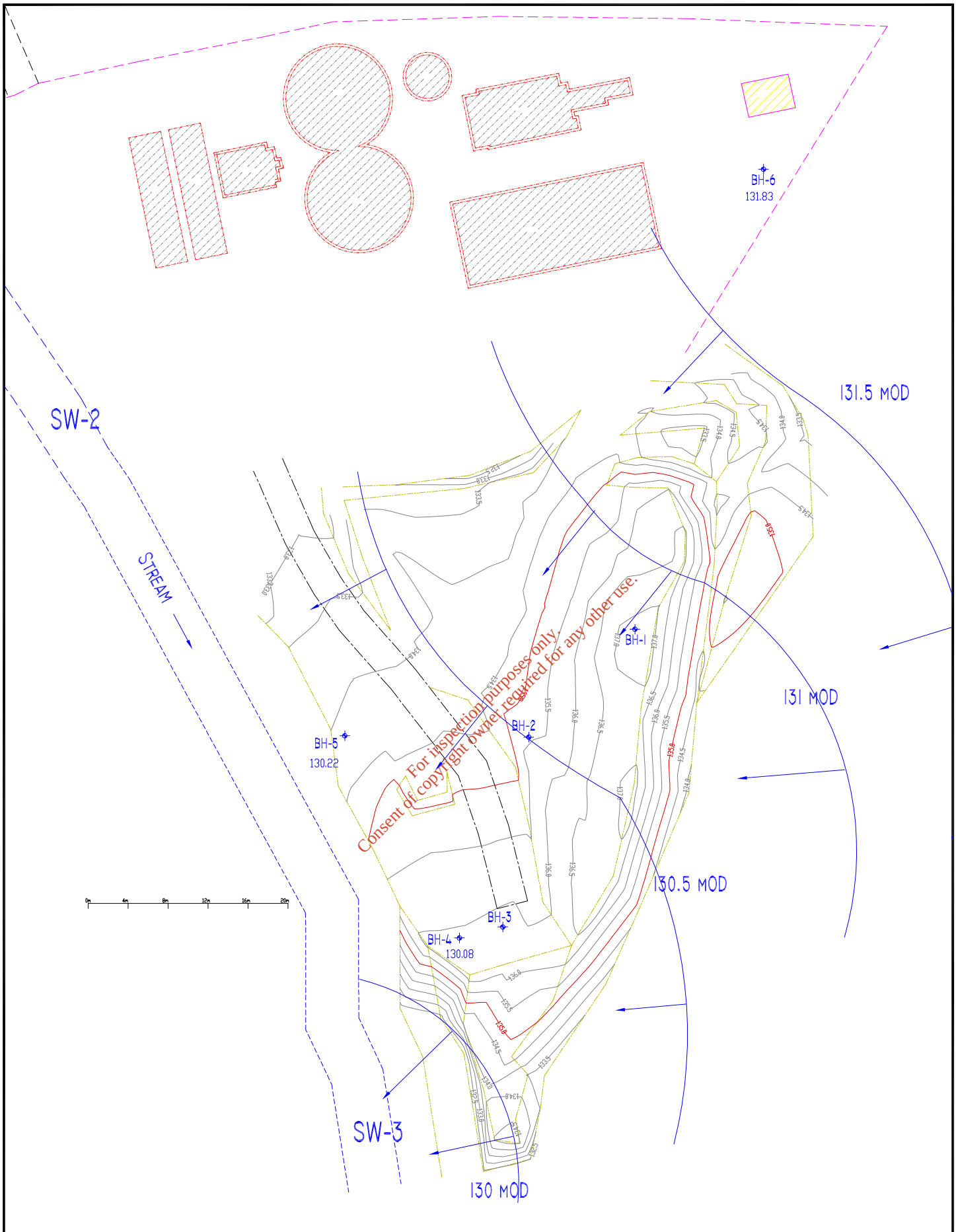
TITLE
Aquifer Vulnerability Classification

Details
Site Location

FIGURE NUMBER
2.4

Scale
Not To Scale

Job Number:
08-039-03



O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork, Ireland.
Tel. (021) 321521 Fax. (021) 321522
email : info@ocallaghanmoran.com
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CORK COUNTY COUNCIL

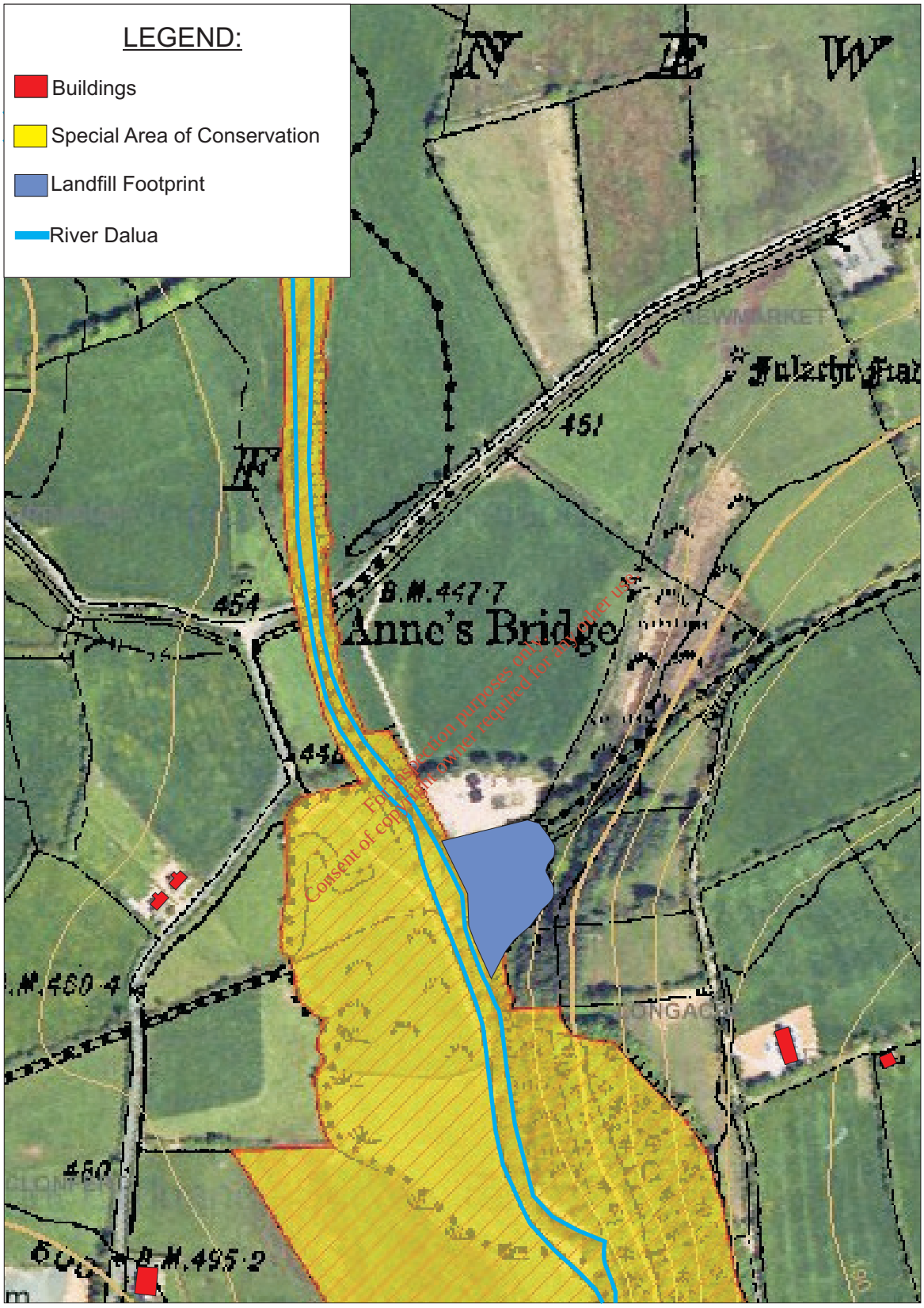
TITLE
GROUNDWATER FLOW DIRECTION 24TH JUNE 2008

DETAILS

DRG. No.
2.5

SCALE
1:500

REV.
A



O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com

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TITLE
Potential Receptors

Figure 2.6

Scale
NTS

Rev.
A

3. SITE INVESTIGATION

3.1 Objectives

The objective of the investigation was to collect sufficient information to allow an assessment of the environmental risk posed by the landfill. This was achieved by:-

- Delineating the lateral and vertical extent of the wastes,
- Characterising the waste,
- Assessing the risk of pollution from leachate run-off to soils, surface water and groundwater, and
- Assessing the risk presented by landfill gas.

3.2 Site Investigation Scope

The site investigation comprised four phases. Phase 1 involved the completion of a geophysical survey to establish the extent of the waste material present. Phase 2 involved the excavation of trial pits to confirm the lateral and vertical extent of the waste, and the collection of waste/soil for characterisation purposes. Phase 3 involved the installation of leachate; landfill gas and groundwater monitoring wells. Phase 4 involved the collection and analysis of groundwater and surface water samples and landfill gas monitoring over a four week period.

3.3 Phase 1

The geophysical survey was completed by Apex Geoservices Ltd on the 23rd May 2008. The full Apex report is presented in Appendix 2 and summarised herein.

The objectives were:

1. To assess the sub-surface conditions including thickness and lateral extent of the buried wastes.

2. To identify possible leachate, especially towards the adjacent river.

3. To locate buried drums within the waste material.

The geophysical methods employed were:

1. EM31 Conductivity mapping to investigate the lateral extent of landfill material and to locate buried drums within the landfill material.

2. 2-D Resistivity Profiles to investigate the lateral and vertical extent of the landfill material, evidence of any leachate plume and the depth to rock.

3. Seismic Refraction Profiles at selected locations to investigate landfill and overburden thickness and the depth to rock.

4. A trial magnetic survey to locate metallic objects within the landfill material.

The survey established that the site was underlain by up to 4m of waste materials. These materials were overlain by what appeared to be between 0.8 and 3m of clay cover material. The survey identified a number of anomalies, which were thought to be indicative of buried steel and possibly leachate. The Apex report identified a number of areas where intrusive investigations should carried out to investigate these anomalies.

3.4 Phase 2

The trial pit survey was carried out on the 9th June 2008. Areas of overgrown vegetation, as shown on Photograph 1, were cleared before the start of the survey. The trial pits were excavated using a track mounted excavator, capable of travelling on variable terrain and with a reach of 5 - 7 mbgl. The locations are shown on Figure 3.1.

Photo1 Overgrown Vegetation prior to investigation.

The excavation was supervised by an OCM Environmental Scientist and each pit was logged in accordance with BS5930. The trial pit logs are included in Appendix 3.

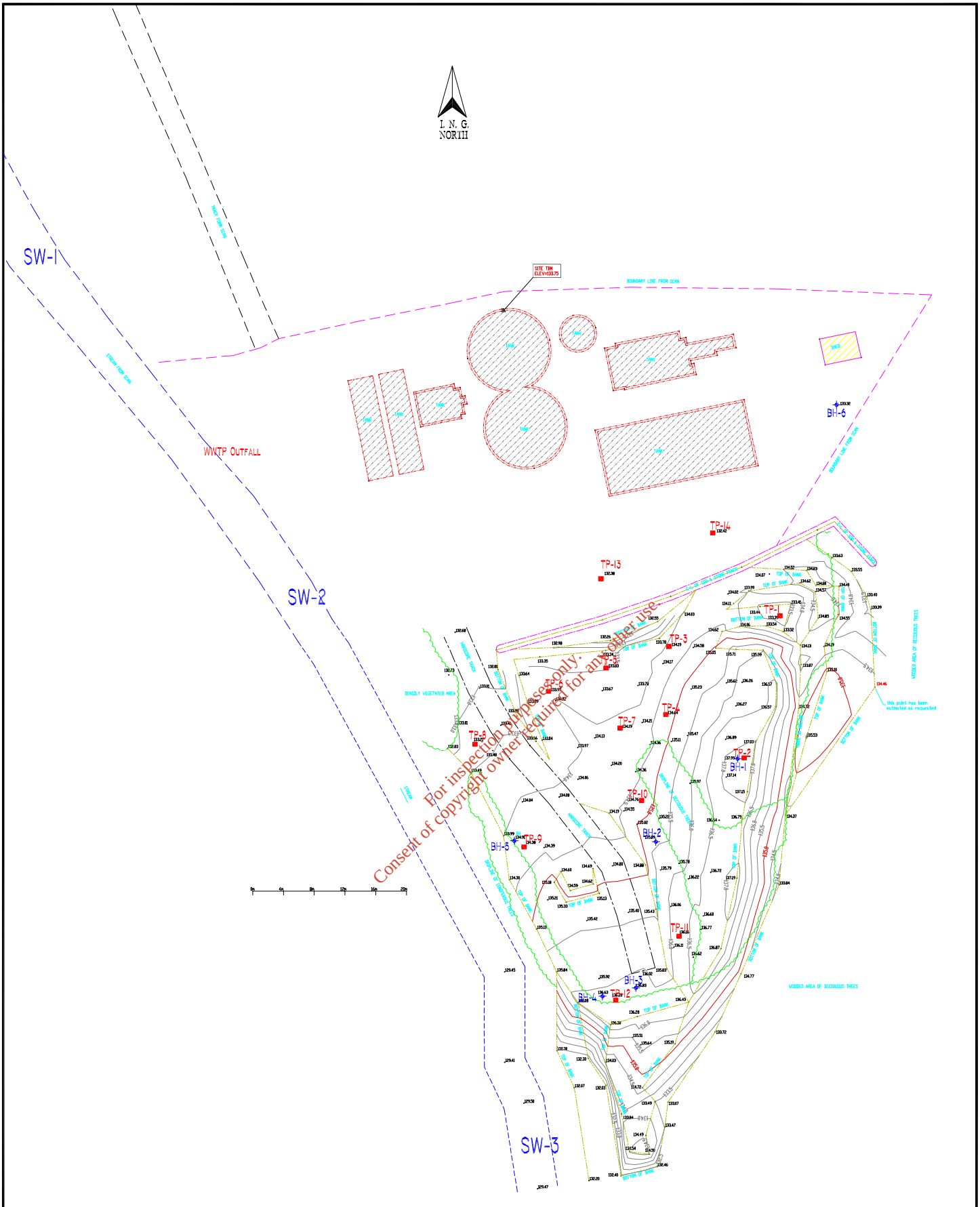
3.4.1 Lateral Extent of the Waste

The northern extent of the landfill was defined by a hedgerow and drainage ditch/stream which separates the site from the adjacent WTP... Wastes were encountered in three (3 No.) trial pits (TP-3, 5 and 6) along the southern side of the hedgerow, but were not found in the two (2 No.) trial pits (TP-13 and 14) to the north of the hedgerow.

The eastern extent of the waste was established in TP-1. TP-8 and TP-9 confirmed that the waste extends approximately 3.5m to the west of the gravel access road. The southern extent of the landfill had to be defined visually, as this area could not be accessed by the mechanical excavator due to the presence of trees and the steep slope of the waste against the natural ground sloping steeply to the south creating a narrow gully between them. The lateral extent of the waste is shown on Figure 3.2, and covers an area of ca 2,300m^2.

3.4.2 Vertical Extent of Waste

Cross-sections through the fill area based on the trial pit logs are shown on Figures 3.3-3.5. The waste is covered by a thin layer of topsoil, which in some areas of the site is underlain by a layer of sandy gravelly clay fill which ranged in thickness from 0.3m (TP-11) to 1.5m (TP-12). This layer was thickest in the southern section of the site. This clay layer was underlain by waste material which ranged in thickness from 0.8m (TP-9) to 3.6m (TP-11). The waste is thickest in the south and east of the site, with an average thickness across the site of 1.75m. The base of the waste is defined by a layer of firm grey clay, which marks the top of the underlying natural subsoils. Flattened steel drums were encountered in the areas identified in the geophysical survey. These drum were empty.



O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork, Ireland.
Tel. (021) 321521 Fax. (021) 321522
email : info@ocallaghanmoran.com
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CORK COUNTY COUNCIL

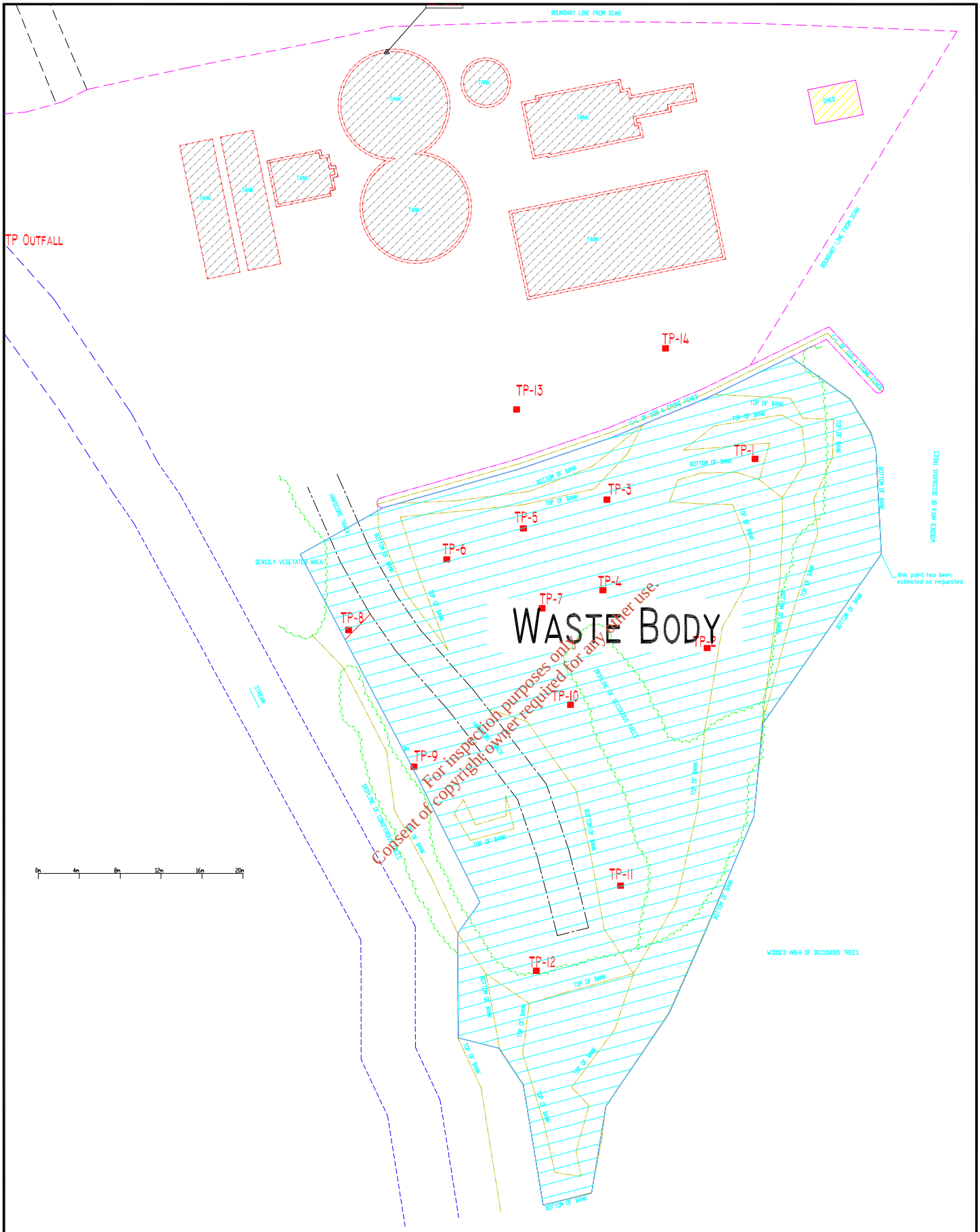
DETAILS

DRG. No.
3.1

TITLE
TRIAL PIT, BOREHOLE AND SURFACE WATER SAMPLING POINT LOCATIONS

SCALE
1:375

REV.
A



O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork, Ireland.
Tel. (021) 321521 Fax. (021) 321522
email : info@ocallaghanmoran.com
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DETAILS

DRG. No.
3.2

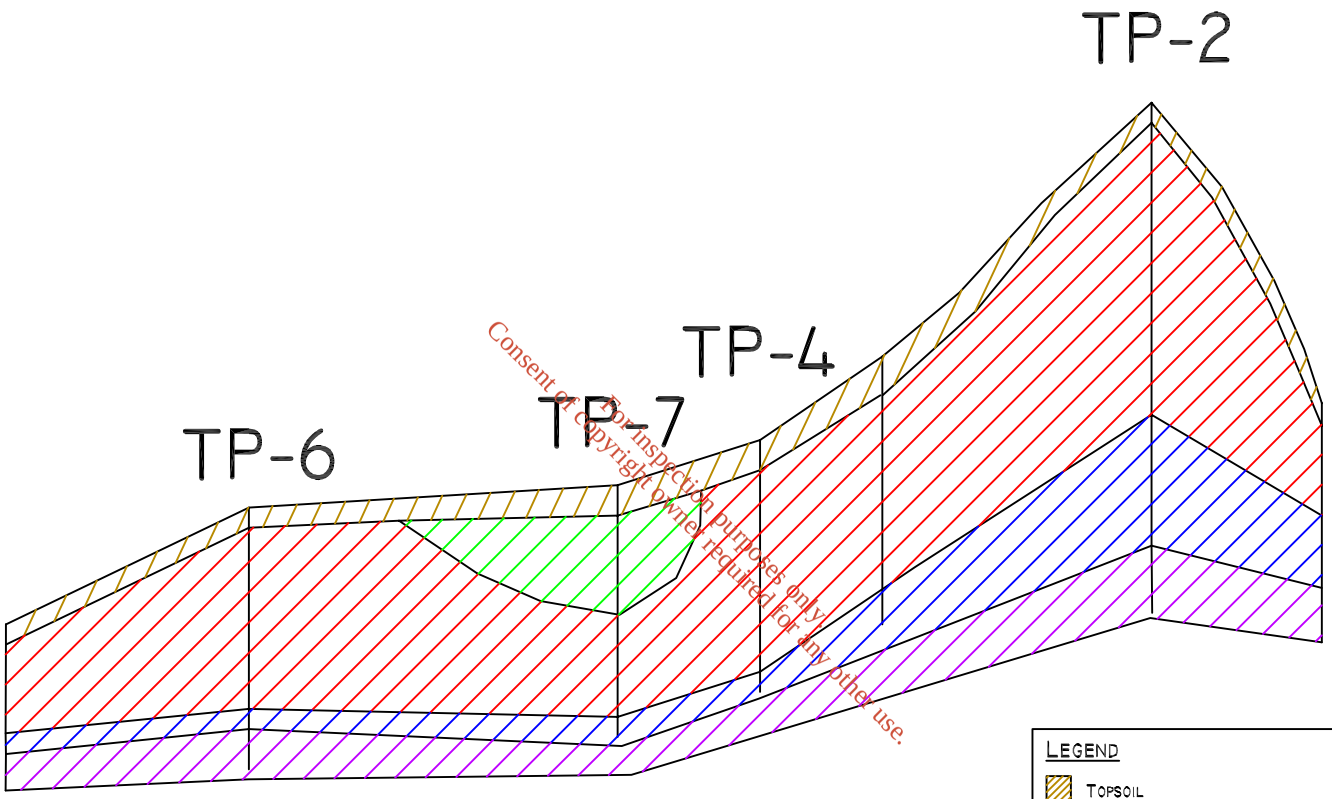
TITLE
EXTENT OF WASTE BODY

SCALE
1:500

REV.
A

NW

SE



VERTICAL EXAGGERATION X3

O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork, Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com
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FIGURE No.
3.3

TITLE
CROSS SECTION TP-6 TO TP-2

SCALE
NTS

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W

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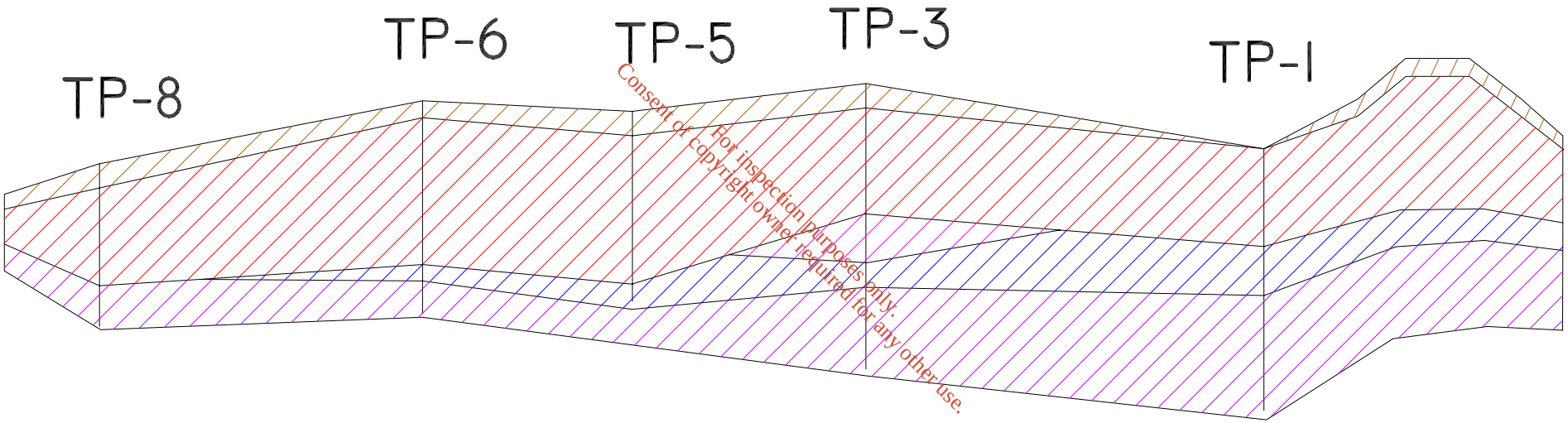

LEGEND

- Topsoil
- Fill Comprising Gravelly Clay
- Waste Material
- Grey Natural Clay
- Brown/Orange Gravelly Natural Clay

VERTICAL EXAGGERATION X3

O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork, Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com
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FIGURE No.: 3.4

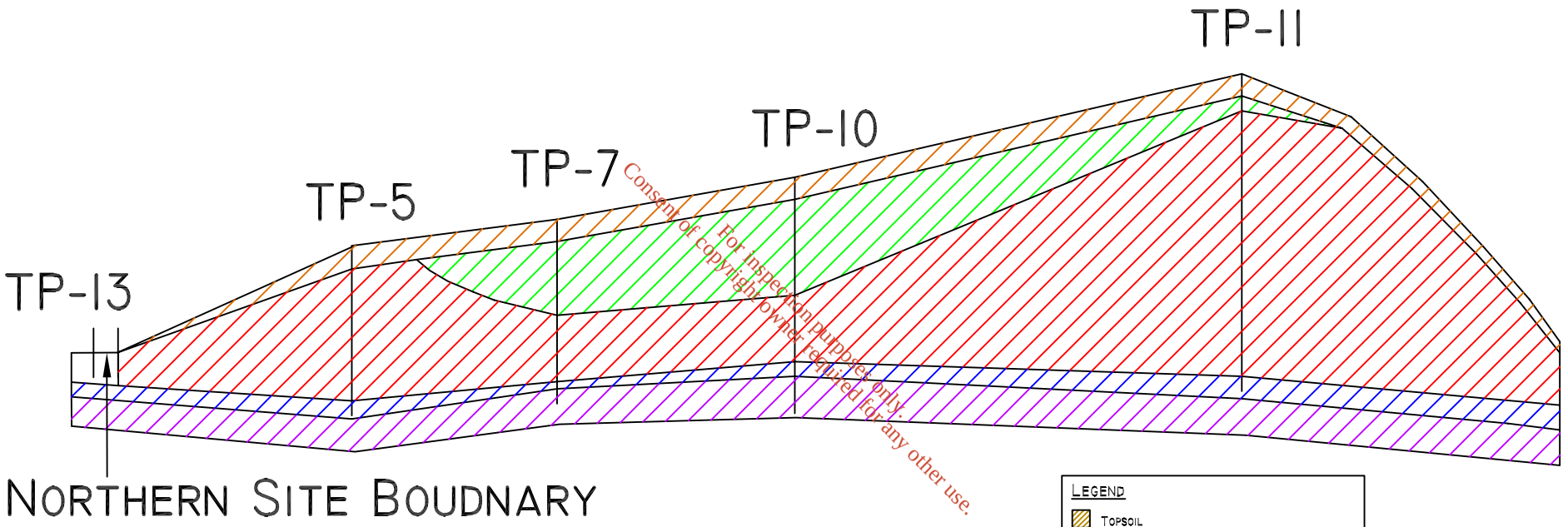
TITLE: Cross Section TP-8 to TP-1

SCALE: NTS

REV.: A

NNW

SSE



VERTICAL EXAGGERATION X3

O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork, Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com
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CLIENT
CORK COUNTY COUNCIL

FIGURE No.
3.5

TITLE
CROSS SECTION TP-13 TO TP-11

SCALE
1:1,250

REV.
A

3.4.4 Waste Characterisation

The waste encountered in the trial pits ranged from damp to dry with some wet zones toward the base. It comprised a mix of plastic and glass bottles, occasional empty flattened steel drums, empty plastic drums, concrete pipes, steel, papers, tyres, tyre tubes, timber and trees, all of which were supported by a sandy clay matrix. It is assumed that the sandy clay was used as cover material when the site was operational, but no discrete layers were noted. No datable materials (newspapers, stationary) which could be used to establish the age of the waste found. There was no evidence of any significant amounts of potentially hazardous waste (e.g. oils, solvents), staining or odours. Leachate was not encountered. Photographs 3-7 illustrate the types of waste encountered.

Photo3 Waste in TP-3.

Photo 4 Waste in TP-7.

Photo 5 Waste in TP-11

Photo 6 Waste in TP-10

Photo 7 Waste in TP-12

3.4.5 Sampling Programmes

Based on the field observations and field screening, which indicated that waste was generally consistent across the site, five (5) waste samples and one (1) sample of the underlying subsoils were initially selected for analysis. Samples of the waste, as well as the underlying natural ground, were collected in accordance with OCM's sampling protocol, a copy of which is included in Appendix 4. The samples were field screened for the presence of volatile organic compounds (VOC) using a photo ionisation detector (PID). The PID readings are included in the trial pit logs. PID readings raged from non detect to 13ppm and were not considered to be indicative of the presence of significant levels of VOCs.

The samples were placed in laboratory prepared containers and stored in coolers prior to shipment to Severn Trent Laboratory, Coventry, England. Chain of custody (COC) documentation is included in Appendix 5.

3.4.6 Laboratory Analysis

The analytical parameters included those specified in the EU Council Decision establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC.

The Council Decision sets threshold limits for a range of inorganic and organic parameters, which define whether a waste is suitable for disposal to an inert, non-hazardous or hazardous waste landfill. The parameters specified in the Council Decision were considered to be appropriate based on the field observations. However, depending on the findings of the leachate analyses, additional testing for other parameters would be carried out.

The solid samples were tested for Total Organic Carbon (TOC), BTEX (benzene, toluene, ethylbenzene and xylene) Polychlorinated biphenyls (PCB), Mineral Oil and Polycyclic Aromatic Hydrocarbons (PAH). Leachate generated from the waste samples were tested for metals (arsenic, barium, cadmium, chromium, copper, mercury, molybdenum, nickel, lead, antimony, selenium and zinc), chloride, fluoride, soluble sulphate, phenols, dissolved organic carbon (DOC) and total dissolved solids (TDS). The laboratory methodologies were all ISO approved or equivalent and the method detection limits (MDL) were all below the relevant guidance limit.

3.4.7 Results

The complete laboratory test results are included in Appendix 5 and summarised in Table 3.1. The Table includes the limits for inert and non-hazardous wastes set in the Council Decision. The Decision does not set limits for PAH, as this is left to the individual member states. The EPA has set a limit of 100mg/kg in a Waste Licence for an inert landfill, and this is used as a guideline.

With the exception of the samples from TP-2 and TP-12 the levels of all the parameters tested were below the waste acceptance criteria (WAC) criteria for inert waste set in the Council Decision.

The levels of TOC the sample from TP-2 (0.5-1m) were 76,000mg/kg, which is higher than the Inert WAC of 30,000mg/kg for TOC. However the Council Decision has a derogation, where the TOC levels above the threshold can be ignored if the Dissolved Organic Carbon (DOC) levels are less than 500mg/kg. The DOC for this sample was 36mg/kg and therefore the sample can be characterised as inert. The TOC of sample the underlying natural soils at a depth of 4-4.2m was 9,800mg/kg, which is significantly below the threshold.

In TP-12 the sulphate, 1,500mg/kg, and total dissolved solids (TDS), 5,300mg/kg, were both above their respective Inert WAC of 1,000mg/gk and 4,000mg/kg. However the Council Decision states that where the sulphate level exceeds its threshold, the material can still be categorised as inert if the TDS value does not exceed 6,000mg/kg. In the case of TP-12 the TDS is below 6,000mg/kg.

OCM considers that the waste can be characterised as inert.

Table 3.1 Waste Characterisation Data

Trial Pit Number	Unit	TP-2	TP-2	TP-3	TP-4	TP-5	TP-12	Inert Landfill	Non-Hazardous Landfill
Depth (m)		0.5-1	4-4.2	0.5-1	0.5-1	0.5-1	0.5-1		
Date		09/06/2008	09/06/2008	09/06/2008	09/06/2008	09/06/2008	09/06/2008		
Antimony	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.06	0.7
Arsenic	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	2
Cadmium	mg/kg	0.0056	<0.005	<0.005	<0.005	<0.005	<0.005	0.04	1
Copper	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2	50
Chromium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	10
Lead	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	10
Nickel	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	10
Molybdenum	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	10
Selenium	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.1	0.5
Zinc	mg/kg	0.16	<0.1	0.24	<0.1	0.14	0.27	4	50
Mercury	mg/kg	0.0031	<0.002	0.0021	<0.002	<0.002	<0.002	0.01	0.2
Barium	mg/kg	0.21	<0.1	0.18	<0.1	0.23	0.57	20	100
Chloride*	mg/kg	22	<20	<20	<20	<20	530	800	15,000
Fluoride	mg/kg	<2	<2	<2	<2	<2	<2	10	150
Sulphate	mg/kg	280	260	<240	<240	250	1,500	1000*	20,000
Dissolved Organic Carbon	mg/kg	36	120	39	48	69	55	500	800
Total Dissolved Solids	mg/kg	<2,000	<2,000	<2,000	2,000	<2,000	5,300	4,000	60,000
Phenols	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	NE
Total Organic Carbon	mg/kg	76,000	9,800	4,900	3,300	5,000	3,900	30000**	NE
Benzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	NE
Toluene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	NE
Ethylbenzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	NE
Total Xylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	NE
PCB Total of 7	mg/kg	0.021	<0.01	0.032	<0.01	0.038	<0.01	1	NE
Total 17 PAH's	mg/kg	4.5	<1	4.3	2.9	19	2.9	NE	NE
Mineral Oil	mg/kg	350	<50	170	100	360	500	500	NE

NE - Not Established

* - sulphate level exceeding inert waste limit may be considered as complying if the TDS value does not exceed 6,000mg/kg at L/S = 10l/kg.

**-a higher limit may be accepted provided the DOC values of 500mg/kg is achieved

3.5 Phase 2

Phase 2 involved the installation of six (6 No.) monitoring wells between 17th and 18th June 2008 at the locations shown on Figure 3.1. The wells were installed using a rotary percussive drilling rig. The drilling and well construction was supervised by an OCM hydrogeologist. The drilling logs and well construction details are included in Appendix 3.

3.5.1 Landfill Gas/Leachate Wells

Three (3 No.) wells (BH-1, BH-2 and BH-3) were installed in the waste body to monitor leachate and landfill gas. The trial pitting had not encountered any leachate within the waste. As a low permeability CLAY layer at the base of the waste was however detected during trial pitting. Based on the findings of the trial pits the gas monitoring wells were extended to the base of the waste but were not advanced through the low permeability clay layer at the base of the waste. This layer was not breached to prevent the development of a conduit from the waste to the underlying subsoils and aquifer.

3.5.2 Groundwater/Landfill Gas Wells

Three (3 No.) wells (BH-4, BH-5 and BH-6) were installed to monitor groundwater levels and quality up and down hydraulic gradient of the site. Based on the topography the direction of groundwater flow was expected to be from the north east to the south west of the site. It was not possible to site a down gradient well outside the waste body in the southern portion of the site as the waste extended to the tree line along the river bank.

BH-4 was located in the most southerly area of the site, which is downgradient of the majority of the waste body. Some waste was encountered during drilling BH-4. The drilling technique was amended so that the well was installed using a bentonite cement slurry to completely seal off the waste, as the well casing was extracted. This type of liquid slurry ensures that there are no preferential pathways for leachate/water migration between the sides of the borehole and the well pipe.

BH-5 was installed in the west of the site, where the trial pits had not identified wastes and is therefore considered to be downgradient of the waste body. BH-6 was located in the north eastern corner of the site, outside of and upgradient of the waste body.

3.5.3 Well Construction

The leachate and landfill gas monitoring wells were constructed using high density polyethylene (HDPE) 50 mm diameter standpipes, which were slotted from the base of the hole (the base of the waste material) to between 1.2m and 1.4m below ground level. A gravel filter pack was inserted in the annular space between the boring and the standpipe to a level of 0.5 m above the slotted section of the standpipe. Above the gravel filter the annular space was filled with a bentonite seal. The solid section of the well pipes was brought above the ground

level and was fitted with landfill gas caps and valves to allow landfill gas monitoring. A steel protective well casing, set in a concrete base, was placed around each standpipe.

The groundwater wells were constructed using HDPE 50 mm diameter standpipes which were slotted from the base of the hole to the top of the bedrock. A solid standpipe was installed from this level to above ground level. A gravel filter pack was inserted in the annular space between the boring and the standpipe to a level of between 0.5 and 1.0 m above the slotted section of the standpipe. Above the gravel the annular space was filled with a bentonite seal from the gravel to the ground surface to prevent any ingress of potentially contaminated surface water from entering the well. The solid section of the well pipe was brought above the ground level. A steel protective well casing, set in a concrete base, was placed around the standpipe.

3.6 Leachate

No leachate was noted during either the trial pitting or the drilling of the boreholes and installation of the well pipes. Following installation, BH-1, BH-2 and BH-3 were monitored on four occasions (17th June, 24th June, 4th July and 9th July 2008) and were fond to be dry on all four occasions.

3.7 Groundwater

Groundwater samples were taken from BH-4, BH-5 and BH-6 on the 24th June 2008. The samples were collected in accordance with the OCM groundwater sampling protocol, which is included in Appendix 4.

After completion of groundwater level measurements, each well was purged to remove the stagnant water in the well and surrounding gravel pack. Purging is required to ensure that the groundwater sample collected is representative of the formation and not the stagnant water in the monitoring well or surrounding gravel filter. The samples were placed in laboratory prepared containers, stored in a cooler, and sent for analyses to Severn Trent Laboratory. The COC documentation is included in Appendix 5. The field measurements recorded are presented in Table 3.2.

Table 3.2 Groundwater Field Measurements

Borehole Number	BH-4	BH-5	BH-6
Water Level (mBTOC)	6.55	4.69	1.49
Top of Casing (mOD)	136.63	134.91	133.32
Water Level (mOD)	130.08	130.22	131.83
pH	7.06	6.93	6.74
EC	198	316	296
Temperature	10.5	10.6	10.5
Colour	Brown then cloudy	Brown then Cloudy	Brown then Cloudy
Odour	None	None	None
Recovery	Good	Good	Moderate -

3.7.1 Laboratory Analysis

The samples were analysed for a range of organic and inorganic parameters that included pH and electrical conductivity, dissolved oxygen, ammonia, nitrite, nitrate, orthophosphate, potassium, sodium, chloride, sulphate, heavy metals to include(arsenic, antimony, barium, cadmium, chromium, copper, fluoride, mercury, manganese, molybdenum, nickel, lead, selenium and zinc), cyanide, Volatile Organic Compounds (VOC), Total Petroleum Hydrocarbons (Diesel Range Organics(DRO), MTBE, Petrol Range Organics (PRO), Phenols, total pesticides.

3.7.2 Laboratory Results

The full laboratory test report is in Appendix 5 and the results are summarised in Table 3.3. Included in the Table are draft Interim Guideline Values (IGV) published by the Agency The EPA IGV limits are proposed water quality standards and are set out in the EPA publication "Towards Setting Guideline Values For Protection of Groundwater In Ireland" - Interim Report. The IGVs are based on likely requirements for water quality that will come into force under amendments to the EU Water Framework Directive in the form of a Groundwater Directive which will have to be adopted by all member states.

Ammonium- was detected at a level of 2.05mg/l in BH-6 the upgradient well. This is higher than the IGV of 0.15mg/lg for ammonium. Ammonium was not detected in the downgradient wells BH-4 and BH-5. Cyanide was detected in BH-4 and BH-6 at levels of 0.03mg/l which are higher than the IGV of 0.01mg/l for cyanide. TPH were detected in BH-6 at a level of 0.038mg/l which is higher than the IGV of 0.01mg/l.

The herbicide Dichlobenil was detected in BH-6 at a level of 0.126µg/l which is higher than the IGV for individual pesticides. The total levels of pesticides detected in BH-6 was however only 0.126µg/l, which is lower than the IGV for total pesticides of 0.5µg/l. All other parameter analyse for were below their respective IGVs or method detection limits.

The analytical data suggests that the waste material on site has not had a negative impact on the groundwater downgradient of the site. . Ammonium, pesticides and TPH were detected at very low levels in the upgradient well BH-6. The only parameter that is higher than its respective IGV downgradient of the waste is cyanide and this is considered to be naturally occurring, as the levels in the up gradient well also exceed the IGV. The low level ammonia, hydrocarbon and pesticide contamination detected in the upgradient well may be linked to agricultural practices locally and possibly minor spills of fuel or oils in the vicinity of the WTP plant. The levels detected are not considered to be associated with the presence of the landfill site.

Table 3.3 Groundwater Results

Parameter	Units	BH-4 Downgradient	BH-5 Downgradient	BH-6 Upgradeint	IGV values
pH	pH Units	7	8.6	7.5	³6.5 and £9.5
Conductivity	mS/cm	0.198	0.274	0.218	1
Dissolved Oxygen	mg/l	1.5	1.8	3.6	No abnormal change
Ammonium	mg/l	<0.3855	<0.3855	2.056	0.15
Orthophosphate as PO_4	mg/l	<0.1	<0.1	<0.1	0.03
Fluoride	mg/l	<0.1	<0.1	<0.1	1
Chloride	mg/l	21	24	25	30
Nitrite	mg/l	<0.1	<0.1	<0.1	0.1
Nitrate	mg/l	2.2	1.3	1	25
Potassium	mg/l	2.7	3.1	3.4	5
Sodium	mg/l	15	16	30	150
Sulphate	mg/l	11	15	24	200
Antimony	mg/l	<0.001	<0.001	<0.001	-
Arsenic	mg/l	<0.001	<0.001	<0.001	0.01
Barium	mg/l	0.006	<0.005	0.007	0.1
Dissolved Cadmium	mg/l	<0.0005	<0.0005	<0.0005	0.005
Dissolved Chromium	mg/l	<0.005	<0.005	<0.005	0.03
Dissolved Copper	mg/l	<0.005	<0.005	<0.005	0.03
Mercury	mg/l	<0.0001	<0.0001	0.0002	0.001
Nickel	mg/l	<0.005	<0.005	<0.005	0.02
Zinc	mg/l	0.025	0.032	0.009	0.1
Selenium	mg/l	<0.001	<0.001	<0.001	-
Lead	mg/l	<0.005	<0.005	<0.005	0.01
Cyanide	mg/l	0.03	<0.01	0.03	0.01
Volatile Oragninc Compounds	ug/l	<2	<2	<2	-
TPH >C6-C40	mg/l	<0.05	<0.05	0.038	0.01
TPH >C6-C8	mg/l	<0.01	<0.01	<0.01	0.01
TPH >C8-C10	mg/l	<0.01	<0.01	<0.01	0.01
TPH >C16-C24	mg/l	<0.02	<0.02	0.038	0.01
TPH >C24-C40	mg/l	<0.05	<0.05	<0.05	0.01
TPH >C10-C16	mg/l	<0.02	<0.02	<0.02	0.01
MTBE	mg/l	<0.001	<0.001	<0.001	0.01
Phenols	ug/l	<0.1	<0.1	<0.1	0.5
Total Pesticides	ug/l	<0.02	<0.02	0.126	0.5
Dichlobenil	ug/l	<0.002	<0.002	0.126	0.1*

* This limit is the IGV for individual pestivides

3.8 Surface Water

The River Dalua, which flows along the western site boundary, is between 0.5m and 4.1m below the waste fill area. The stream which flows along the northern boundary of the waste body discharges to the River. There is also a seasonal drain along the southern site boundary, which after periods of heavy rainfall discharges to the river.

Given the direction of groundwater flow from northeast to southwest there is the potential for leachate to enter the river either via shallow groundwater recharge, or as surface water run-off from the landfill to the adjacent streams.

The flow in the river is from north to south. Surface water samples were taken in the stream at three locations on 24th June 2008. SW-1 is the upgradient sample location and was located north of the site and the WTP, SW-2 was taken downstream of the WTP but still upstream of the landfill and the drains that discharge to the river. SW-3 was taken downstream of the waste body itself and of all surface water discharges into the river from the landfill. The location of the sampling points can be seen on Figure 3.1.

Treated effluent from the WTP discharges into the river upstream of the landfill site and could mask the impact of any leachate. Therefore the treated effluent discharge was stopped 45 minutes prior to the surface water sampling event.

The surface water samples were collected in accordance with OCM sampling protocols, a copy of which is in Appendix 4 and were placed in laboratory prepared containers and stored in a cooler. Field measurement and observations recorded at the time of sampling are presented in Table 3.5. The samples were sent for analyses to Severn Trent Laboratory. The COC documentation is included in Appendix 5.

3.8.1 Laboratory Analysis

The samples were analysed for a range of organic and inorganic parameters that included pH, electrical conductivity, dissolved oxygen, ammonia, nitrite, nitrate, orthophosphate, potassium, sodium, chloride, sulphate, heavy metals to include(arsenic, antimony, barium, cadmium, chromium, copper, Fluoride, mercury, manganese, molybdenum, nickel, lead, selenium and zinc), cyanide, Volatile Organic Compounds (VOC), Total Petroleum Hydrocarbons (Diesel Range Organics(DRO), MTBE, Petrol Range Organics (PRO)), Phenols, total pesticides.

3.8.2 Laboratory Results

The laboratory test report is contained in Appendix 5 and the results are summarised in Table 3.4. The table includes for comparative purposes Environmental Quality Standards (EQS) published by the EPA. The EQS limits are proposed water quality standards and are derived from the EU Directive on Drinking Water Quality 80/778/EEC and the Directive on the Protection of Groundwater against pollution caused by certain dangerous substances 80/66/EEC.

Table 3.4 Surface Water Field Measurements.

Surface Water Sampling Point	**SW-1**	**SW-2**	**SW-3**
pH	6.78	6.93	5.39
EC	187	192	145
Temperature	12.4	12.4	12.4
Colour	Slight brown tinge	Slight brown tinge	Slight brown tinge
Odour	None	None	None

Cyanide was detected at levels greater than the EQS for cyanide (0.01mg/l) in all three samples taken. SW-1 which is upgradient of the site had the highest levels of cyanide (0.06mg/l) while SW-2 and SW-3 had levels of 0.03mg/l.

All other parameter analysed for were below their respective EQS or method detection limits. The water quality between all three samples was generally very consistent with the levels of dissolved oxygen rising form 2.9mg/l (SW-1) to 5.4mg/l (SW-3) between the upstream and downstream sample locations.

The detection of cyanide in the upstream location similarly to the groundwater indicates that this parameter appears to be either present naturally above the relevant guideline limits and is not due to the presence of the landfill site.

Table 3.5 Surface Water Results

Parameter	Units	SW-1	SW-2	SW-3	EQS Values
pH	pH Units	7.3	7.9	7.9	³6.5 and £9.5
Conductivity	mS/cm	0.145	0.15	0.149	1
Dissolved Oxygen	mg/l	2.9	6.5	5.4	No abnormal change
Ammonium	mg/l	<0.3855	<0.3855	<0.3855	0.02 NH3
Orthophosphate as PO_4	mg/l	<0.1	<0.1	<0.1	-
Fluoride	mg/l	<0.1	<0.1	<0.1	5
Chloride	mg/l	16	17	17	250
Nitrite	mg/l	<0.1	<0.1	<0.1	-
Nitrate	mg/l	0.7	0.7	0.8	50
Potassium	mg/l	1.3	1.2	1.2	-
Sodium	mg/l	9.8	10	10	-
Sulphate	mg/l	<5	<5	<5	200
Antimony	mg/l	<0.001	<0.001	<0.001	-
Arsenic	mg/l	0.001	<0.001	<0.001	0.025
Barium	mg/l	0.005	<0.005	0.005	0.1
Dissolved Cadmium	mg/l	<0.0005	0.0006	<0.0005	0.005
Dissolved Chromium	mg/l	<0.005	<0.005	<0.005	0.03
Dissolved Copper	mg/l	<0.005	<0.005	<0.005	0.03
Mercury	mg/l	<0.0001	<0.0001	<0.0001	0.001
Nickel	mg/l	0.006	<0.005	<0.005	0.05
Zinc	mg/l	0.009	0.013	0.03	0.1
Selenium	mg/l	0.003	<0.001	<0.001	-
Lead	mg/l	<0.005	<0.005	<0.005	0.01
Cyanide	mg/l	0.06	0.03	0.03	0.01
Volatile Organic Compounds	ug/l	<2	<2	<2	-
TPH >C6-C40	mg/l	<0.05	<0.05	<0.05	0.01
TPH >C6-C8	mg/l	<0.01	<0.01	<0.01	0.01
TPH >C8-C10	mg/l	<0.01	<0.01	<0.01	0.01
TPH >C16-C24	mg/l	<0.02	<0.02	<0.02	0.01
TPH >C24-C40	mg/l	<0.05	<0.05	<0.05	0.01
TPH >C10-C16	mg/l	<0.02	<0.02	<0.02	0.01
MTBE	mg/l	<0.001	<0.001	<0.001	0.01
Phenols	ug/l	<0.1	<0.1	<0.1	0.5
Pesticdes	ug/l	<0.02	<0.02	<0.02	-

3.9 Landfill Gas

Landfill gas monitoring was conducted in all three monitoring wells (BH-1, BH-2 and BH-3) on 17th and 24th June, 4th and 9th July 2008. The programme included the measurement of methane, carbon dioxide, oxygen and atmospheric pressure using a Gas Data LSMx gas analyser. The meter was calibrated before use. The detection limit is 0.1% for methane, carbon dioxide and oxygen.

The monitoring results are presented in Table 3.5 The table includes guideline limits from the Department of the Environment (DOE) publication on the 'Protection of New Buildings and Occupants from Landfill Gas' (1994). The guidelines stipulate that, where carbon dioxide or methane are present in a landfill at 0.5% v/v and 1% v/v respectively, then housing should not be erected within 50 m of the landfill and private gardens should not be allowed within 10 m. No such buildings are located within 200m of the site though there are buildings located approximately 40m to the north at the wastewater treatment plant.

3.9.1 Landfill Gas Readings

Carbon dioxide was detected in all three wells throughout the monitoring programme at levels between 3.7% and 5.2%. The carbon dioxide levels are typical of an aged waste. The carbon dioxide levels exceeded the DOE limit of 1%.

Methane was detected in BH-3 at a level of 0.5% on only one occasion (18th June 2008). This level is equal to the DOE limit for methane. Methane was not detected in BH-2 or BH-3 on any occasion.

There are no private dwellings located within 200m of the landfill site. The WTP plant is separated from the site by a stream which provides a natural barrier to landfill gas migration from the landfill.

Based on the age of the waste and relatively low landfill gas levels detected OCM considers that the risk posed by landfill gas to be insignificant.

Table 3.5 Landfill Gas Monitoring Data: June and July 2008

Location	Methane (%)				Carbon Dioxide (%)				Oxygen$_2$ (%)				Barometric Pressure (mb)			
	18th June 2008	24th June 2008	4th July 2008	9th July 2008	18th June 2008	24th June 2008	4th July 2008	9th July 2008	18th June 2008	24th June 2008	4th July 2008	9th July 2008	18th June 2008	24th June 2008	4th July 2008	9th July 2008
BH-1	0	0	0	0	4.3	3.8	4.1	3.7	10.3	14.3	13.3	11.1	1002	1011	1011	
BH-2	0	0	0	0	3.8	4.5	4	4.2	11.7	12.3	13.2	11.8	1002	1011	1011	
BH-3	0.5	0	0	0	5.2	4	4.9	3.9	8.3	13.4	9.5	12.1	1002	1011	1011	
DOE limits	0.5	0.5	0.5	0.5	1	1	1	1	-	-	-	-	-	-	-	-

- DOE limit not established
* Measurement not taken due to a gas cap fault

4. TIER 3 REFINEMENT OF CONCEPTUAL SITE MODEL

The COP requires the Conceptual Site Model (CSM) developed during Tier 1 should be refined after completion of the Tier 2 site investigations. Where a site is deemed to pose a high or moderate risk to the environment or human health then a Quantitative Risk Assessment (QRA) should then be undertaken. Having reviewed the Tier 2 site investigation data OCM has concluded that this site is a Low Risk Site therefore a QRA was not required or undertaken.

OCM, using the information obtained in the site investigation, refined the CSM in the Tier 1 Assessment. The refined model is presented in Figure 4.1 and described below.

The most recently landfilled waste is estimated to be approximately 24 years old with much of the waste emanating from the 1950s to 1970s. The waste is covered by relatively free draining sandy soils and was observed to be dry during excavation. It appears that the organic fraction of the waste has almost completely biodegraded and testing confirms that the waste can be categorised as inert. Rain falling on the landfill can infiltrate the waste and discharge along the base of the waste into the surrounding surface water drains/streams or migrate vertically toward the subsoils.

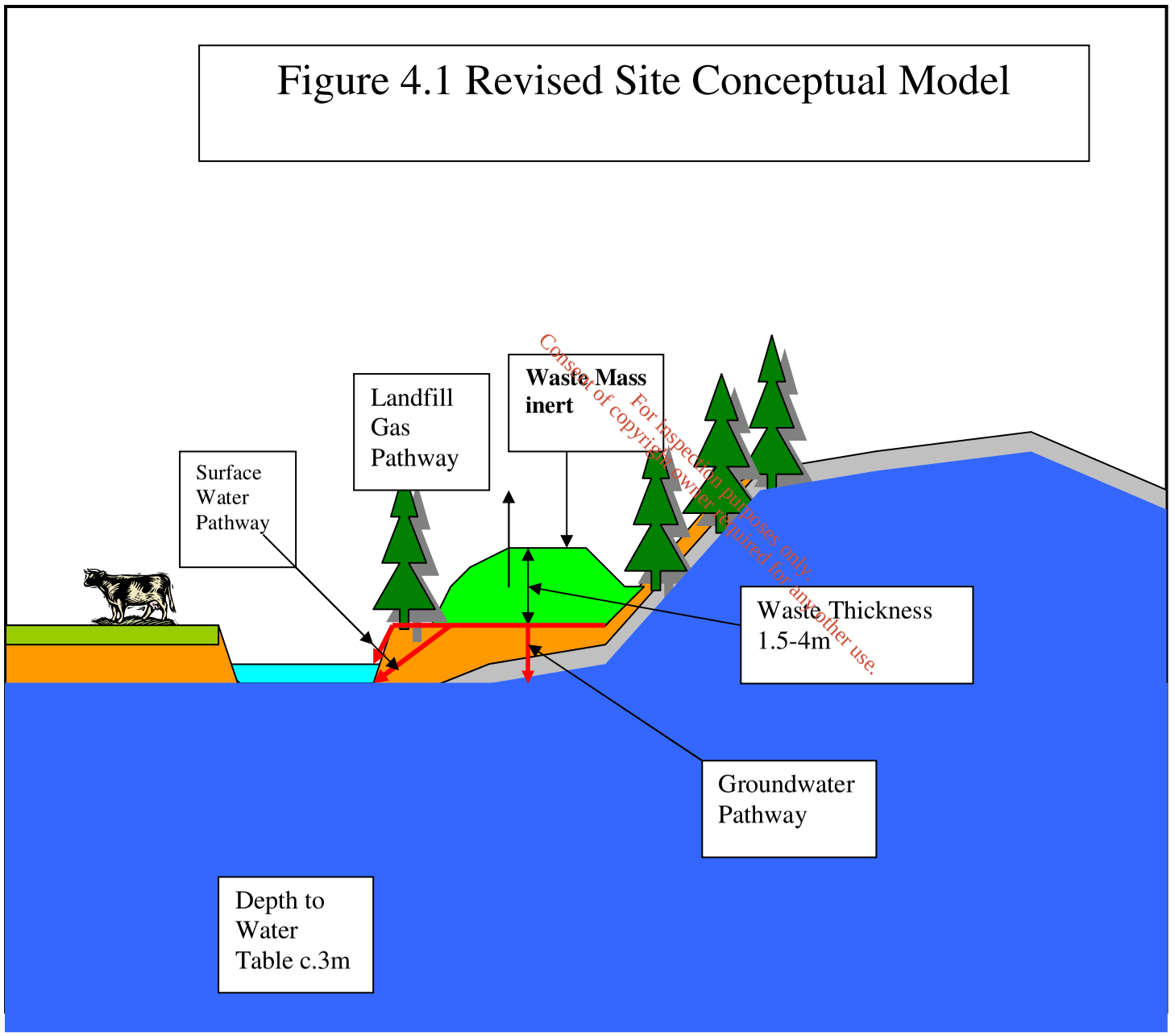
The natural subsoils beneath the waste appear to be of low permeability and will retard the downward movement of infiltrating rainfall. It is likely that most of the rainfall reaching the base of the waste ultimately discharges laterally along the base of the waste into the surrounding surface water drainage system, with a small amount reaching the water table and ultimately entering the adjacent Dalua River as shallow baseflow.

The groundwater monitoring results indicate that the waste body is having little or no impact on the underlying aquifer or on the Dalua River. Given the age of the waste it is likely that any potentially mobile contaminants have long since leached out into the surface water system. Any residual leachate generated at the site is not impacting on off-site receptors.

Landfill gas generation at the site is very low and due to the free draining nature of the waste can vent freely to atmosphere. While carbon dioxide levels have been measured around 3.7 – 5.2% the landfill gas risk from the site is considered to be insignificant. The closest potential receptor is the WTP, but the stream running between the plant and the landfill which effectively cuts off any potential migration pathway.

The conceptual model is based on a review of the Source-Pathway-Receptor linkages outlined on Figures 4.2 to 4.4 The Tier 2 investigation has established that the waste (Source) is essentially inert and as such the pathway and receptor elements are redundant.

Figure 4.1 Revised Site Conceptual Model



Conceptual Site Model

Landfill: Newmarket
Site Ref: 23/N
Division: North Cork
Area: Newmarket

Sources:

Waste Body

Receptors:

Groundwater

Private Dwelling

Grazing Land

Road

River

Geology:

Rock

Alluvium

Source waste is inert and no leachate generated

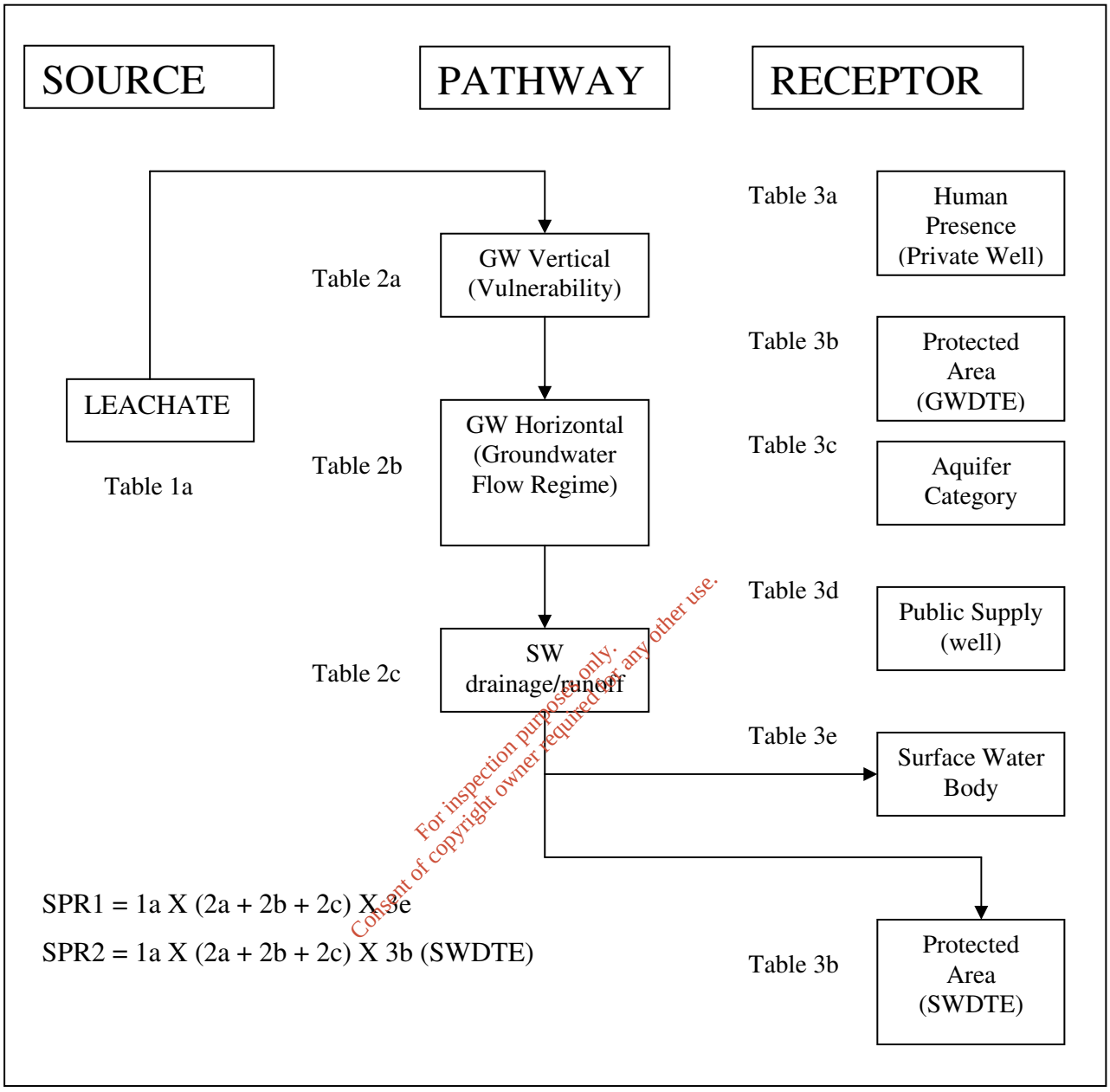


Figure 4.2 Network Diagram for Leachate Migration through combined groundwater and surface water pathways

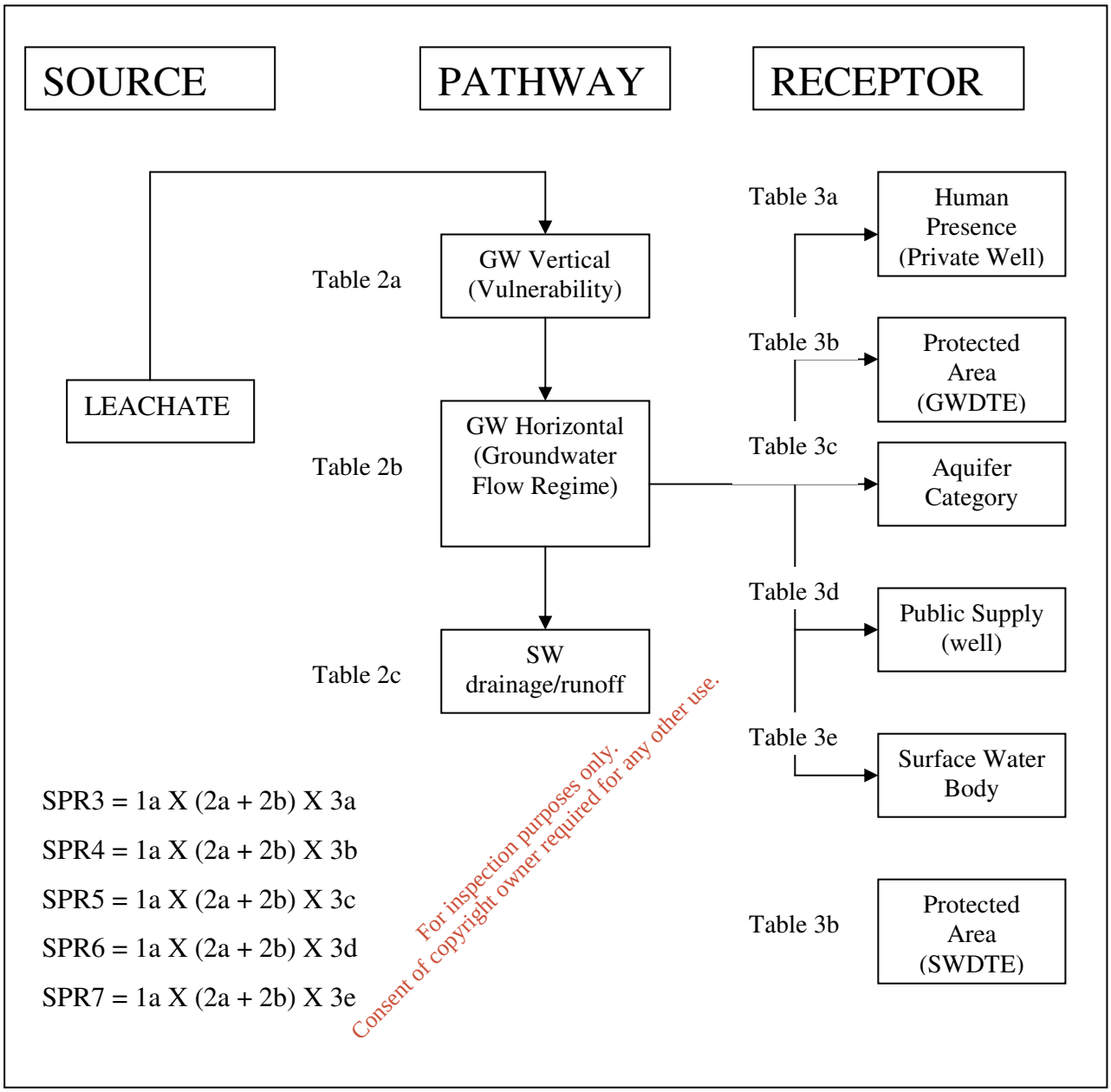


Figure 4.3 Network Diagram for Leachate Migration through Groundwater Pathway.

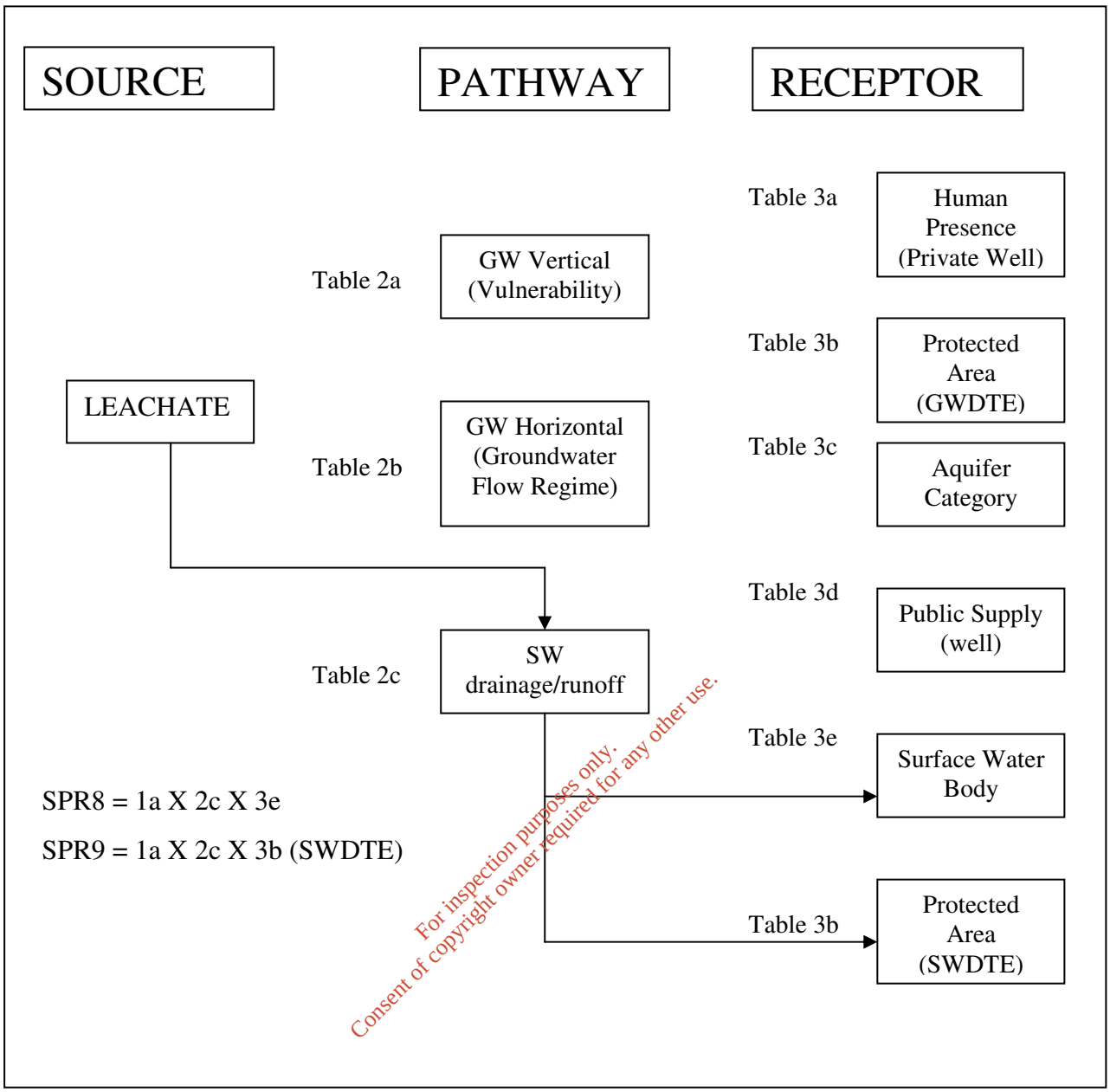


Figure 4.4 Network Diagram for Leachate Migration through Surface Water Pathway only.

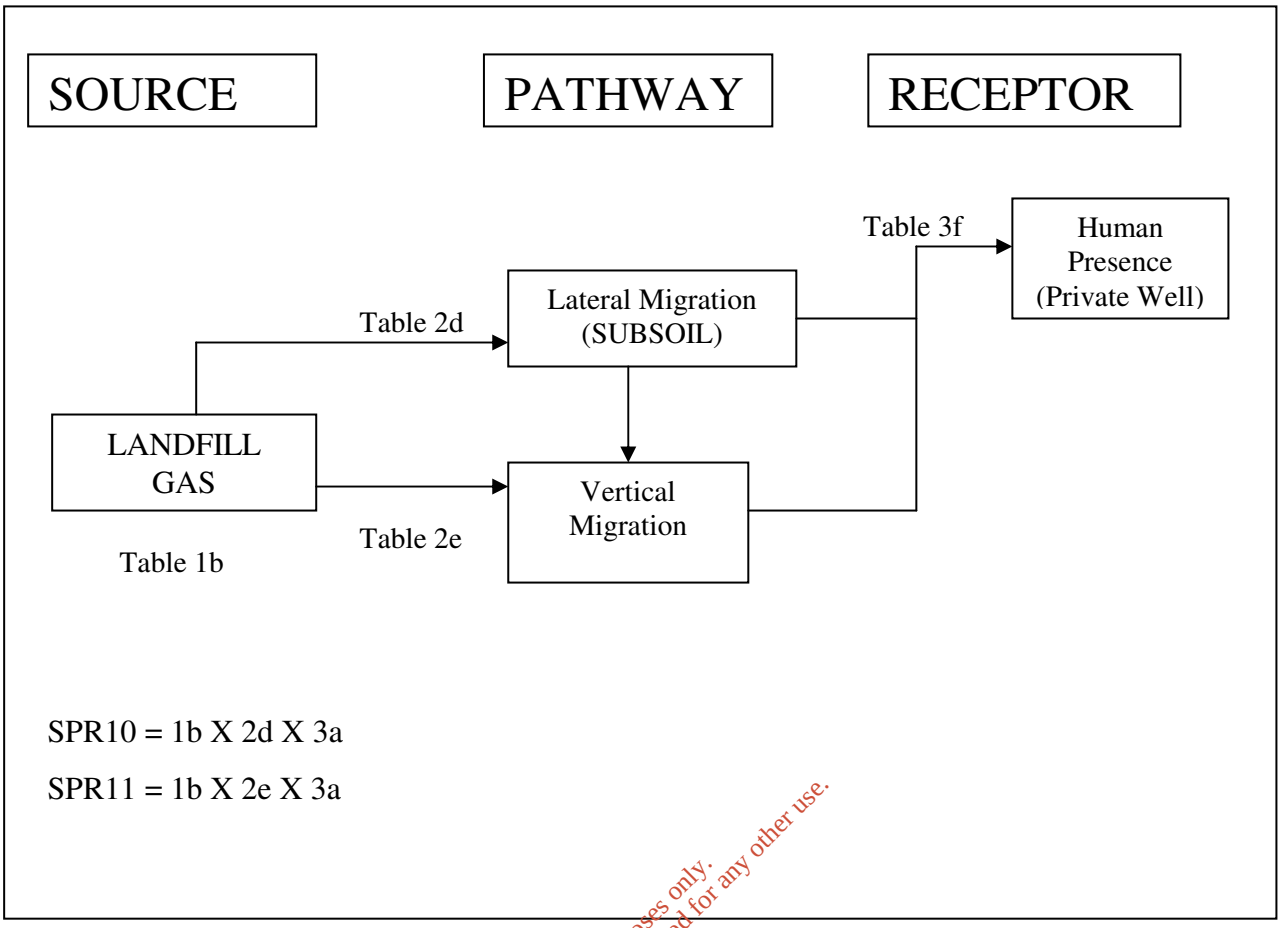


Figure 4.4 Network Diagram for Landfill Gas Migration Pathways (Lateral and Vertical).

Source/Hazards

Waste Types

The waste encountered comprised plastic and glass bottles, occasional empty flattened steel drums, empty plastic drums, concrete pipes, steel, papers, tyres, tyre tubes, timber and trees, all of which were supported by a sandy clay matrix. There was no evidence of food or putrescible waste. The nature of waste observed is typical of household waste that has been buried for more than 24 years and which has undergone considerable biodegradation. With the exception of one parameter in one trial pit (TP-12) analysis has shown that the materials in the landfill are inert.

The analysis of the subsoils underlying the waste indicates that the waste material has not impacted on the natural ground confirming that little or no leaching is not occurring.

Waste Area

The lateral extent of the waste body on site is shown on Figure 3.2. The northern and western extents of the waste body are defined by a line of trees and the Dalua River respectively. The southern and eastern extent of the waste material is defined by the hill to the east and south east of the site.

The investigation proved that thickness of the waste ranged from 0.8m to 3.6m, with an average thickness of 1.75m. The area covered by the waste body is 2,300m^2. It is estimated, that approximately 4,000m^3 of waste is deposited at the site.

Leachate

Leachate was not encountered in the waste material either during the site investigation or as part of the monitoring programme. Rain falling on the waste body will infiltrate the waste and discharge along the base into the surrounding surface water streams or migrate vertically toward the subsoils. The natural subsoils beneath the waste appear to be of low permeability and appear to retard the movement of infiltrating rainfall. It is likely that most of the rainfall reaching the base of the waste ultimately discharges laterally along the base of the waste into the surrounding surface water drainage system with a small amount reaching the water table and ultimately entering the adjacent Dalua River as shallow baseflow.

Landfill Gas

The landfill gas monitoring has established that the waste is not a significant a source of landfill gas. The gas levels measured indicate that the waste is in the final stages of landfill gas generation, with negligible amounts of methane and low carbon dioxide concentrations. This is consistent with the type of waste observed, its age and relatively shallow thickness.

The site investigation did not identify the presence of discrete layers of daily cover material placed over the waste, with the exception of the final cover. It is probable that when the site was operational daily cover was not regularly applied. This would have encouraged the aerobic breakdown of the organic waste fraction. These conditions would have reduced the risk of build up of gas pressure, which is the primary driver of landfill gas migration.

4.1 Pathways

4.1.1 Leachate Migration Pathways

Groundwater Vulnerability

The GSI has categorised the aquifer vulnerability of area occupied by the site as **Extreme**. The site investigation data confirmed this rating.

The waste is unsaturated and water/leachate was not encountered in any of the trial pits or borehole installed in the landfill. Leachate can freely along the sides and base of the waste.

The waste is underlain by a layer of firm grey clay which would greatly retard the downward movement of any leachate resulting in preferential flow to the surface water system

Groundwater Flow Regime

The bedrock aquifer is characterised by the GSI as a Poor Aquifer that is productive only in local zones. This means that groundwater flow paths are short probably 10s to 100s of metres. It is likely that groundwater that manages to infiltrate through the clay beneath the waste will enter the river as shallow baseflow.

4.1.2 Landfill Gas Pathways

The sandy CLAY cover material over the waste is free draining and landfill gas vents freely to atmosphere. The site is surrounded by surface water streams/drains which essentially prevent the migration off-site of landfill gas.

4.2 Receptors

4.2.1 Leachate Migration Receptors

Human Presence

There is no record of any groundwater wells in the vicinity of the site.

Aquifer Category

The bedrock aquifer is classified as locally important (Ll). Based on the results of the upgradient and downgradient groundwater analysis the landfill is not having an impact on the underlying aquifer.

Surface Water Bodies

The Dalua River runs along the western site boundary. The drains that run along the northern and western boundaries of the landfill discharge directly to the river. The surface water body (SWB) for the area is SW_Blackwater190Dalua_1Allow. The SWB is deemed to be at risk of failing to achieve Good Status. The source of the risk is the WTP discharge.

There is an EPA quality monitoring point located downstream of the site. The quality status of the River downstream of the site is Q-3. Based on this assessment programme the discharge from the WTP and or upstream sources is likely to be the cause of this poor quality rating and not the landfill.

4.2.2 Landfill Gas Receptors

Human Presence

The WTP is located within 20m of the landfill site. The risk posed by landfill gas to workers at the WTP is considered to be negligible due to the freely venting nature of the waste body and the presence of a surface water stream running between the landfill and the WTP. There are two private dwelling located to the west of the site and one to the south east which are within 200m from the waste area. The risk posed by landfill gas to off-site receptors is considered to be negligible.

4.3 Risk Assessment

The COP provides a scoring matrix where points are assigned, based on a source-pathway-receptor (SPR) model, to assess risk. There are eleven (11) possible SPRs, which are based on a range of hazard sources (leachate, landfill gas) pathways (soils, surface water and groundwater) and receptors (humans, ecosystems, groundwater supplies).

The scoring system recommended in the COP is included in Appendix 6. The point scores for the individual parameters are derived from the Tables in the Code of Practice. The scores are normalised to 1 -100. High risk sites are those with a score =>70 for any one SPR. Moderate risk are sites scoring between 40 -70. Low risk sites, which are considered not to pose a significant risk to the environment or human health, are those with a score below 40. In the Tier 1 assessment the site score was 50.

While the site investigation has confirmed the wastes are inert and the site presents a low risk, there is no mechanism in the scoring matrix to reflect this. The matrix assigns scores to the source based on the nature of the waste when it was first deposited e.g. Municipal, and does not take account of changes that occur over time, which alter the risk, for example extensive biodegradation. The only option is to amend the source/hazard type to Pre-1977, which essentially means it is inert. This reduces the score to 10 which changes the status of the site from Moderate to Low Risk.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Risk Category

The Tier 2 Risk Assessment process has resulted in a reduction in the risk rating from Moderate to Low Risk.

Landfill Gas

The risk posed by landfill gas to workers at the adjacent WTP or off-site private dwellings is considered to be negligible.

Groundwater

Based on the groundwater quality data gather during the investigation the landfill is not having an impact on the groundwater quality.

Surface Water

Based on the surface water quality data gather during the investigation the landfill is not having an impact on the water quality of the River Dalua.

SAC

The landfill is not impacting on the groundwater or the surface water OCM concludes that the site is not therefore impacting on the SAC adjacent to the site.

5.2 Recommendations

OCM recommend that the landfill be covered by a layer of subsoil and top soil of c.250mm thickness. There is most likely sufficient cover material on site to achieve this coverage without the requirement for importing additional material. A mechanical excavator/dozer could be used to redistribute the cover across the site.

OCM recommend that the site be planted with grass seed to prevent the discharge of sediment from the landfill cover entering the surface water drainage system.

APPENDIX 1

Tier I Risk Assessment

Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites

Tier 1 Study

Conceptual Site Model, Risk Screening & Prioritisation

For

Landfill Site: Newmarket
Site Reference: 23/N
Division: North Cork
Area Office: Newmarket/Kanturk

TIER 1 RISK RATING	MODERATE

Report by: Kieran Coffey
Environment Directorate
Cork County Council
August 2007

Contents

Site Summary

Newmarket Landfill Site is situated 1Km south west of Newmarket town and is adjacent to the town sewage treatment plant (GIS Coordinates E131,006, N106,780). The site is directly beside the Dalua River which is adjacent to the western boundary. This site covers an area of approximately 0.29 Ha.

Location of Newmarket Landfill Site (•)

It is estimated that waste had been delivered to this site since the 1950's. A variety of wastes are thought to have been deposited here including Municipal and C&D wastes It is also suspected that wastewater sludges and oil/barrels may also have been disposed of here. Local staff remembered fires being set and the occasional small explosion from canisters. This site was not a regular site for the disposal of waste by council vehicles because of access difficulties (but was used in emergencies). The site was open to the public between 2pm and 4pm on Fridays. It is estimated that this site closed in 1984 (a year after the closure of Sally's Cross).

Walkover Survey:
Surface waste is evident on much of this site (see attached photos). There is a skip full of waste on site also. Three houses are within 200m of the site and the town sewage treatment plant is within 20m (There is a steel clad control building on this site). The site is bounded to the South and East by a forested hill and to the west by the Dalua

River. The land on the opposite side of this river is agricultural land. There was no evidence of leachate or gas during the walkover survey although there was some odour from the skip.

Geology:

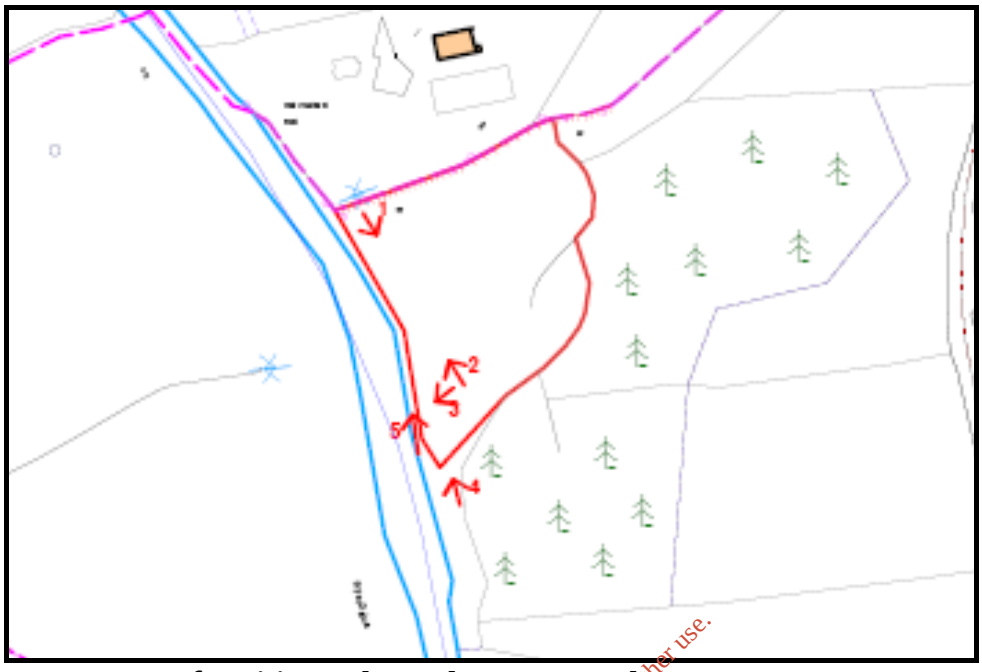
The site is located in a region where there is bedrock close to the surface and it is in an area of a Locally Important Aquifer (LI). It is also located in an extreme groundwater vulnerability area. During the Tier 1 risk screening this site has been identified as having a 50% risk rating for leachate drainage to a surface water body as well as to a Special Area of Conservation (SAC).

Risk Rating: MEDIUM

Recommendations:

Proceed to Tier 2 – Site Investigation and Testing. Particular attention during Tier 2 investigations should focus on proving/disproving that there is on-going pollution being caused by leachate seepage into the adjacent watercourse/SAC.

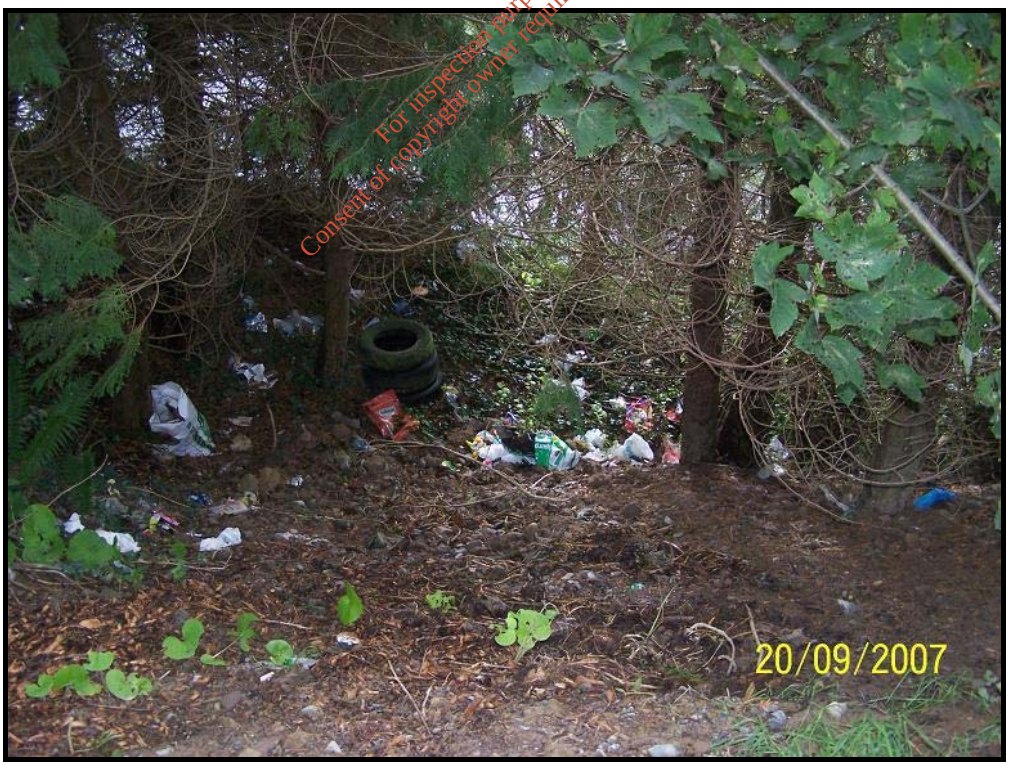
Site Photos & Layout Map



Layout map of positions where photos were taken

1. Photo looking at access to site

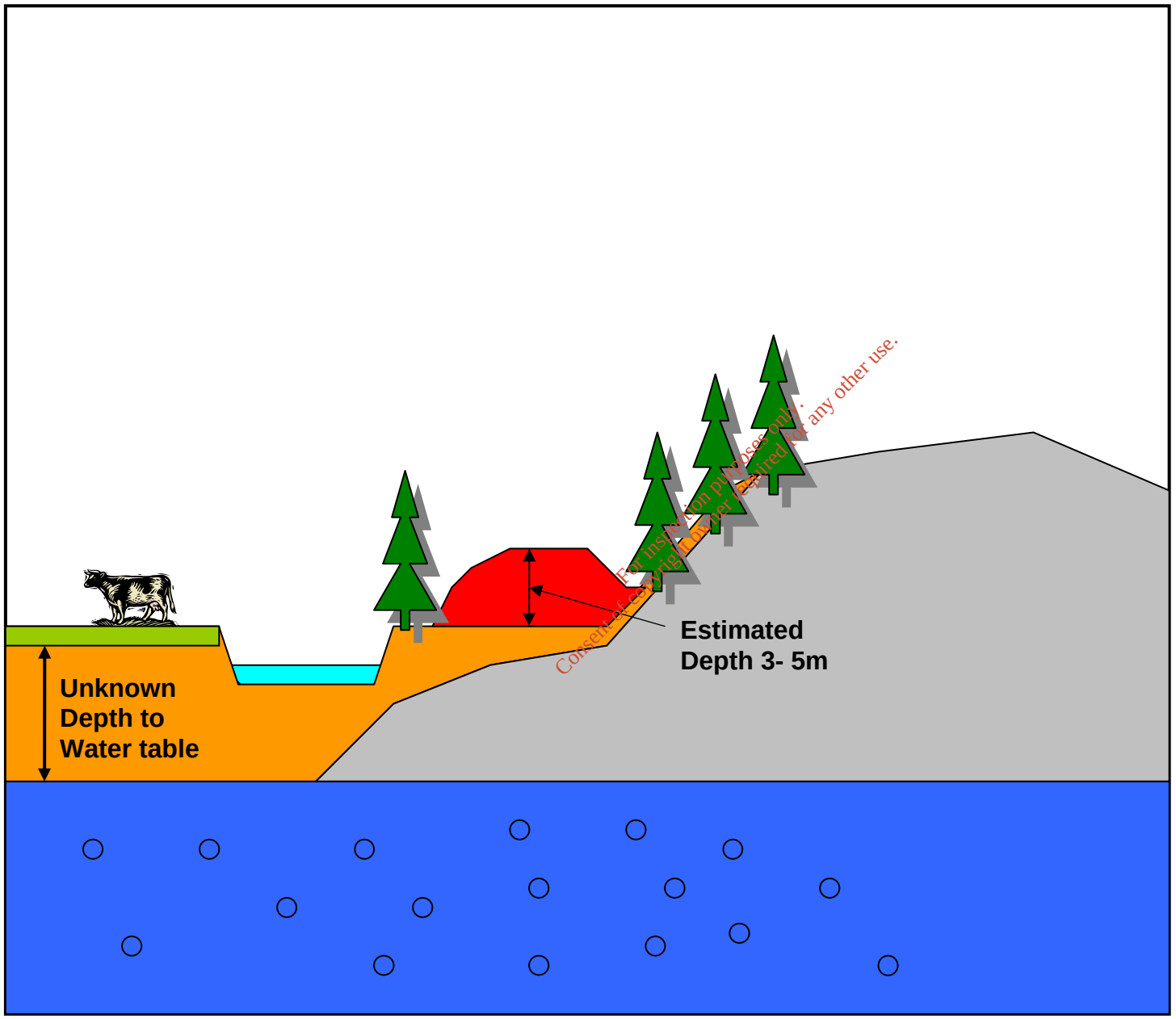
2. Photo facing north west towards entrance to site



3. Photo facing south west down along bank

4. Photo taken from end of site facing north

5. Photo along adjacent riverbank



Conceptual Site Model

Landfill: Newmarket
Site Ref: 23/N
Division: North Cork
Area: Newmarket

Sources:

Waste Body

Receptors:

Groundwater

Private Dwelling

Grazing Land

Road

River

Geology:

Rock

Alluvium

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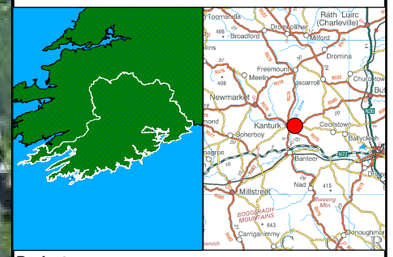

Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description

CSM Plan

Landfill Name & Ref No:

Newmarket - 23/N

Division:

North Cork

Area Office:

Newmarket/Kanturk

Legend

- Roads
- Buildings
- Landfill Area
- River

Issue Details

Drawn: KC		**File Ref.** 23-N CSM Plan	
Checked: -			
Approved:			
Scale:		**Drawing No.**	**Rev.**
Date: 9th Oct 07		**23/N_CSM**	**0**

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4. Risk Screening & Prioritisation Calculations

Risk Screening/ Prioritisation

Table 1a LEACHATE: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	1	1.5
Municipal	5	7	10
Industrial	5	7	10
Pre 1977 sites	1	2	3

1a =	5

Table 1b LANDFILL GAS: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	0.75	1
Municipal	5	7	10
Industrial	3	5	7
Pre 1977 sites	0.5	0.75	1

1b =	5

Table 2a : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER VULNERABILITY (Vertical Pathway)	Points
Extreme Vulnerability	3
High Vulnerability	2
Moderate Vulnerability	1
Low Vulnerability	0.5
High - Low Vulnerability (use where vulnerability not on GIS)	2

2a =	3

Table 2b : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER FLOW REGIME (Horizontal Pathway)	Points
Karstified Groundwater Bodies (Rk)	5
Productive Fissured Bedrock Groundwater Bodies (Rf & Lm)	3
Gravel Groundwater Bodies (Rg and Lg)	2
Poorly Productive Bedrock Groundwater Bodies (Ll, Pl, Pu)	1

2b =	1

Risk Screening/ Prioritisation

Table 2c : LEACHATE MIGRATION: PATHWAYS	
SURFACE WATER DRAINAGE (Surface water pathway)	**Points**
Is there a direct connection between drainage ditches associated with the waste body and adjacent surface water body? Yes	2
If no direct connection	0

2c =	**2**

Table 2d : LANDFILL GAS: PATHWAY	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	**Points**
Sand and Gravel, Made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc - moderate permabi	1.5
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2d =	**1**

Table 2e : LANDFILL GAS: PATHWAY (assuming receptor located above source)	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	**Points**
Sand and Gravel, Made ground, urban, karst	5
Bedrock	3
All other Tills (including limestone, standstone etc - moderate permab	2
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2e =	**1**

Table 3a : LEACHAGE MIGRATION: *RECEPTORS*	
HUMAN PRESENCE (presence of a house indicaates potential private wells)	**Points**
On or within 50m of the waste body	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0

3a =	**2**

Risk Screening/ Prioritisation

Table 3b : LEACHAGE MIGRATION: RECEPTORS PROTECTED AREAS (SWDTE or GWDTE)	Points
Within 50m of waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0
Undesignated sites within 50m of waste body	1
Undesignated sites greater than 50m but less than 250m	0.5
Undesignated sites greater than 250m of the waste body	0

3b =	3

Table 3c : LEACHAGE MIGRATION: *RECEPTORS*	
AQUIFER CATEGORY (resource potential)	Points
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally Important Aquifers (LI, Lm, Lg)	3
Poor Aquifers (Pl, Pu)	1

3c =	3

Table 3d : LEACHAGE MIGRATION: *RECEPTORS*	
PUBLIC WATER SUPPLIES (Other than private wells)	Points
Within 100m of site boundary	7
Greater than 100m but less than 300m or with in Inner SPA for GW supplies	5
Greater than 300m but less than 1km or within Outer SPA (SO) for GW supplies	3
Greater than 1km (karst aquifer)	3
Greater than 1km (no karst aquifer)	0

3d =	0

Table 3e : LEACHAGE MIGRATION: *RECEPTORS*	
SURFACE WATER BODIES	Points
Within 50m of site boundary	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km	1
Greater than 1km	0

3e =	3

Landfill SiteName: Newmarket
Landfill Ref. No. : 23/N

Tier 1 Study

Risk Screening/ Prioritisation

Table 3f : LANDFILL GAS : *RECEPTORS*	
HUMAN PRESENCE	**Points**
On site or within 50m of site boundary	5
Greater than 50m but less than 150m	3
Greater than 150m but less than 250m	1
Greater than 250m	0.5

3f =	**5**

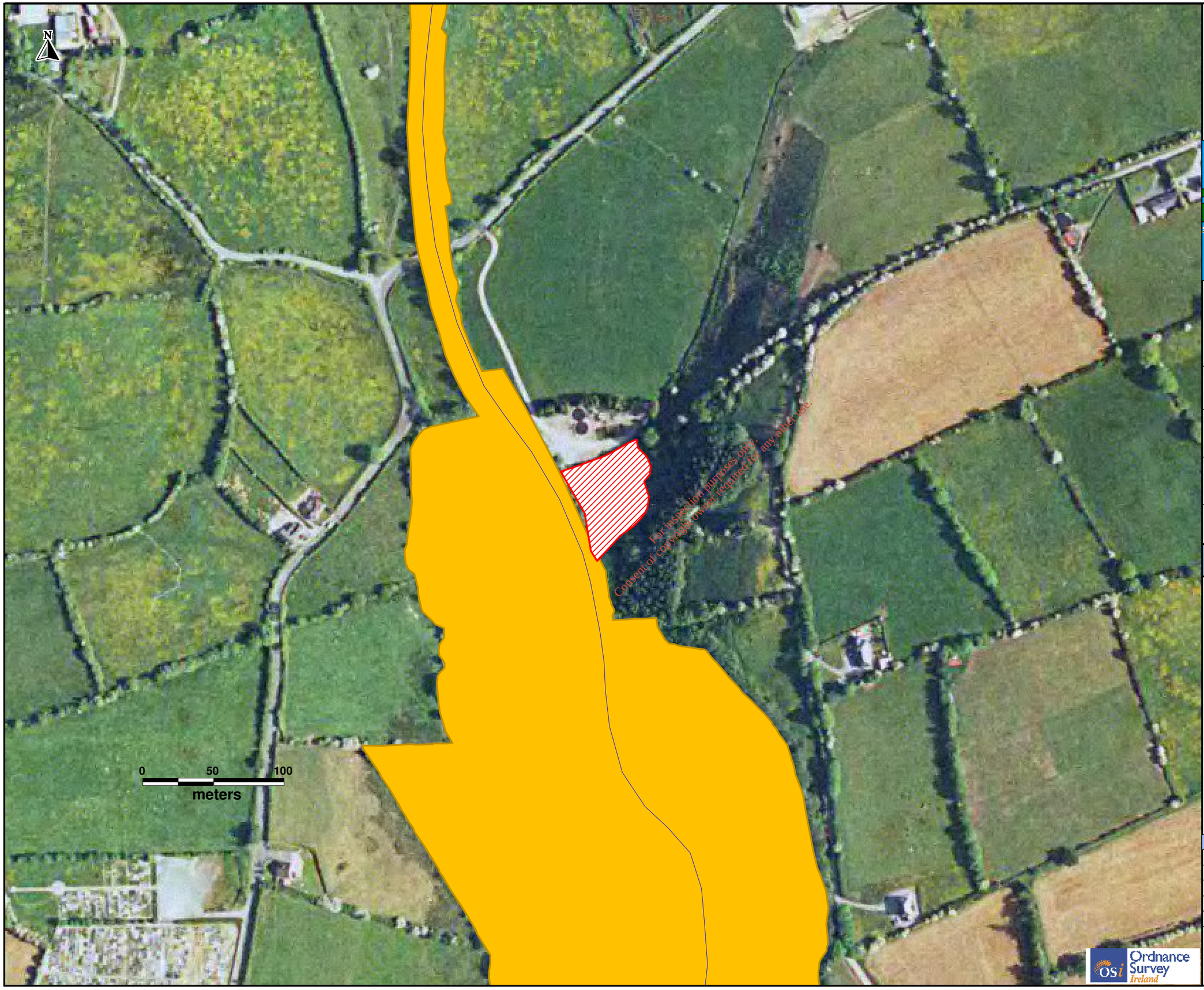
Note: The table below represents the Tier 1 risk rating for this site. SPR 1 to 9 represent the leachate risk scores. SPR 10 & 11 represent Landfill Gas risks. The migration pathways are colour coded as follows:

Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	90	300	Leachate => surface water	**30%**
SPR 2 =	90	300	Leachate => SWDTE	**30%**
SPR 3 =	40	240	Leachate => human presence	**17%**
SPR 4 =	60	240	Leachate => GWDTE	**25%**
SPR 5 =	60	400	Leachate => Aquifer	**15%**
SPR 6 =	0	560	Leachate => Surface Water	**0%**
SPR 7 =	60	240	Leachate => SWDTE	**25%**
SPR 8 =	30	60	Leachate => Surface Water	**50%**
SPR 9 =	30	60	Leachate => SWDTE	**50%**
SPR 10 =	25	150	Landfill Gas => Human Presence	**17%**
SPR 11 =	25	250	Landfill Gas => Human Presence	**10%**

Risk Classification	Range of Risk Scores
Highest Risk (Class A)	**Greater than or equal to 70% for any individual SPR lingage**
Moderate Risk (Class B)	**Between 40-70% for any individual SPR linkage**
Lowest Risk (Class C)	**Less than or equal to 40% for any individual SPR linkage**

OVERALL RISK RATING	**MODERATE**



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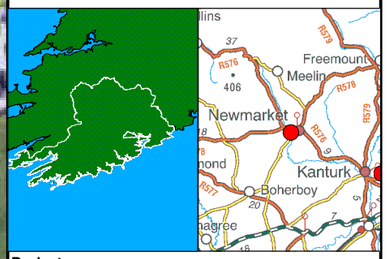

Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description

Protected Areas Map

Landfill Name & Ref No:

Newmarket - 23/N

Division:

North Cork

Area Office:

Newmarket/Kanturk

Legend

- Landfill Area
- SAC
- NHA
- SPA
- National Park
- Nature Reserve
- Rivers

Issue Details

Drawn:	KC	**File Ref.**	
Checked:	-	23-N Protected Areas Map	
Approved:			
Scale:	1:2500	**Drawing No.**	**Rev. 1**
Date:	9th Oct 2007	**23/N_PA1**	

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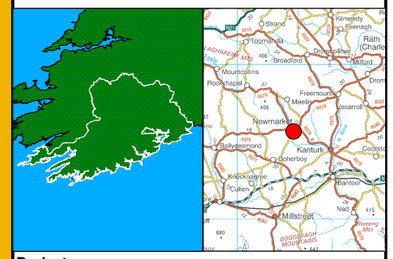

Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:

Aquifer Map

Landfill Name & Reference No:

Newmarket - 23/N

Division:

North Cork

Area Office:

Newmarket/Kanturk

Legend

Landfill Area

AQUIFER CATEGORY

- LI - Locally Important
- Pending Classification
- PI - Poor Bedrock Aquifers
- Pu - Poor Bedrock Aquifers
- Rf - Regionally Important Aquifer
- Rkd - Regionally Important Karstified Aquifer

Rivers

Issue Details

Drawn: KC		**File Ref.**	
Checked: -		**23/N**	
Approved:			
Scale: N/A		**Drawing No.** 23N_AC_1	**Rev. 1**
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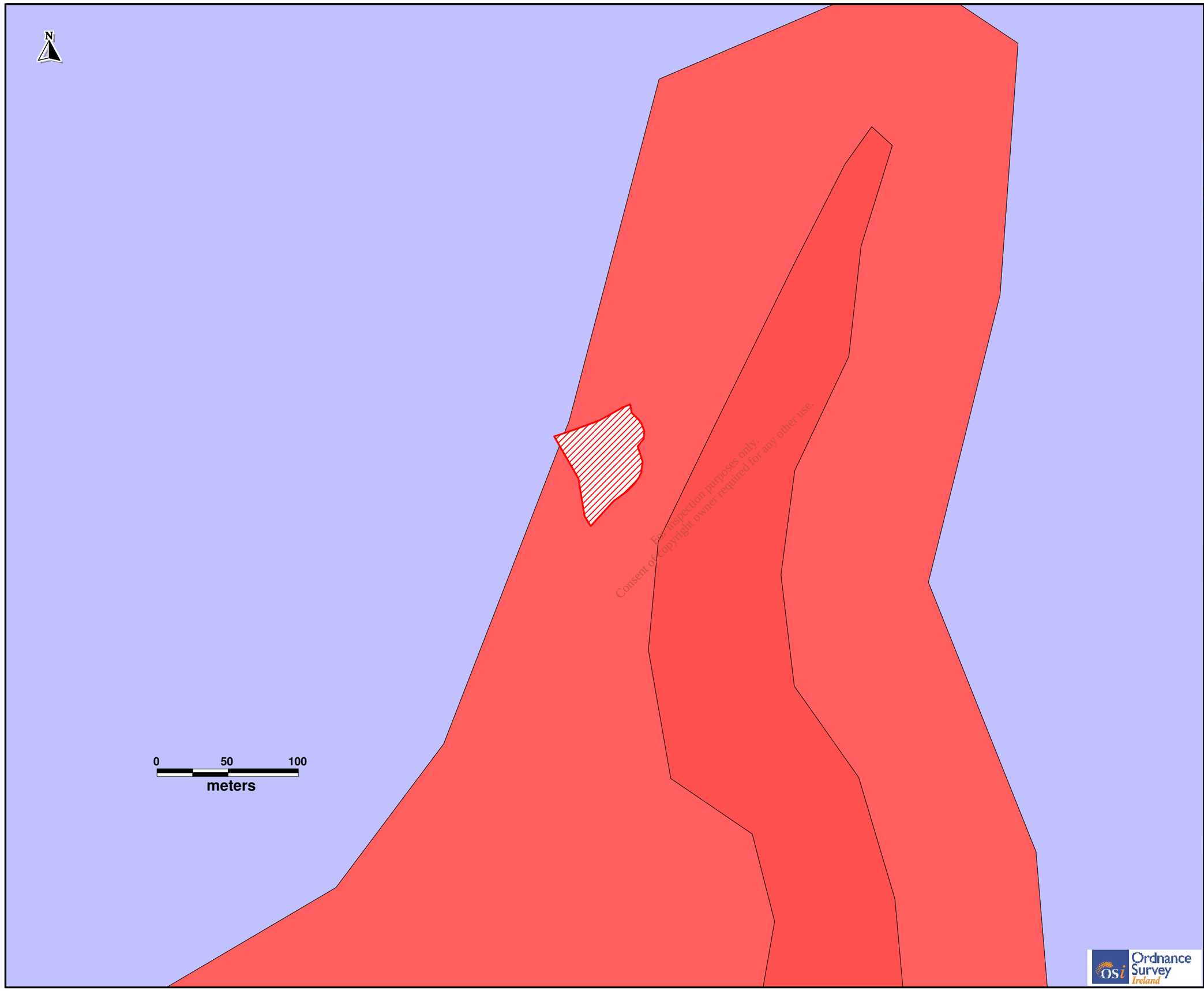

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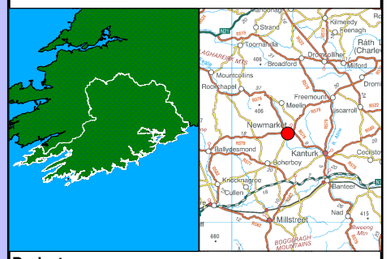

Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:

Groundwater Vulnerability Map

Landfill Name & Ref No:

Newmarket - 23/N

Division:

North Cork

Area Office:

Newmarket/Kanturk

Legend

Landfill Area

SWRBD_Groundwater Vulnerability

- E (Rock near Surface or Karst)
- E - Extreme
- H - High
- HL - High/Low
- M - Moderate
- L - Low
- Water

Issue Details

Drawn:	KC	**File Ref.**	
Checked:	-	**23/N_GV_Rev0**	
Approved:			
Scale:	na	**Drawing No.** 04/N_GV_0	**Rev. 0**
Date:	25th Sept 2007		

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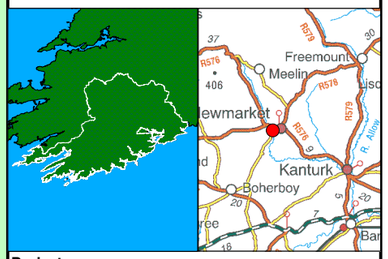

Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:

Subsoils Map

Landfill Name & Ref No:

Newmarket - 23/N

Division:

North Cork

Area Office:

Newmarket/Kanturk

Legend

- Landfill Area
- Soil type

Alluvium *	MGs
BktPt	Msi
GDSs	ROCK *
GLs	Scree
GNSSs	TDCSsS
IrSTDSs	TdlMr
KaRck	TDSs
L	TLPSsS
Made	TLs
Marsh	TNSSs *
Mbs	Water
Mesc	Ws

Issue Details

Drawn:	KC	File Ref.	23-N Subsoil Type
Checked:	-		
Approved:			
Scale:		Drawing No.	Rev. 1
Date:	9th Oct 2007	23/N_ST0	

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APPENDIX 2

Apex Geoservices Report

AGL08109_1

REPORT

ON THE

NEWMARKET (23/N) LANDFILL SITE,

GEOPHYSICAL SURVEY

AT

NEWMARKET,

CO. CORK

FOR

O' CALLAGHAN MORAN & ASSOCIATES.

06RD JUNE 2008

PRIVATE AND CONFIDENTIAL

THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THE REPORT.

PROJECT NUMBER	**AGL08028**		
AUTHOR	**CHECKED**	**REPORT STATUS**	**DATE**
IAN SHARKEY DIP. MINERAL ENG.	P O'CONNOR P.GEO., M.SC (GEOPHYSICS), DIP EIA MGT.	V.1	06RD JUNE 2008

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

- APEX Geoservices Ltd. was requested by O' Callaghan Moran and Associates to carry out a geophysical survey at the unregulated Newmarket landfill site, ref: (23\N) which is situated approximately 1Km South-West of Newmarket town Co. Cork.

- The fill material has been described as predominantly municipal and C&D waste. There is also a possibility that wastewater sludges and oil barrels were disposed on site. The site was overgrown and inaccessible in places.

- The objectives of the survey were to assess the sub-surface conditions including thickness and extent of the landfill, to identify possible leachate plumes and locate buried drums within the waste material.

- EM31 conductivity, 2D resistivity and seismic refraction were recorded across the accessible parts of the site.

- The four resistivity profiles confirm the lateral extent of the landfill. Interpreted sections 8109-4 to 8109-7 indicate an average landfill thickness of 4m capped with between 0.2 and 2.0 m of inert fill material.

- High EM31 conductivity readings have outlined areas of fill overlain by thin inert capping material. Lower conductivity readings occur over areas of thicker capping.

- High EM31 inphase values contoured on map 8109-2 indicate the presence of possible metallic objects in the fill material. A trial magnetic survey also indicated the presence of possible buried metallic objects.

- Two seismic refraction profiles shown on Map 8109-1 indicate a fresh bedrock profile at approximately 5-6 m bgl (130mOD). 1-2m of weathered rock is indicated above the fresh rock. The resistivity values for the bedrock indicate a sandstone/shale material.

- The seismics confirm a soft-firm ,inert capping layer approximately 0.8m-3.0m in thickness overlying approximately 4m of soft-firm landfill material.

- The main subsurface anomalies indicated by the conductivity and magnetic data are shown on maps 8109-2 to 8109-10. Confirmatory pitting/drilling of these anomalies should be carried out at the following locations:

Trial pit	Easting	Northing
TP1	131029.756	106809.731
TP2	131020.379	106802.981
TP3	131002.365	106776.062
TP4	131024.326	106792.627
TP5	131011.080	106792.349
TP6	131007.482	106790.989
TP7	131013.130	106781.912

Borehole	Easting	Northing
PBH1	131018.595	106801.887
PBH2	131004.327	106771.515

2. INTRODUCTION

APEX Geoservices Ltd. was requested by O' Callaghan Moran and Associates to carry out a geophysical survey at the unregulated Newmarket landfill site, ref: (23\N) which is situated approximately 1Km South-West of Newmarket town Co. Cork.

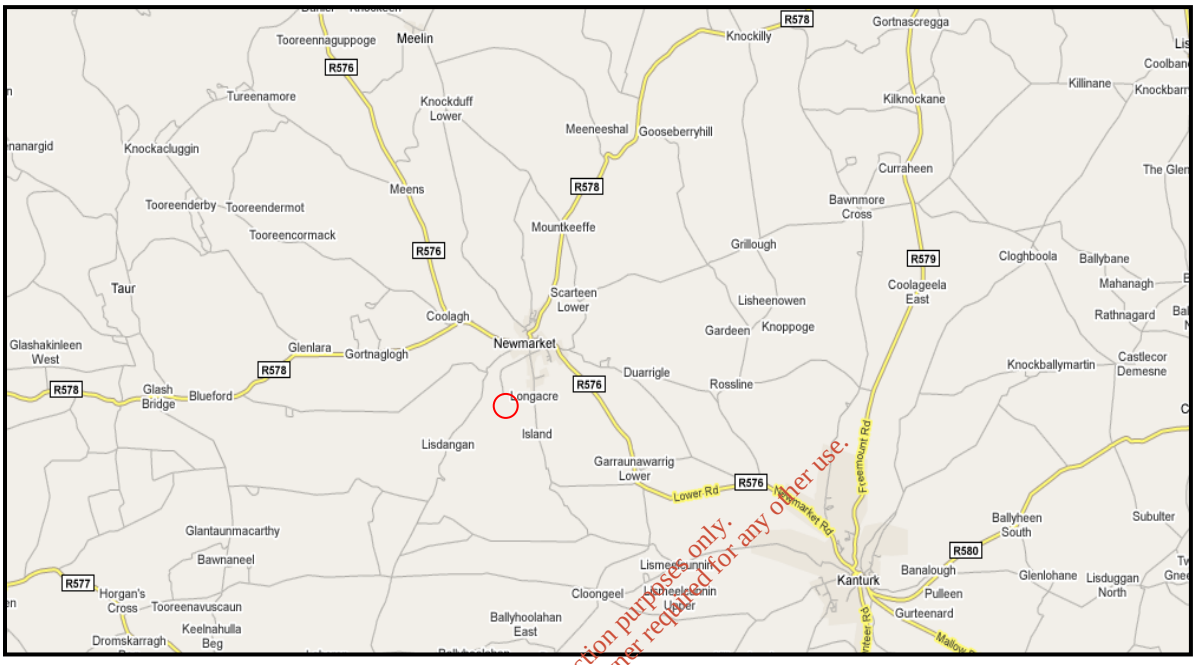

Fig. 1 Site Location

2.1 Survey Objectives

The objectives of the survey were:

- To assess the sub-surface conditions including thickness and extent of the landfill.
- Too identify possible leachate, especially towards the adjacent river
- To locate buried drums within the waste material.

2.2 Survey Methodology

The following survey was carried out:

- EM31 Conductivity mapping to investigate the lateral extent of landfill material and to locate buried drums within the landfill material.
- 2-D Resistivity Profiles to investigate the lateral and vertical extent of the landfill material, evidence of any leachate plume and the depth to rock.
- Seismic Refraction Profiles at selected locations to investigate landfill and overburden thickness and the depth to rock.
- A trial magnetic survey to locate metallic objects within the landfill material.

2.3 Site Background & Geological Setting

The site is located approximately 1Km South West of Newmarket town, Co. Cork. The site covers an area of approximately 0.29 Ha and is adjacent to the the town sewage treatment plant on the Northern boundary and the Dalua river on the Western boundary. Forested hills lie to the South and West of the site. The site access is restricted due to dense vegetation.

Fig. 2 Location of Resistivity profile 4

Fig. 3 Location of Seismic profile 1

The fill material has been described as predominantly municipal and C&D waste. There is also a possibility that wastewater sludges and oil barrels were disposed on site.

The geological map for the area (Geology of Cork-Kerry, Sheet 21, 1:100,000 Bedrock Series, Geological Survey of Ireland) indicates that the site is underlain by Namurian undifferenciated shales and sandstones. The GSI database indicates alluvium overburden overlying shale bedrock.

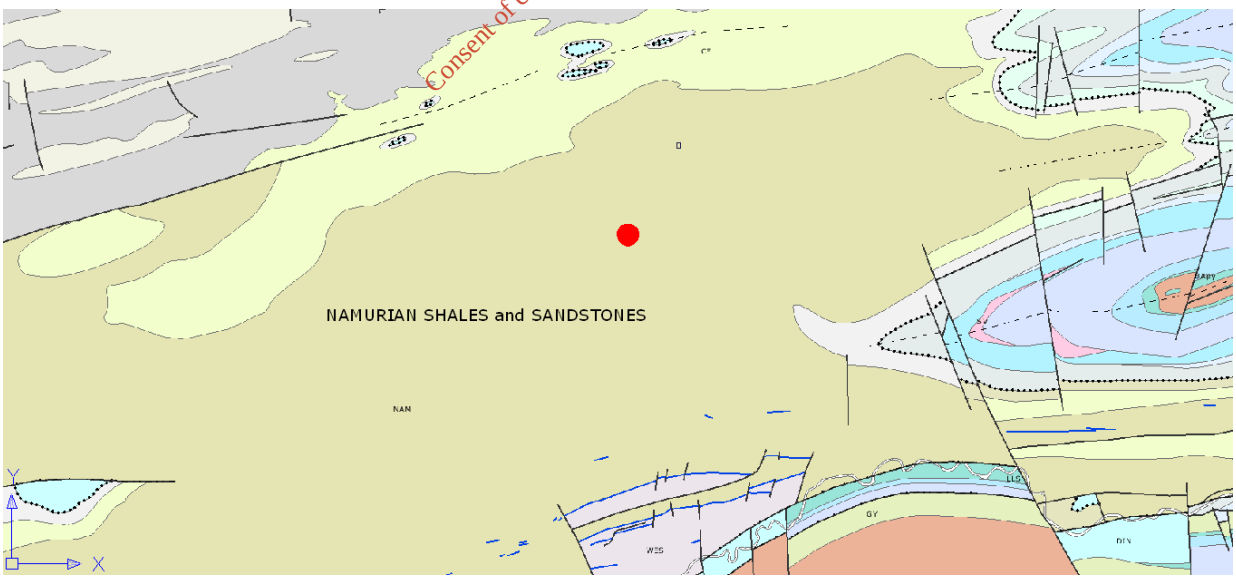

Fig. 4 Site Geology

2.4 Report Outline

- The survey results are discussed in Section 3.
- The locations of the geophysical readings are shown on Map 8109-1.
- The processed EM31 conductivity and Inphase data are contoured on Map 8109-2.
- The Interpreted EM31 conductivity and Inphase data are shown Map 8109-3.
- The Interpreted resistivity profiles are shown Maps 8109-4 to 8109-7.
- The Interpreted seismic profiles are shown Maps 8109-8 and 8109-9.
- The Interpreted magnetic profile M1 is shown Map 8109-10.
- Recommended direct investigation are shown on Map 8109-3.
- Appendix I contain an account of the geophysical methods, equipment used and data processing.
- Appendix II contain the seismic refraction data.

3. INTERPRETED RESULTS

EM31 Conductivity
Recorded conductivity values ranged from 0.6 to 40mS/m. The conductivity data were interpreted on the following basis:

Conductivity value (mS/m)	**Interpretation**
>20	Thin (<1m) inert or capping material over fill
<20	Thick (1-3m) inert or capping material over fill
Inphase Value (ppm)	**Interpretation**
<900	Overburden/Alluvium - Weathered Shale
>900	Approx 3-5m of landfill waste over Alluvium - Weathered Shale.

Note. Contour maps interpolate and average between the measured data points and features that are present smaller than the grid size may not be apparent on the contour map.

The conductivity and inphase data have been contoured on Map 8109-2. A combined interpretation of the conductivity and resistivity data is shown on map 8109-3.

The high conductivity values (>20mS/m) indicate landfill waste overlain by approximately 0.2m to 1.0m of inert capping material. Conductivity values in the range of 16 to 20mS/m are generally due to an increased thickness of the inert capping layer.

Readings over buried metal give a sharp variation in conductivity as well as an increase in the inphase value. The Inphase values recorded on site are relatively low compared with similar sites. The highest values (>900ppm) are coincident with the high conductivity values and indicate the presence of possible metal objects.

The magnetic data (Profile M1) is shown on Interpreted Section 8109-10. The recorded values ranged from 47628nT to 48807nT with an average of 48325nT. This wide range of indicates the presence of possible metallic objects between 11.5m and 55.5m along the profile.

2D Resistivity
Four 2D Resistivity profiles were recorded across the site (Map 8109-1). The interpreted resistivity profiles are shown on interpreted sections 8109-4 to 8109-7. The resistivity data were interpreted on the following basis:

2D Resistivity value (ohm-m)	**Geophysical Interpretation**
170-1000	Inert/capping material
10 - 170	Made ground/landfill waste /leachate/buried metal/sludge
50-1072	Sandstone/Shale bedrock

The average thickness of the landfill is 3.5m capped with an average 0.8m of inert material. The bedrock is interpreted as sandstone/ shale.

Layers of material between the landfill and the bedrock such as alluvium may be masked due its low resistivity similar to that of shales.

R4 has very low resistivity values (80-200 Ohm-m) between 32m and 48m along the profile to a depth of 12m. These are low values for bedrock and may be due to migration of leachate through fracturing in the rock. Similar low bedrock resistivities were also recorded on R1 and R2.

Two seismic refraction profiles S1 and S2, were recorded on Resistivity profiles R3 and R4 respectively. The profile locations are shown on map 8109-1 and are interpreted on sections 8109-8 and 8109-9. The seismic data were interpreted on the following basis:

Layer	P-waveSeismic Velocity (m/sec)	Geophysical Interpretation	Average Thickness (m)
1	93-436	Soft to firm made ground –capping layer	0.8
2	268-850	Soft-firm made ground/landfill waste	5.1
3	2828 - 3346	Sandstone/Shale bedrock	

The bedrock elevation is approximately 130mOD.

4. RECOMMENDATIONS

- TP1 targets possible source of buried metal at 31m on Magnetic profile 1.
- TP2 targets possible source of buried metal at 42m on Magnetic profile 1.
- TP3 targets thin inert capping material at 50m on Resistivity profile 3.
- TP4 targets 3m thickness of inert capping material at 46.5m on Resistivity profile 1.
- Additional trialpits 5, 6 and 7 may be placed on the high conductivity/high inphase values shown on map 8109-1 to investigate the fill material and possibilities of metallic objects in the fill material.
- Proposed borehole PBH1 should investigate the low resistivity bedrock on R4 and the possible leachate migration through fracturing in the bedrock.
- Proposed borehole PBH2 should confirm the high resistivity, tighter bedrock at 55m on R3. This will also investigate the weathered shale/alluvium layer overlying the bedrock.
- If a geophysical survey of the remainder of the site is required then site clearance should take place in advance.

Trial pit	Easting	Northing
TP1	131029.756	106809.731
TP2	131020.379	106802.981
TP3	131002.365	106776.062
TP4	131024.326	106792.627
TP5	131011.080	106792.349
TP6	131007.482	106790.989
TP7	131013.130	106781.912

Borehole	Easting	Northing
PBH1	131018.595	106801.887
PBH2	131004.327	106771.515

Co-ordinates are in Irish national grid.

The geophysical data should be reviewed based on the findings of any direct investigation.

5. REFERENCES

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Soske, J.L., 1959;
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MAPS

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Kilanerin, Gorey, Co. Wexford, Ireland.
Tel. +353-(0)402-21842
Fax. +353-(0)402-21843
E: info@apexgeoservices.ie
www.apexgeoservices.ie

INDEX MAP:

LEGEND:

- Resistivity Profile
- Seismic Profile
- Magnetic Profile
- Conductivity Reading
- Survey Area

PROJECT:	8109 Newmarket
DRAWING No.:	8109-1 Geophysics Locations
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
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Version:	Date:	Drawn By:	Checked:
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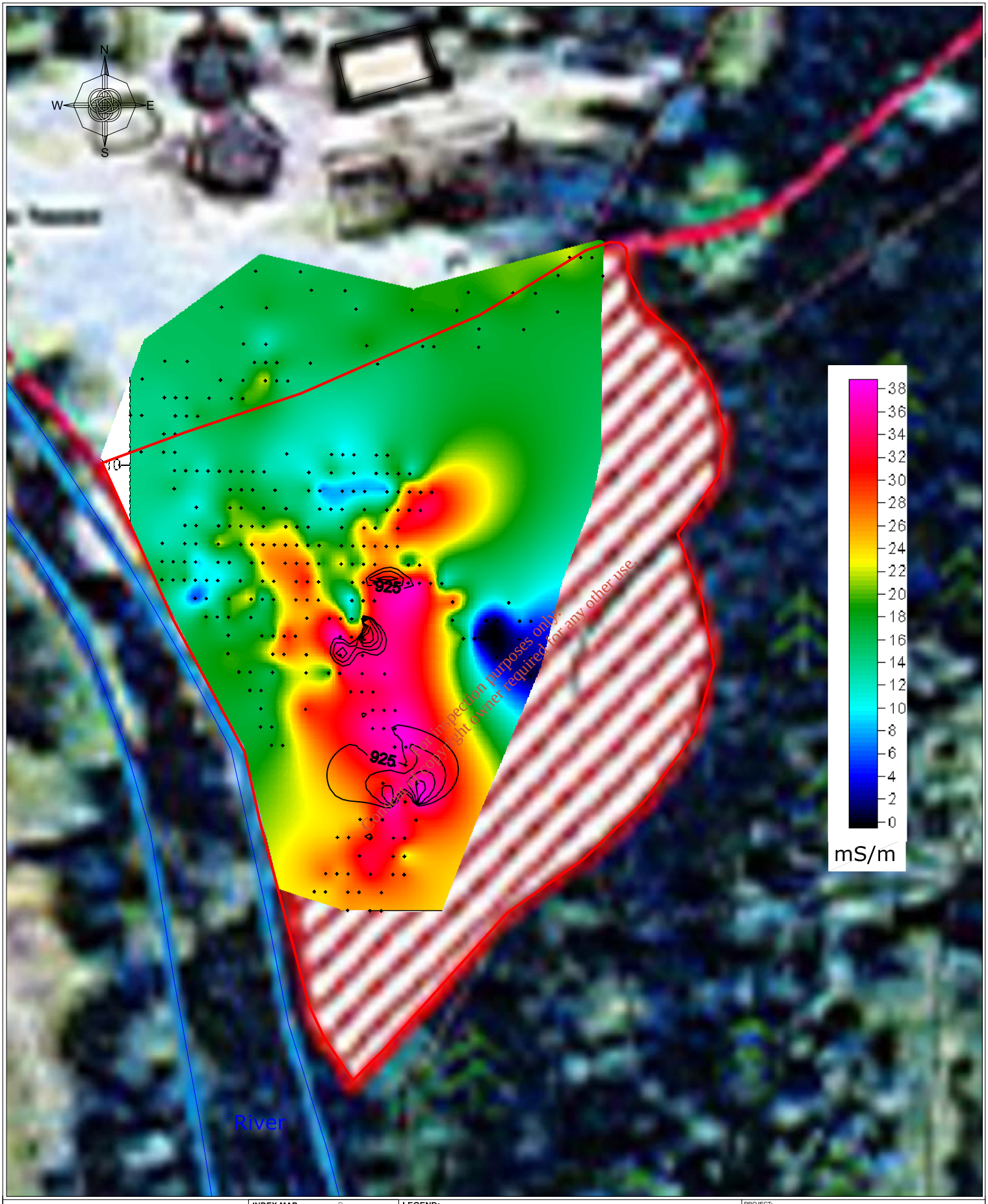

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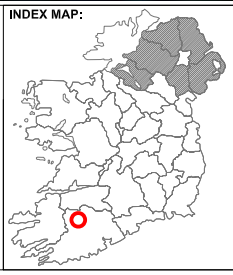

LEGEND:

- Survey Area
- Conductivity Reading
- Conductivity Inphase Anomaly
- Conductivity Values (mS/m)

PROJECT:	8109 Newmarket
DRAWING No.:	8109-2 Conductivity Map
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
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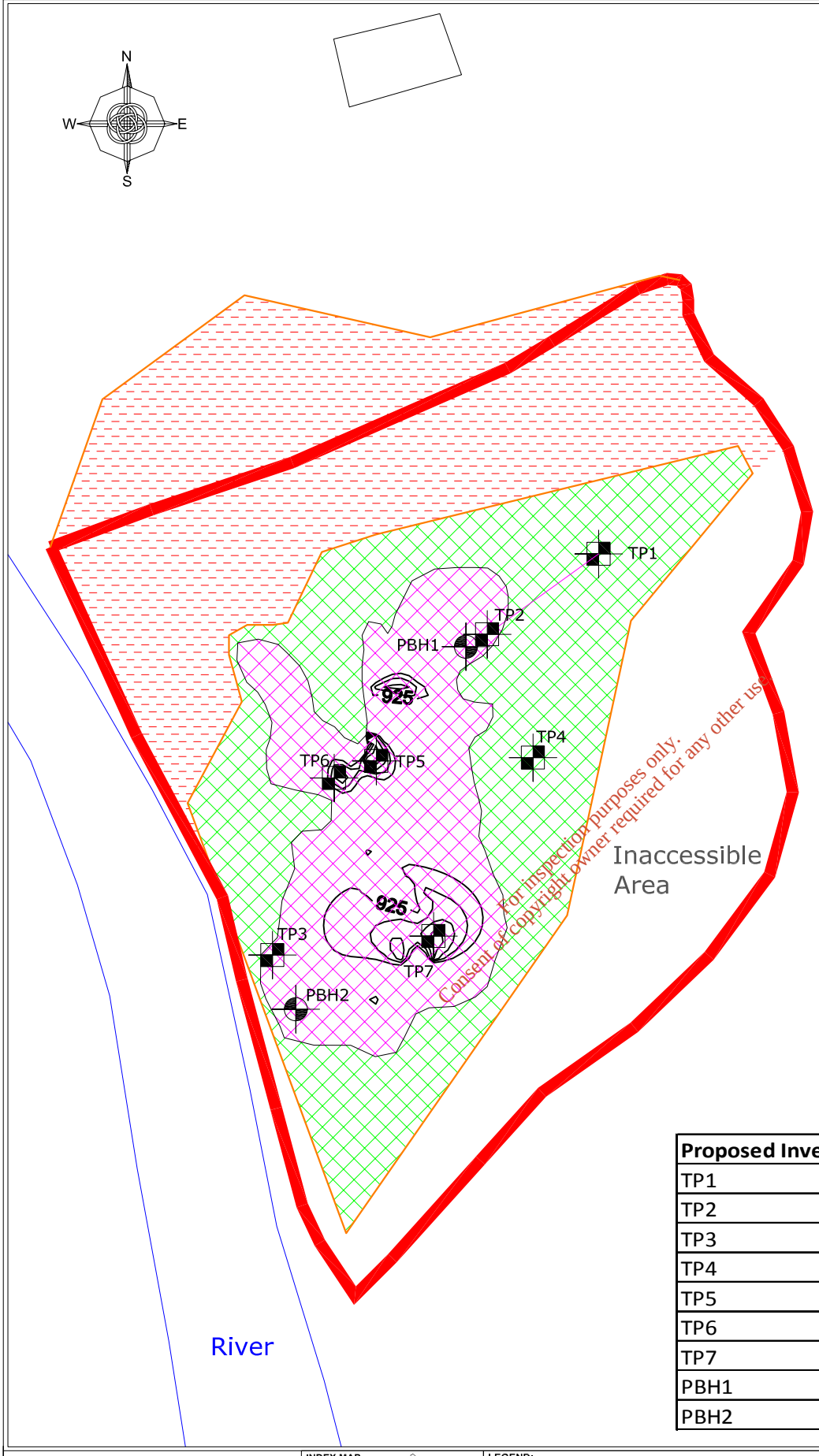

Proposed Investigation	Easting	Northing
TP1	131029.756	106809.731
TP2	131020.379	106802.981
TP3	131002.365	106776.062
TP4	131024.326	106792.627
TP5	131011.080	106792.349
TP6	131007.482	106790.989
TP7	131013.130	106781.912
PBH1	131018.595	106801.887
PBH2	131004.327	106771.515

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Fax. +353-(0)402-21843
E: info@apexgeoservices.ie
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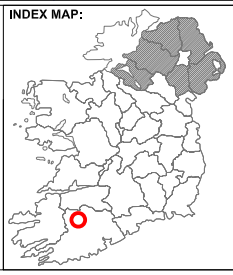

LEGEND:

- Overburden/Alluvium
- Fill with thin capping
- Fill with thick capping
- InPhase Contours/ Possible buried metal

PROJECT:	8109 Newmarket
DRAWING No.:	8109-3 Interpreted Conductivity Map
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
SCALE:	1:500 @A4

Version:	Date:	Drawn By:	Checked:
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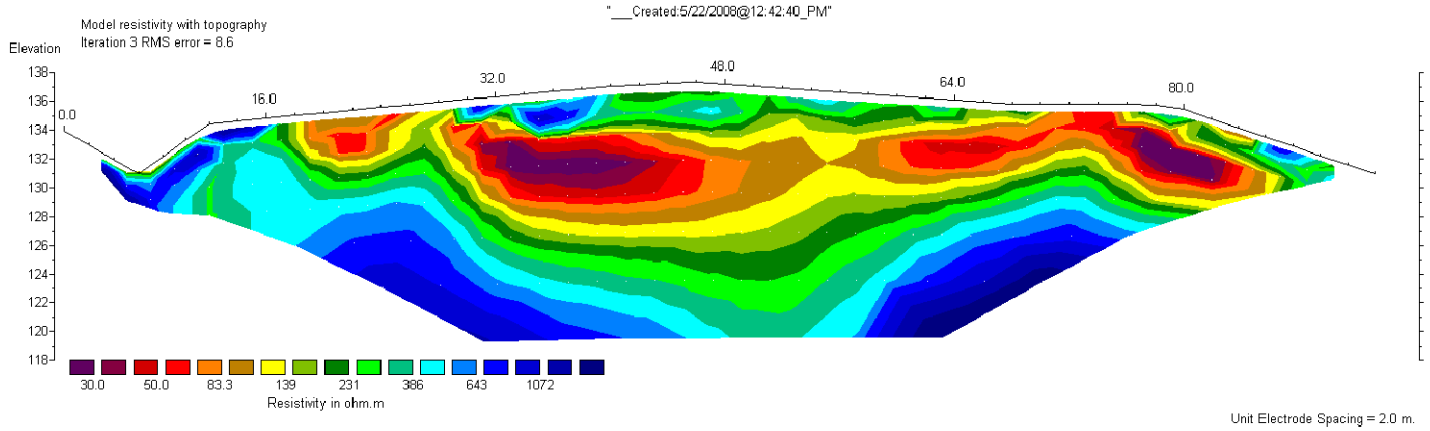
INTERPRETED SECTIONS

R1

NE SW



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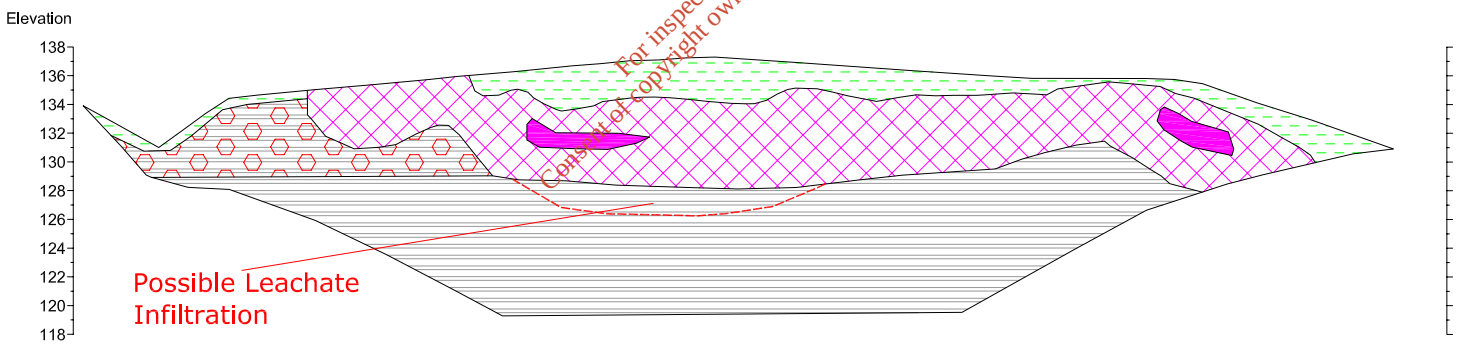
Vertical exaggeration in model section display = 1.00
First electrode is located at 0.0 m.
Last electrode is located at 94.0 m.



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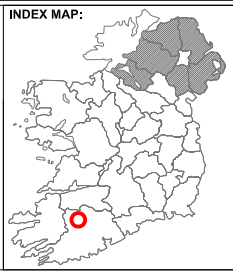

LEGEND:

- Made Ground/ Inert Capping Layer
- Mixed Organic, C&D Waste + Metal
- Concentrated Organic Waste/Sludges/Metal
- Alluvium/ Weathered Shale
- Sandstone/Shale
- Possible Leachate Infiltration

PROJECT:	8109 Newmarket
DRAWING No.:	8109-4 Interpreted Resistivity Profile 1
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
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Version:	Date:	Drawn By:	Checked:
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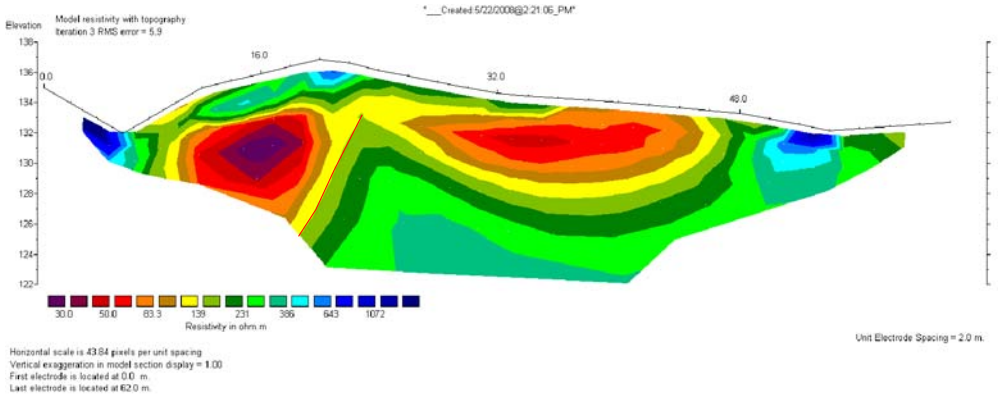
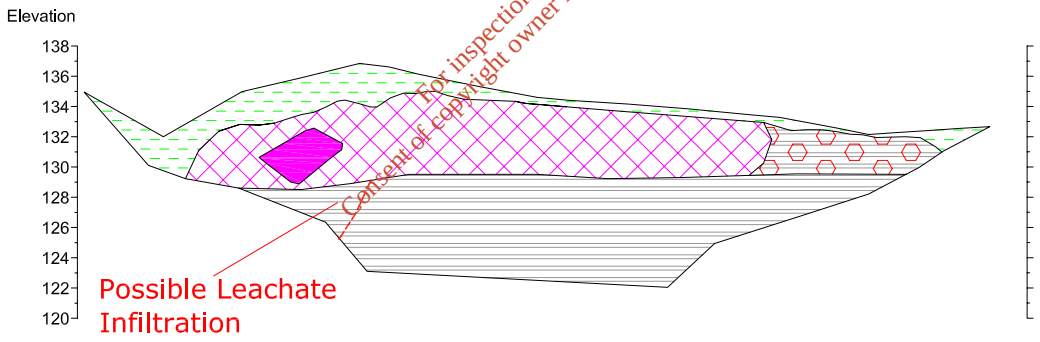
R2

SE NW





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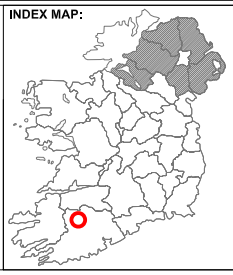

LEGEND:

- Made Ground/ Inert Capping Layer
- Mixed Organic, C&D Waste + Metal
- Concentrated Organic Waste/Sludges/Metal
- Alluvium/ Weathered Shale
- Sandstone/Shale
- Possible Leachate Infiltration

PROJECT:	8109 Newmarket
DRAWING No.:	8109-5 Interpreted Resistivity Profile 2
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
SCALE:	1:500 @A4

Version:	Date:	Drawn By:	Checked:
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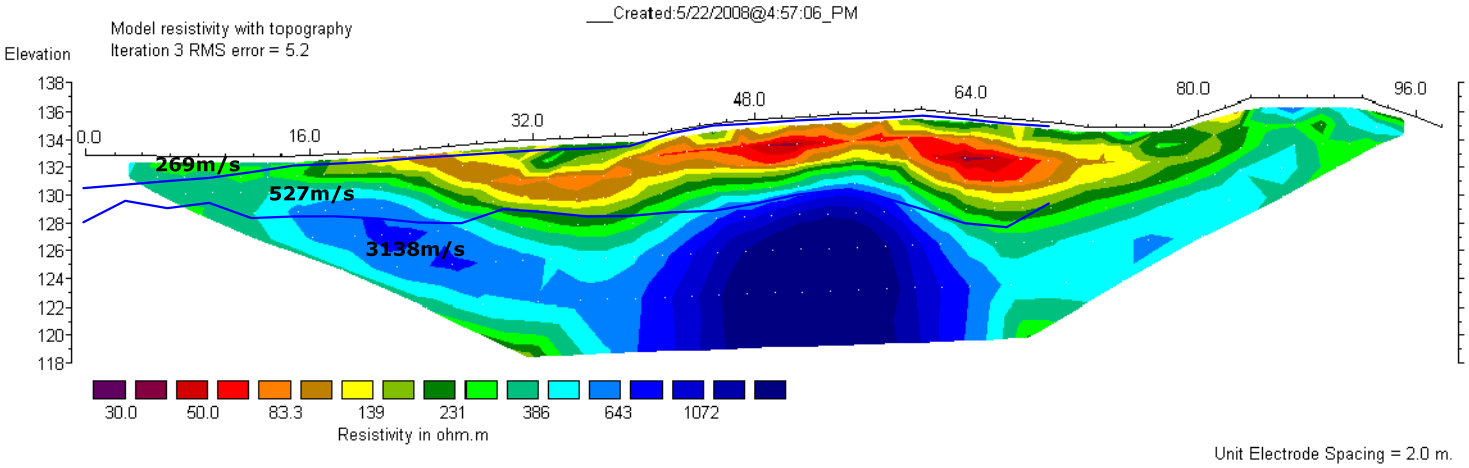
R3

NW SE



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Vertical exaggeration in model section display = 1.00
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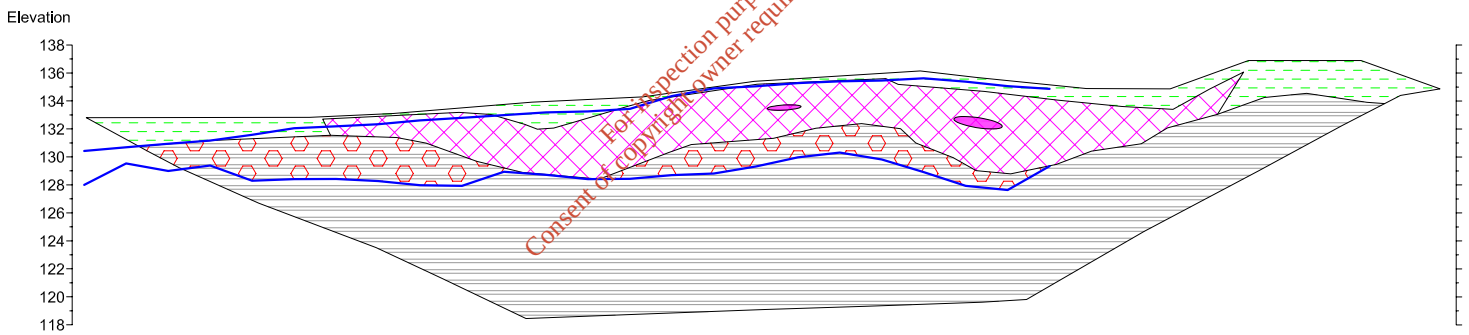
Last electrode is located at 98.0 m.



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Fax. +353-(0)402-21843
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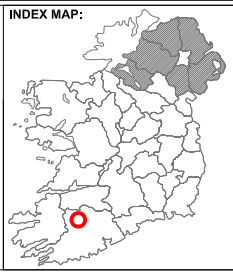
INDEX MAP:



LEGEND:

- Made Ground/ Inert Capping Layer
- Mixed Organic, C&D Waste + Metal
- Concentrated Organic Waste/Sludges/Metal
- Alluvium/ Weathered Shale
- Sandstone/Shale
- Possible Leachate Infiltration

PROJECT:	8109 Newmarket
DRAWING No.:	8109-6 Interpreted Resistivity Profile 3
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
SCALE:	1:500 @A4

Version:	Date:	Drawn By:	Checked:
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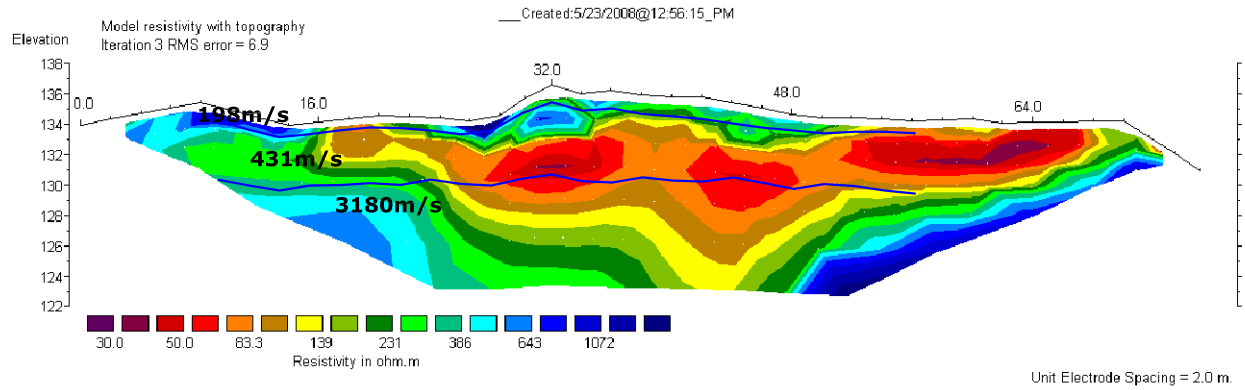
R4

NE SW



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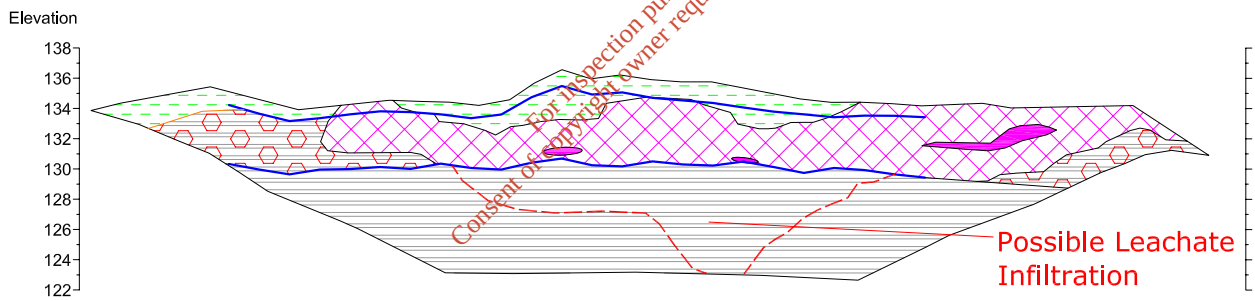
Last electrode is located at 76.0 m.



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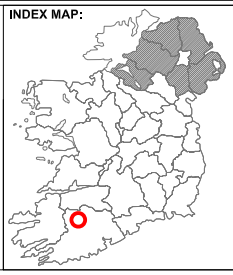

LEGEND:

- Made Ground/ Inert Capping Layer
- Mixed Organic, C&D Waste + Metal
- Concentrated Organic Waste/Sludges/Metal
- Alluvium/ Weathered Shale
- Sandstone/Shale
- Possible Leachate Infiltration

PROJECT:	8109 Newmarket
DRAWING No.:	8109-7 Interpreted Resistivity Profile 4
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
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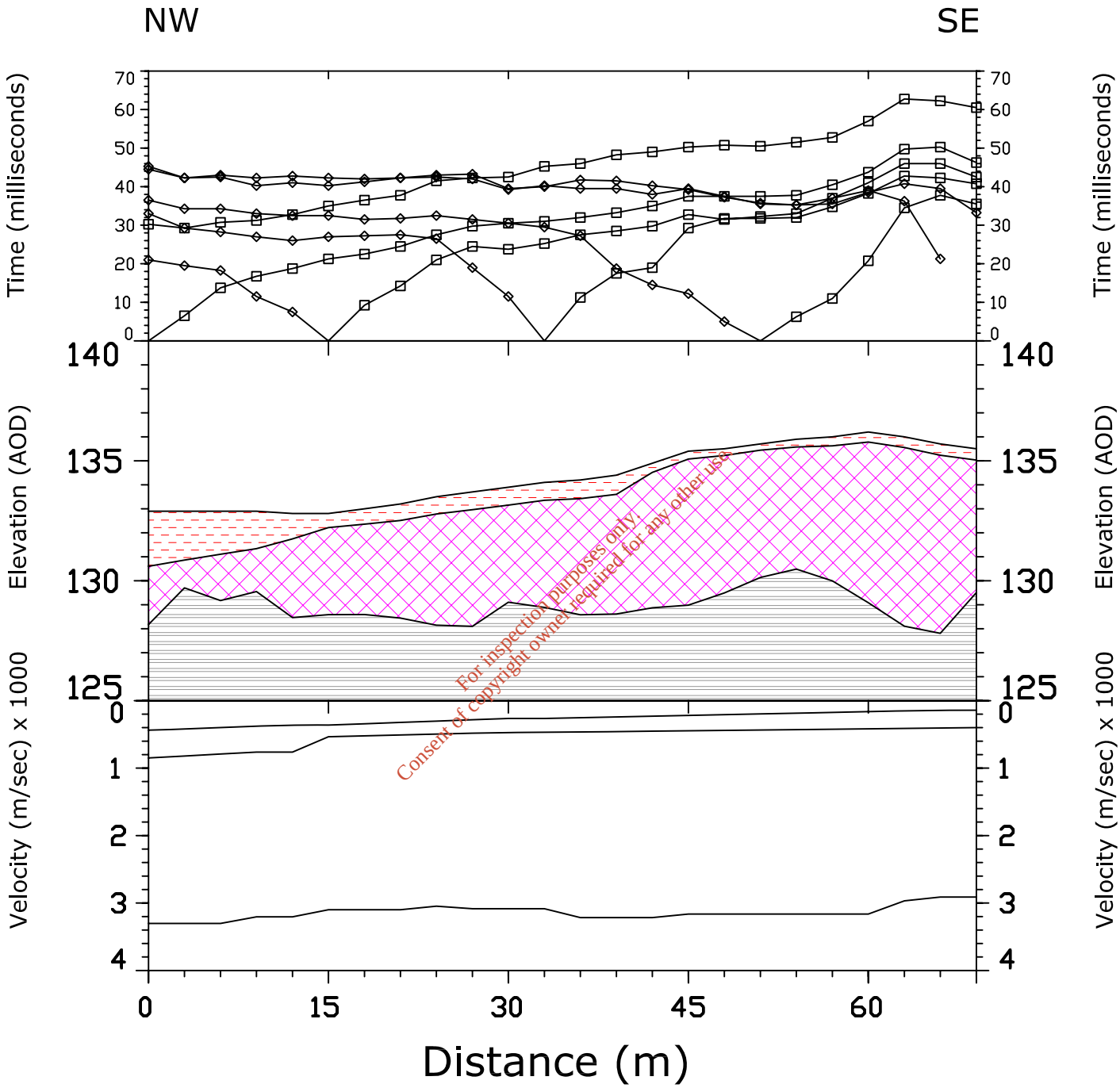
S1



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Kilanerin, Gorey, Co. Wexford, Ireland.
Tel. +353-(0)402-21842
Fax. +353-(0)402-21843
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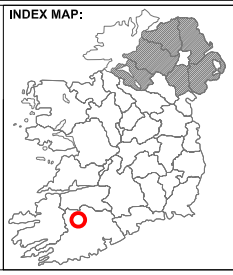
INDEX MAP:



LEGEND:

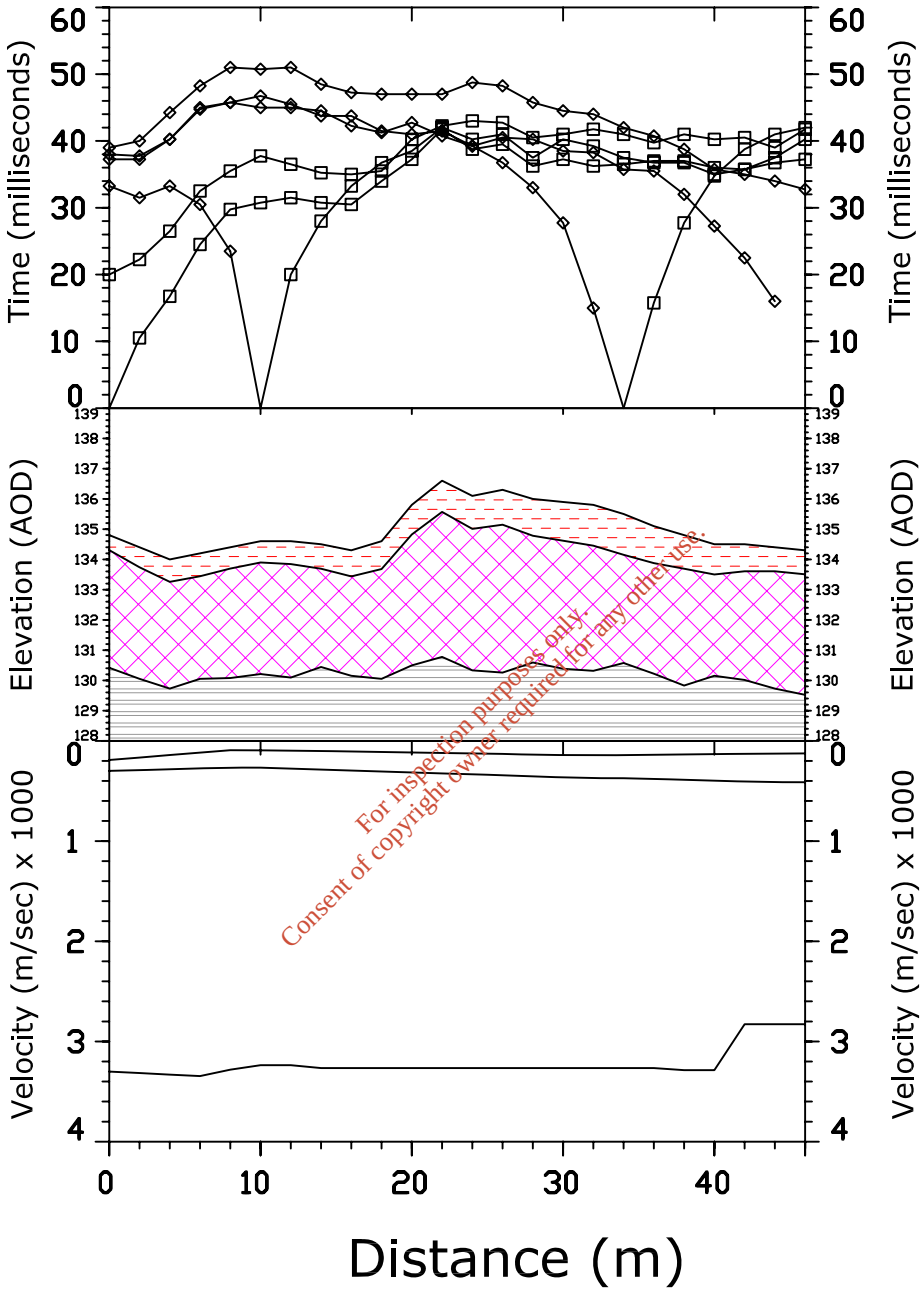
- Made Ground/ Inert Capping Layer
- Mixed Organic, C&D Waste + Metal
- Sandstone/Shale

PROJECT:	8109 Newmarket
DRAWING No.:	8109-8 Interpreted Seismic Profile 1
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
SCALE:	1:500 @A4

Version:	Date:	Drawn By:	Checked:
001	06062008	IS	POC

S2

NE SW



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Kilanerin, Gorey, Co. Wexford, Ireland.
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Fax. +353-(0)402-21843
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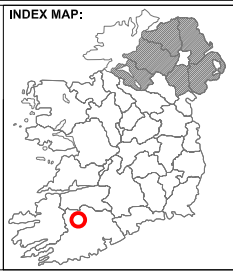
INDEX MAP:



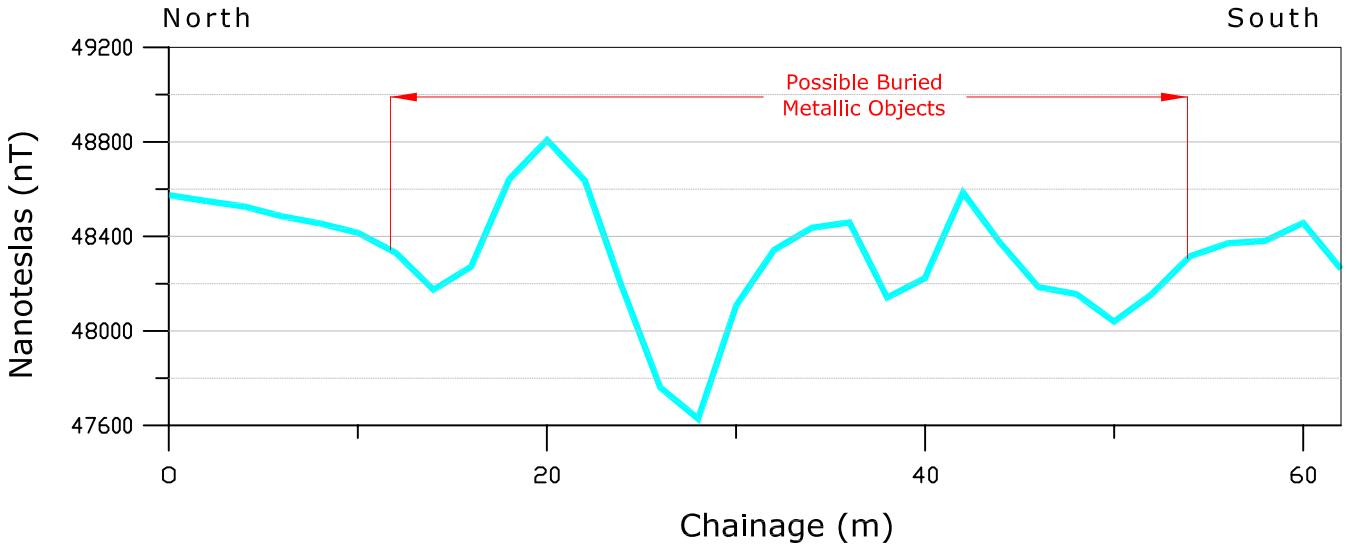
LEGEND:

- Made Ground/ Inert Capping Layer
- Mixed Organic, C&D Waste + Metal
- Sandstone/Shale

PROJECT:	8109 Newmarket
DRAWING No.:	8109-9 Interpreted Seismic Profile 2
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
SCALE:	1:500 @A4

Version:	Date:	Drawn By:	Checked:
001	06062008	IS	POC

Magnetics Profile 1



Maximum	48807nT
Minimum	47628nT
Average	48325nT
Range	1179nT

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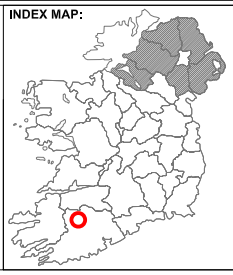
INDEX MAP:



LEGEND:

PROJECT:	8109 Newmarket
DRAWING No.:	8109-10 Interpreted Magnetic Profile 1
DATE:	06th June 2008
CLIENT:	O'Callaghan Moran and Associates Ltd.
SCALE:	1:400 @A4

Version:	Date:	Drawn By:	Checked:
001	06062008	IS	POC

APPENDIX I GEOPHYSICAL METHODLOGY

M1. Methods Used

1.1 EM31 Conductivity

This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). In addition, a second parameter – the relative Inphase value – is also derived from the secondary electro-magnetic field and provides information on the occurrence of metal objects in the subsurface.

As the effective penetration of this method is around 6m below ground level the measured conductivity is a function of the different overburden layers and/or rock from 0 to 6m below ground level.

1.2 2D-Resistivity Profiling

The resistivity surveying technique used for the survey makes use of the Wenner resistivity array whereby four electrodes are placed in a line in the ground and a current is passed through the two outer electrodes. The potential difference is measured across the two inner electrodes. The measured potential is divided by the current value to obtain the resistance. The resistivity is determined from the resistance using the following formula:

Resistivity = Resistance* 2 * Pi * Spacing.

The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of 32 to 64 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

1.3 Seismic Refraction Profiling

This method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

1.4 Magnetic Profiling

This surveying technique is carried out with a proton precession magnetometer which operates on the principle of the realignment of protons in a hydrocarbon fluid. Following the application of a current through a coil surrounding the hydrocarbon fluid, the protons realign in the direction of the external field (the earth's magnetic field) measured in NanoTeslas (nT). Large deviations in the recorded magnetic field would indicate the presence of metallic objects.

M2. Equipment Used

2.1 EM31 Conductivity

The equipment used was a GF CM031 Conductivity meter equipped with data logger. This instrument features a real time graphic display of the previous 20 measurement points to monitor data quality and results.

2.2 2D-Resistivity Profiling

The profiles were recorded using a Tigre resistivity meter, imaging software, two 32 takeout multicore cables and 64 stainless steel electrodes. The recorded data was processed and viewed immediately after the survey.

2.3 Seismic Refraction Profiling

The data were recorded using a Ras-24 high resolution 24 channel digital seismograph with geophone spacings of 2-3m. The source of the seismic waves was a sledgehammer. A total of two seismic spreads were recorded.

2.4 Magnetic Profiling

Magnetic profiling was carried out using a Geometrics G856 proton precession magnetometer. The survey was carried out on the 23rd May 2008.

2.5 Surveying

Where good satellite coverage was available survey measurements were recorded with a Trimble DGPS RTK system to an accuracy of c.30mm.

M3. Field Procedure

The locations of the geophysical measurements are shown on Map 8109-1.

3.1 EM31 Conductivity

The data were recorded on the 22nd May 2008. Readings of electrical conductivity and in-phase values were taken on a 2m by 1m grid on accessible areas of the site. A total of 450 readings were taken. All data was recorded onto a datalogger.

3.2 2D-Resistivity Profiling

The data were recorded on the 22nd and 23rd May 2008. The 2D-Resistivity profiles have the following recording parameters:

Profile	Electrodes	Spacing	Length	Depth of Investigation	Azimuth
No.	No.	(m)	(m)	(m)	
1	48	2	94	16	SW
2	32	2	62	12	SE
3	50	2	98	16	SE
4	32	2	76	13	SW

3.3 Seismic Refraction Profiling

The data were recorded on the 22nd and 23rd May 2008. The seismic refraction profiles have the following recording parameters:

Profile	Geophones	Spacing	Length	Min. depth of investigation	Azimuth
No.	No.	(m)	(m)	(m)	
S1	24	3	69	23	SE
S2	24	2	46	15	SW

3.3 Magnetic Profiling

Readings were recorded on a 2m station intervals along resistivity profile 4.. Local conditions and variations were recorded. Three readings were taken at each station to check repeatability and a base station was repeated throughout the survey.

M4. Data Processing

4.1 EM31 Conductivity

The grid data were contoured using the SURFER (Golden Software, 2001) package to produce an image map showing the conductivity in milliSiemens/metre (mS/m) (Map 8109-2) with a contoured overlay of the relative Inphase values.

Note. *Contour maps interpolate and average between the measured data points and features that are present smaller than the grid size may not be apparent on the contour map*.

4.2 2D-Resistivity Profiling

The field readings were stored in computer files and inverted using the RES2DINV package (Campus Geophysical Instruments, 1997) with up to 3 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed on Interpreted Sections 8109-4 to 8109-7. The distance is indicated along the horizontal axis of the profile. All profiles have been contoured using the same contour intervals and colour codes.

4.3 Seismic Refraction Profiling

The recorded data was interpreted using the ray-tracing and intercept time methods. First break picking in digital format was carried out using FIRSTPIX software for input into GREMIX software. Topographic data were input. Material types were assigned and estimation made of material properties, cross-referenced to the conductivity and 2D Resistivity data. The results are contained in Appendix II and the thickness estimates were also plotted at the relevant locations on Interpreted Sections 8109-9 and 8109-9.

4.4 Magnetic Profiling

Drift corrections were applied to the data and a scaled plot of the total magnetic field in nanoTeslas (nT) against distance was prepared (Map 8109-10).

APPENDIX II SEISMIC REFRACTION DATA

Profile	STATION (m)	VELOC 1 m/s	VELOC 2 m/s	VELOC 3 m/s	Thickness Z1 (m)	Thickness Z1+Z2 (m)	Topography mOD	Base Layer mOD	Base Layer mOD
S1	0	436	850	3302	2.3	4.7	132.9	130.6	128.2
S1	3	418	821	3302	2.0	3.2	132.9	130.9	129.7
S1	6	399	791	3302	1.8	3.7	132.9	131.1	129.2
S1	9	381	762	3204	1.6	3.4	132.9	131.3	129.6
S1	12	362	762	3204	1.1	4.3	132.8	131.8	128.5
S1	15	362	534	3100	0.6	4.2	132.8	132.2	128.6
S1	18	342	522	3100	0.6	4.4	133.0	132.4	128.6
S1	21	323	509	3100	0.7	4.8	133.2	132.5	128.4
S1	24	303	496	3046	0.7	5.4	133.5	132.8	128.2
S1	27	283	483	3084	0.7	5.6	133.7	133.0	128.1
S1	30	264	470	3084	0.8	4.8	133.9	133.2	129.1
S1	33	264	470	3084	0.8	5.2	134.1	133.4	128.9
S1	36	253	464	3215	0.8	5.6	134.2	133.4	128.6
S1	39	241	459	3215	0.8	5.8	134.4	133.6	128.6
S1	42	230	453	3215	0.4	6.0	134.9	134.5	128.9
S1	45	219	447	3162	0.3	6.4	135.4	135.1	129.0
S1	48	208	441	3162	0.3	6.0	135.5	135.2	129.5
S1	51	197	435	3162	0.3	5.6	135.7	135.4	130.1
S1	54	186	429	3162	0.3	5.4	135.9	135.6	130.5
S1	57	175	423	3162	0.4	6.0	136.0	135.6	130.0
S1	60	163	418	3162	0.4	7.1	136.2	135.8	129.1
S1	63	152	412	2968	0.5	7.9	136.0	135.6	128.1
S1	66	141	406	2911	0.5	7.9	135.7	135.2	127.8
S1	69	141	400	2911	0.5	6.0	135.5	135.0	129.5
S2	0	190	300	3300	0.5	4.4	134.8	134.3	130.4
S2	2	166	292	3315	0.7	4.4	134.4	133.7	130.1
S2	4	142	284	3331	0.7	4.3	134.0	133.3	129.7
S2	6	117	276	3346	0.8	4.2	134.2	133.4	130.1
S2	8	93	268	3282	0.7	4.3	134.4	133.7	130.1
S2	10	93	268	3238	0.7	4.4	134.6	133.9	130.2
S2	12	97	277	3238	0.8	4.5	134.6	133.9	130.1
S2	14	102	287	3266	0.8	4.1	134.5	133.7	130.4
S2	16	107	296	3266	0.9	4.2	134.3	133.4	130.2
S2	18	111	306	3266	0.9	4.6	134.6	133.7	130.1
S2	20	116	315	3266	1.0	5.3	135.8	134.8	130.5
S2	22	121	325	3266	1.0	5.8	136.6	135.6	130.8
S2	24	125	334	3266	1.1	5.8	136.1	135.0	130.3
S2	26	130	344	3266	1.2	6.1	136.3	135.2	130.3
S2	28	135	353	3266	1.2	5.4	136.0	134.8	130.6
S2	30	139	363	3266	1.3	5.5	135.9	134.6	130.4
S2	32	144	372	3266	1.4	5.5	135.8	134.5	130.3
S2	34	144	372	3266	1.4	4.9	135.5	134.2	130.6
S2	36	140	380	3266	1.2	4.9	135.1	133.9	130.2
S2	38	136	388	3286	1.1	5.0	134.8	133.7	129.8
S2	40	133	396	3286	1.0	4.4	134.5	133.5	130.2
S2	42	129	404	2828	0.9	4.5	134.5	133.6	130.0
S2	44	125	412	2828	0.8	4.7	134.4	133.6	129.7
S2	46	125	412	2828	0.8	4.8	134.3	133.5	129.5

APPENDIX 3

Trial Pit and Borehole Logs

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-1

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 3.2m

Groundwater entry: 2.9mbgl

SWL (m): 2.9mbgl

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Fill Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyres.			0ppm
1	***Clay*** Firm grey Clay.			0ppm
2	***Clay*** Firm brown slightly sandy (medium) gravelly (subangular) Clay with occasional cobbles. **Groundwater inflow at 2.9mbgl.**			0ppm
3				
4				
5				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-2

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 4.7m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyres.		0.5-1.0m	0ppm
1				0ppm
2				
3	***Clay*** Firm grey Clay. Waste materials present in the clay.			0ppm
4	***Clay*** Firm grey Clay.		4-4.2m	
	Clay Firm brown slightly sandy (medium) gravelly (subangular) Clay with occasional cobbles.			
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-3

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 3m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyres.		0.5-1.0m	13ppm
1				
2	***Silt*** Brown/yellow sandy Silt.			0ppm
	Clay Firm grey Clay.		2.3-2.5m	0ppm
3	***Clay*** Firm brown slightly sandy (medium) gravelly (subangular) Clay with occasional cobbles.			
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-4

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 2.5m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyres.		0.5-1.0m	0ppm
1				
2	***Clay*** Firm grey Clay.		2.3-2.5m	0ppm
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-5

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 2.3m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyres.		0.5-1.0m	8ppm
1				
2			2.1-2.3m	0ppm
	Clay Firm grey Clay.			
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-6

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 2.6m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyres.			2ppm
1				
2	***Clay*** Firm grey Clay.			0ppm
	Clay Firm brown slightly sandy (medium) gravelly (subangular) Clay with occasional cobbles.			
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-7

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 3m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising brown sandy gravelly Clay.			2ppm
1				
	Clay Firm grey Clay.			
2				0ppm
	Clay Firm brown slightly sandy (medium) gravelly (subangular) Clay with occasional cobbles.			
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-8

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 2m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising brown sandy Clay with fragments of plastics, papers and timer.			13ppm
1				
	Clay Firm brown slightly sandy (medium) gravelly (subangular) Clay with occasional cobbles.			0ppm
2				
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-9

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 1.8m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising brown sandy Clay.			
	Fill Fill material comprising brown sandy Clay with fragments of plastics, papers and timer.			0ppm
1				
	Clay Firm brown slightly sandy (medium) gravelly (subangular) Clay with occasional cobbles.			0ppm
2				
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-10

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 3.3m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising brown sandy Clay.			
1				
	Fill Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyre.			0ppm
2				0ppm
	Clay Grey firm Clay.			
	Clay Firm brown slightly sandy (medium) gravelly (subangular) Clay with occasional cobbles.			
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-11

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 4.3m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising brown sandy Clay.		0.5-1.0m	0ppm
1	***Fill*** Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyre.			
2				
3				
4			4.1-4.3m	0ppm
	Clay Grey firm Clay.			
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-12

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 4.5m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil			
	Fill Fill material comprising brown sandy Clay. Minor traces of plastics.		0.5-1.0m	0ppm
1				
	Fill Fill material comprising black sandy Clay with fragments of concrete blocks, cobbles, plastic bags, cloth, glass bottles, plastic bottles and car tyre.			
2				
3				
	Clay Grey firm Clay.		3.8-4.0m	0ppm
4	***Clay*** Yellow/brown stiff sandy gravelly Clay.			
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-13

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 1m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Fill Limestone Gravel.			
	Clay Grey firm Clay.			
1	***Clay*** Brown stiff sandy gravelly Clay.			
2				
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-14

Project: 08-039-03

Client: Cork County Council

Location: Newmarket

Completion Depth: 1m

Groundwater entry: NA

SWL (m): NA

Depth	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Fill Limestone Gravel.			
	Clay Grey firm Clay.			
1	***Clay*** Brown stiff sandy gravelly Clay.			
2				
3				
4				
5				
6				

Excavation Method: 12 tonne track mounted excavator

Geologist: B. Sexton

Excavation Date: 9th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Borehole I.D. BH-1

Project: 08-039-03

Client: Cork County Council

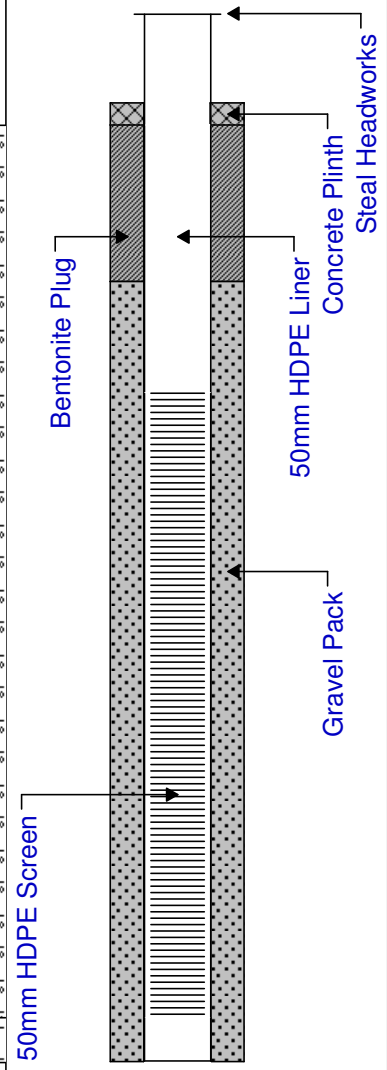
Location: Newmarket

Borehole Depth: 4.2m

SWL (m):

Borehole Type: Gas Well

Depth	Lithology Description	Lithology	Well Construction Details
0	Ground Surface		
	Fill Fill material comprising black sandy Clay with fragments of plastic, empty flattened steel drums, cloth, concrete blocks, pieces of rubber, tyre tubes, concrete pipe fragments, papers, glass and plastic bottles.		
4	***Clay*** Grey firm Clay.		
5			



Drilling Contractor: Glovers

Hole Size: 150mm

Drill Method: Rotary Percussion

Geologist: B. Sexton

Drill Date: 17th June 2008

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Borehole I.D. BH-2

Project: 08-039-03

Client: Cork County Council

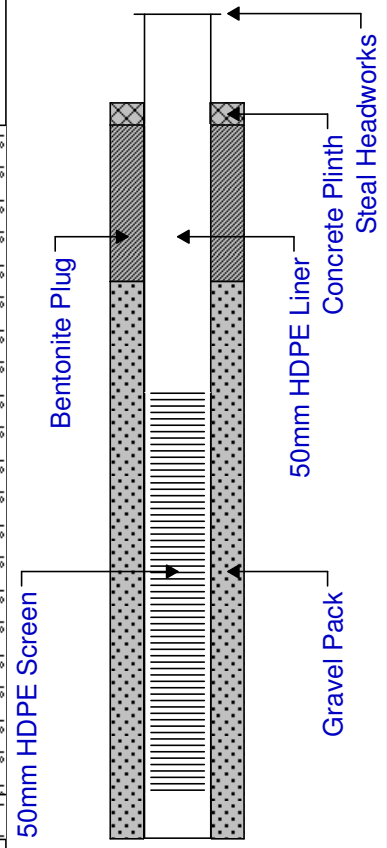
Location: Newmarket

Borehole Depth: 3.2m

SWL (m): GW not encountered

Borehole Type: Gas Well

Depth	Lithology Description	Lithology	Well Construction Details
0	Ground Surface		
	Fill Fill material comprising black sandy Clay with fragments of plastic, empty flattened steel drums, cloth, concrete blocks, pieces of rubber, tyre tubes, concrete pipe fragments, papers, glass and plastic bottles.		
1			
2			
3	***Clay*** Grey firm Clay.		
4			
5			



Drilling Contractor: Glovers

Drill Method: Rotary Percussion

Drill Date: 17th June 2008

Hole Size: 150mm

Geologist: B. Sexton

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Borehole I.D. BH-3

Project: 08-039-03

Client: Cork County Council

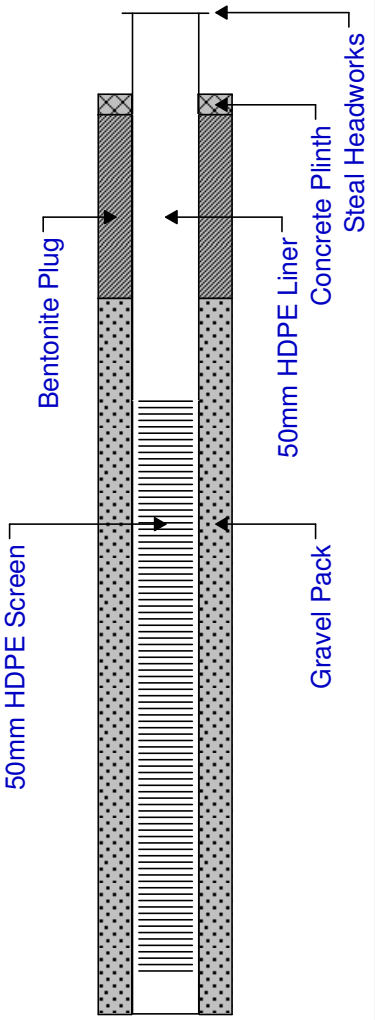
Location: Newmarket

Borehole Depth: 4.4m

SWL (m): GW not encountered

Borehole Type: Gas Well

Depth	Lithology Description	Lithology	Well Construction Details
0	Ground Surface		
	Fill Fill material comprising black sandy Clay with fragments of plastic, empty flattened steel drums, cloth, concrete blocks, pieces of rubber, tyre tubes, concrete pipe fragments, papers, glass and plastic bottles.		
1			
2			
3			
4	***Clay*** Grey firm Clay.		
5			



Drilling Contractor: Glovers

Drill Method: Rotary Percussion

Drill Date: 17th June 2008

Hole Size: 150mm

Geologist: B. Sexton

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Borehole I.D. BH-4

Project: 08-039-03

Client: Cork County Council

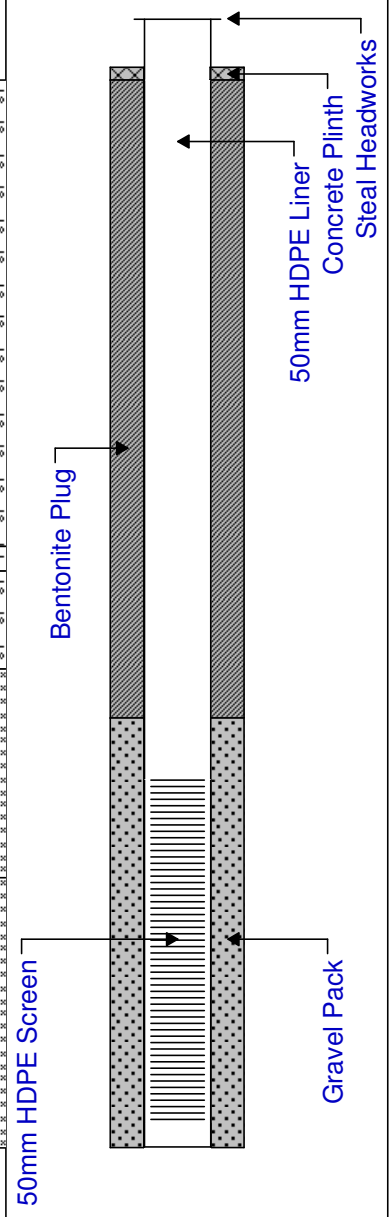
Location: Newmarket

Borehole Depth: 8.7m

SWL (m): 130.38mOD

Borehole Type: Groundwater Well

Depth	Lithology Description	Lithology	Well Construction Details
0	Ground Surface		
	Fill Fill material comprising black sandy Clay with fragments of plastic, empty flattened steel drums, cloth, concrete blocks, pieces of rubber, tyre tubes, concrete pipe fragments, papers, glass and plastic bottles.s.		
4	***Clay*** Grey firm Clay.		
	Clay Brown sandy (medium) gravelly (subangular) Clay.		
5	***Siltstone*** Very broken grey siltstone.		
7	***Siltstone*** Slightly fractured Siltstone. **Groundwater encountered at 7mbgl.**		
9			



Drilling Contractor: Glovers

Drill Method: Rotary Percussion

Drill Date: 17th June 2008

Hole Size: 150mm

Geologist: B. Sexton

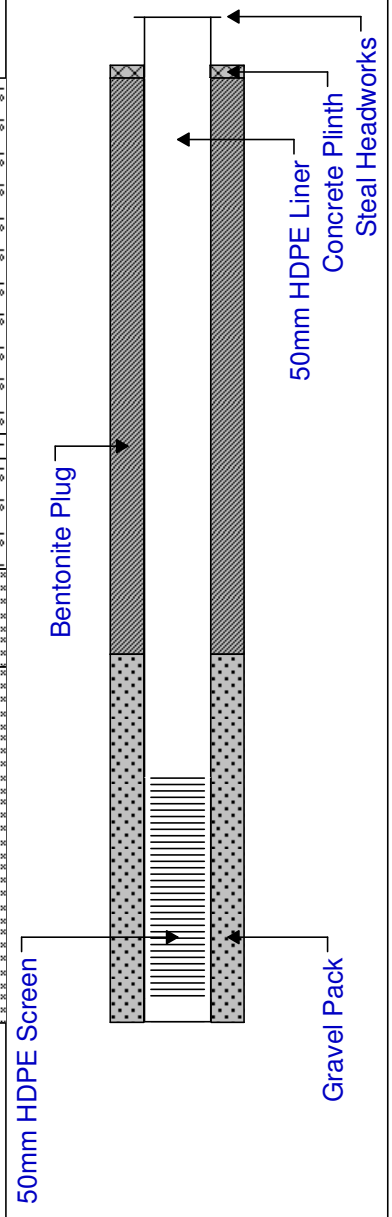
Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Borehole I.D. BH-5

Project: 08-039-03
Borehole Depth: 7.7m
Client: Cork County Council
SWL (m): 130.22mOD
Location: Newmarket
Borehole Type: Groundwater Well

Depth	Lithology Description	Lithology	Well Construction Details
0	Ground Surface		
	Fill Fill material comprising black sandy Clay with fragments of plastic, empty flattened steel drums, cloth, concrete blocks, pieces of rubber, tyre tubes, concrete pipe fragments, papers, glass and plastic bottles..		
3	***Clay*** Grey firm Clay.		
	Clay Brown sandy (medium) gravelly (subangular) Clay.		
4	***Siltstone*** Very broken grey siltstone.		
5	***Siltstone*** Slightly fractured Siltstone.		
	Groundwater encountered at 6.1mbgl.		
8			
9			



Drilling Contractor: Glovers
Hole Size: 150mm
Drill Method: Rotary Percussion
Geologist: B. Sexton
Drill Date: 18th June 2008
Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Borehole I.D. BH-6

Project: 08-039-03

Client: Cork County Council

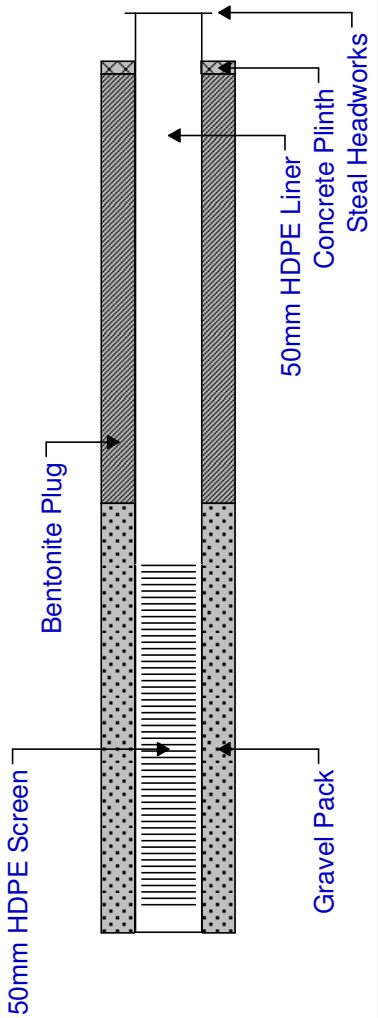
Location: Newmarket

Borehole Depth: 7m

SWL (m): 131.83mOD

Borehole Type: Groundwater Well

Depth	Lithology Description	Lithology	Well Construction Details
0	Ground Surface		
	Fill Limestone gravel fill.		
1	***Clay*** Grey firm Clay.		
	Clay Brown sandy (medium) gravelly (subangular) Clay.		
2	***Siltstone*** Very broken grey siltstone.		
	Siltstone Slightly fractured Siltstone.		
3			
4			
	Siltstone Purple Siltstone.		
5	**Groundwater encountered at 5.7mbgl.**		
6			
7			
8			
9			



Drilling Contractor: Glovers

Drill Method: Rotary Percussion

Drill Date: 18th June 2008

Hole Size: 150mm

Geologist: B. Sexton

Sheet: 1 of 1

APPENDIX 4

OCM Sampling Protocols

STANDARD OPERATING PROCEDURE

WASTE SAMPLING

The sampling technique described herein will be followed to ensure that the samples are representative of the waste body they are intended to characterise.

It is assumed that the sampling will be carried out in accordance with a site specific workplan, approved by the relevant regulatory authority, that presents the sampling strategy, identifies the sample locations, the number of waste samples, method of sample collection, field screening, analytical testing regime, decontamination measures and Health & Safety requirements.

1.0 SAMPLING

(A) Locate the sampling point in accordance with the workplan, which should also specify the number and type of samples to be taken. Place a wooden stake into the ground one metre from the sample location and mark sample location on the stake.

(B) Record the location in the field logbook and, if possible, photograph the location.

(C) The samples will be collected at the depth specified in the workplan and record the depth in the field notebook. The method of excavation and sample collection will be as specified in the workplan.

(D) Wear the appropriate level of protection when taking samples (gloves, safety glasses, hard hat, breathing apparatus etc.), as specified in the workplan. Collect samples as specified in the workplan using appropriate sampling equipment, e.g. stainless steel trowel, spade, corer, or similar device.

(E) Typically disturbed samples will be collected. Ensure that the sample volume is appropriate for the testing regime specified in the workplan. If unexpected wastes are encountered immediately inform the Team Leader, who will determine if there is a need to amend the sampling programme. .

(F) Deposit each sample into the appropriate (clean, laboratory prepared) container. Conduct field screening of the sample, as specified in the work plan (e.g. headspace, colourmetric test, immunoassay etc).

(G) Fill out labels with waterproof ink and attach to the sample container. The following information will be recorded on each sample label: -

Client/Site Name
Date Collected
Time Collected
Analysis
Sample Identification Number

(H) Decontaminate sampling equipment as specified in the workplan.

2.0 FIELD DOCUMENTATION

Record weather conditions at the time of sampling in the field notebook. Provide a complete description of the sample location, nature of the material encountered, odours, depth change, lateral variation, groundwater/leachate ingress, and a photograph, if necessary. Record the sample container lot numbers. The Field Team Leader will initial the logbook entries for correctness.

3.0 FIELD QA/QC SAMPLES

See the separate SOP on Field QA/QC samples for appropriateness and preparation of DI Water Field Blanks, Cross-contamination Field Blanks, Trip Blanks and Field Duplicate Samples.

4.0 PACKAGING AND TRANSPORT

Check to be sure that all necessary information is on the sample container label. Complete and sign the laboratory chain-of custody form, retain field copy and ensure others accompany the samples to the testing laboratory. Package, label and transport the samples to the testing laboratory in accordance with national and international requirements for the transport of environmental and potentially hazardous samples.

5.0 REFERENCES

BS 10175:2001 Investigation of potentially contaminated sites-Code of Practice.

Contaminated Land Management: Ready Reference 2002.

END.

STANDARD OPERATING PROCEDURE

SOIL SAMPLING

The soil sampling technique described below will be followed to ensure that soil samples are representative of the environment which they are intended to characterise.

1.0 SAMPLING

(A) Locate the soil sampling station in accordance with the workplan which will specify the number and type of samples to be taken. Place a wooden stake into the ground one metre from the sample location and record sample location on the stake.

(B) Record the location in the field logbook and, if possible, photograph the location.

(C) Collect soil samples from the depth specified in the workplan and record the depth in the field notebook. Describe the colour and texture of each sample and record in notebook.

(D) Wear appropriate level of protection when taking samples (gloves, safety glasses, hard hat etc.) as specified in the workplan. Collect soil samples as specified in the workplan using decontaminated stainless steel trowel, soil corer, or similar device. Collect discrete soil samples from each station.

(E) If required by the workplan, composite discreet soil samples by placing equal volumes of soil into the container and mixing thoroughly to a homogenous mixture. Samples may be hand picked, if necessary, to remove larger materials, such as leaves, sticks, gravel, rocks etc., if specified in the workplan. Record in notebook the nature of any materials removed from soil samples.

(F) Deposit each soil sampled into a (clean, pre-washed) container. At the time of collection, the sample bottle will be filled to the top with soil sample.

(G) Fill out labels with waterproof ink and attach to the sample container. The following information will be recorded on each sample label: -

Client/Site Name
Date Collected
Time Collected
Analysis
Preservative
Sample Identification Number

(H) Decontaminate sampling equipment as described below unless otherwise specified in the site workplan. When using stainless steel sampling equipment: -

- wash with non-phosphate detergent in potable water,
- rinse sequentially in potable water, methanol, acetone, methanol and D1 water and;
- allow to air dry in a containment free area.

(I) Wrap the decontaminated sampling equipment in aluminium foil which has been decontaminated in accordance with Section H.

2.0 FIELD DOCUMENTATION

Record sample information in the field notebook. Provide a complete description of the sample location, and a photograph, if necessary. Describe the soil appearance, especially if the presence of oil or an odour is noted. Document the sample bottle lot numbers in the field notebook. Record weather conditions at the time of sampling. The Field Team Leader will initial the logbook entries for correctness.

3.0 FIELD QA/QC SAMPLES

See the separate SOP on Field QA/QC samples for appropriateness and preparation of D1 Water Field Blanks, Cross-contamination Field Blanks, Trip Blanks and Field Duplicate Samples.

4.0 PACKAGING AND TRANSPORT

Check to be sure that all necessary information is on the sample container label. Complete the chain-of custody form. Package, label and transport the samples to the testing laboratory in accordance with requirements for packing, shipping and labelling environmental samples.

END.

STANDARD OPERATING PROCEDURE

GROUNDWATER SAMPLING

The primary objective of groundwater sampling is to establish groundwater quality and evaluate whether the potential contaminant sources at a site have impacted the groundwater in the underlying aquifer. The additional objective is to measure hydraulic gradient, or slope, of the water table to evaluate the direction of groundwater flow.

The purpose of this procedure is to ensure that representative samples of groundwater are collected and documented using consistent methods to ensure sample integrity.

1.0 SAMPLING PROCEDURES

1.1 Well Operating and Purging Procedures

All groundwater sampling will be conducted after the installed and developed wells have been allowed to equilibrate for at least 2 to 3 days. A Field Data Sheet for Well Sampling will be completed for each well.

Groundwater sampling teams will use to following procedure for approaching, opening, purging and sampling all wells, unless directed otherwise by a site specific workplan.

1) Prior to placing any equipment into the well, decontaminate the sampling equipment according to standard decontamination protocol.

2) Ensure you have a working FID/PID, a well key, and a depth-to-water meter.

3) Unlock and open the well cap just enough to insert the probe of the PID/FID. Take and record a reading. A decision to upgrade PPE may be necessary based on the FID/PID readings in the breathing zone.

4) Where practical, the surface water column will be visually examined for the presence of hydrocarbons, if present or suspected, the thickness of the hydrocarbon layer will be measured using an oil/water interface probe prior to taking the depth-to-water measurement.

5) Insert the water level probe into the well and measure and record the static water level to the nearest 0.01 m with respect to the established survey point on top of the well casing.

6) Decontaminate the water level probe with DDI water (Do not rinse with any solvents unless product was encountered).

7) Calculate and record the minimum volume of water to be purged according to the following conversion factors: -

1 well volume	=	water column in metres x litres/linear metre
50mm casing	=	2.0 LPM
100mm casing	=	8.1 LPM
150mm casing	=	18.2 LPM
200mm casing	=	32.4 LPM

8) Purge the well of at least 3 casing volumes by pumping or bailing with a decontaminated submersible pump or PVC bailer equipped with a bottom filling check valve (if the purge volume is low, generally less than 100 litres, the sampling team might find it more efficient to purge with a bailer than a pump). Use a graduated bucket to track the amount of water removed from the well. Periodically determine the pH, temperature and specific conductance of the purged water. Continue purging until the well has been completely evacuated or until the pH and specific conductance measurements have stabilised for at least one well volume. Wells that become dewatered before producing three casing volumes will be sampled as soon as practical once they recover sufficiently.

9) Dispose of purge water collected in the graduated bucket by pouring onto the ground at a distance of 50 to 60 metres from the vicinity of the well. If the water is known or suspected to be significantly contaminated, it may be necessary to store the purge water in a secure container, such as a drum, pending proper disposal.

10) Be aware and record any unusual occurrence during purging such as cascading (a shallow water entry zone that trickles into the borehole).

1.2 Field Parameter Measurement

Measurements of field parameters of pH, temperature and electrical conductivity are collected and organic vapour screening is conducted while the well is purged. To facilitate the collection of basic field parameters, the field team needs to: -

- Purge three well volumes of water from the well and measure field parameters for each well volume removed.

- Collection of water samples should take place after stabilisation of the following parameters: -

  - Temperature $^{+}$/- 1^{o}C
  - pH (meter or paper) $^{+}$/- 0.2 units
  - Specific conductivity $^{+}$/- 5%

- If the aforementioned parameters do not stabilise within three purge volumes, the well will be purged up to a maximum of six borehole volumes unless two consecutive sets of stabilised parameters are obtained.

- Note any observations in the field logbook.

1.3 Collection of Water Samples

All samples or chemical analysis will be placed in laboratory prepared bottles. The types of sample containers and preservative required for each type of analysis are described in the workplan. If required, preservatives will be placed in the sample containers prior to collecting the samples.

The following procedure will be used to sample a well: -

1) After the well has been purged and allowed to recover, sample the well using a properly decontaminated or dedicated disposable bailer. Gently lower the bailer into the water column. Allow the bailer to sink and fill with a minimum of surface disturbance.

2) Slowly raise the bailer out of the well. Do not allow the bailer line to contact the ground, either by coiling it on a clean plastic sheet or by looping it from arm to arm as the line is extracted from the well.

3) Samples will be collected for VOCs analysis immediately after purging is complete and before other samples are collected. Pour the samples slowly into the laboratory prepared 40 ml glass vial. Overfill each vial slightly to eliminate air bubbles, a convex meniscus should be present at the top of the vial. Ensure that the Teflon liner of the septum cap is facing inward and that no bubbles are entrapped. After capping securely, turn bottle upside-down, tap it against your other hand, and observe sample water for bubbles. If bubbles are observed, remove the cap, overfill the vial and reseal. Repeat this step for each vial until the samples with no bubbles are obtained.

4) Place a label on the container and enter the following information: -

   Client/Site Name
   Date Collected
   Time Collected
   Analysis
   Preservative
   Sample Identification Number

5) Record pertinent information in the field logbook and on the Field Data Sheet for Well Sampling. Complete chain-of-custody form.

6) Place custody seals on the container caps. As soon as possible, place sample containers in a cooler with ice packs and maintain at 4^{o}C until extraction. Surround the bottles with appropriate packaging.

7) Obtain the semi-volatile compound/pesticides/PCBs sample(s) by transferring the water to a laboratory prepared 1000 ml amber glass bottle with Teflon-lined cap. Fill the bottle to the bottom of the neck and follow steps 4, 5 and 6 above.

8) Dissolved metals (if necessary) requires the team to filter the sample water through a .45 micron filter. The water is collected in a 1 litre, unpreserved, plastic or glass bottle with HNO_3 preservative. Filtering must be done within 15 minutes of sample collection.

9) Obtain the total metals sample by directly transferring the water from the bailer into a laboratory prepared 1000 ml plastic or glass bottle with HNO_3 preservative.

10) Be sure the pH of the metals sampled is less than 2 by pouring off an aliquot in a clean jar and testing for pH using litmus paper. Dispose of this water and rinse the jar.

11) Collect and prepare Field QA/QC samples in accordance with separate SOP.

12) Be sure to record all data required on the Field Data Sheet or Well Sampling and appropriate entries into the field logbook.

13) Secure the well cap and replace the locking cover.

14) Decontaminate all sampling equipment according to procedure.

15) Decontaminate submersible pumps as follows: -

Scrub pump and cord in a tub of appropriate detergent and potable water
Pump at least 80 litres of soapy water through pump
Rinse with potable water
Pump at least 80 litres of rinse water through the pump
Rinse with DI water before lowering pump into the next well.

END.

STANDARD OPERATING PROCEDURE

LANDFILL GAS MONITORING

The primary objective of landfill gas monitoring is to assess if gas generation would be likely to give rise to a risk to human health or to the environment. It also helps determine trends in gas generation and migration and evaluates the effectiveness of any in-situ gas control measures. The purpose of this procedure is to ensure that representative measurements of landfill gas are collected using appropriate safety procedures.

1.0 SAMPLING PROCEDURES

All landfill gas monitoring equipment used will be certified intrinsically safe. All landfill gas monitoring equipment shall be regularly calibrated and serviced according to the manufacturer's specification.

The following procedure will be used for monitoring of landfill gas levels in all monitoring boreholes, unless directed otherwise.

1) On arrival at the site, test the equipment in accordance with manufacturer's recommendations and record the ambient gas concentrations, atmospheric pressure and temperature in a field notebook. This ensures the gas analyser chamber is purged prior to monitoring. Record the wind speed and direction and other weather conditions.

2) Unlock the borehole cover. Examine the appearance of the standpipe, cap and gas valve and note any damage or changes since previous recordings. Record any visible (steam), audible or olfactory signs of gas migration. Record the ground conditions (e.g. dry, wet, frozen, compacted, loose etc). If signs of gas migration are noted, measurement of gas concentrations should be made around the standpipe to ensure there are no dangerous accumulations of gas.

3) If the standpipe is fitted with a gas valve, switch on the gas analyser and securely connect the gas analyser inlet port to the gas sample valve via the inlet tube. Open the gas valve and switch on the analyser pump. Run the pump for sufficient time to remove a representative sample from the borehole. Turn the pump off.

4) Record methane (CH_4), carbon dioxide (CO_2) and oxygen (O_2) peaks and steady concentrations.

5) Record atmospheric pressure (mb) and temperature (°C).

6) When measurements are completed, the gas sample valve must be closed and the analyser disconnected.

7) A measurement of the depth to water in the borehole should be undertaken after completion of all gas measurements. Insert the water level probe into the well and measure and record the static water level to the nearest 0.01 m with respect to the established survey point on top of the well casing.

8) Be sure to record all data required in the field log book.

9) Secure the well cap and replace the locking cover.

10) Briefly run the pump on the gas analyser to purge the analyser chamber with ambient air before proceeding to the next monitoring location.

END.

APPENDIX 5

Full Laboratory Reports

APPENDIX 6

Code of Practice Risk Assessment Scoring Matrix

Table 1a LEACHATE: Source/hazard Scoring Matrix			
Waste Type	Waste Footprint (ha)		
	≤1ha	>1≤5ha	>5ha
C&D	0.5	1	1.5
Municipal	5	7	10
Industrial	5	7	10
Pre 1977 sites	1	2	3
1A			**1**

Table 1b LANDFILL GAS: Source/hazard Scoring Matrix			
Waste Type	Waste Footprint (ha)		
	≤1ha	>1≤5ha	>5ha
C&D	0.5	0.75	1
Municipal	5	7	10
Industrial	3	5	7
Pre 1977 sites	0.5	0.75	1
1B			**0.5**

Table 2a LEACHATE MIGRATION: Pathways	
Groundwater Vulnerability (Vertical Pathway)	Points
Extreme Vulnerability	3
High Vulnerability	2
Moderate Vulnerability	1
Low Vulnerability	0.5
High – Low Vulnerability	2
2A	**3**

Table 2b LEACHATE MIGRATION: Pathways	
Groundwater Flow Regime (Horizontal Pathway)	Points
Karstified Groundwater Bodies (Rk)	5
Productive Fissured Bedrock Groundwater Bodies (Rf & Lm)	3
Gravel Groundwater Bodies (Rg & Lg)	2
Poorly Productive Bedrock Groundwater Bodies (Ll, Pl, Pu)	1
2B	**1**

Table 2cLEACHATE MIGRATION: Pathways	
Surface Water Drainage (Surface Water Pathway)	Points
Is there direct connection between drainage ditches associated with the waste body and adjacent surface water body? Yes	2
If no direct connection.	1
2C	**2**

Table 2d LANDFILL GAS: Pathways	
Landfill Gas Lateral Migration Potential	Points
Sand and Gravel, Made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc – moderate permeability)	1.5
All Namurian or Irish Sea Tills (low permeability)	1
Clay, Alluvium, Peat	1
2D	**1**

Table 2e LANDFILL GAS: Pathways (receptor above source)	
Landfill Gas Lateral Migration Potential	Points
Sand and Gravel, Made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc – moderate permeability)	1.5
All Namurian or Irish Sea Tills (low permeability)	1
Clay, Alluvium, Peat	1
2E	**1**

Table 3a LEACHATE MIGRATION: Receptors	
Human Presence (presence of a house indicates potential private wells)	Points
On or within 50m of the waste body	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km	1
Greater than 1km of the waste body	0
3A	**2**

Table 3b LEACHATE MIGRATION: Receptors	
Protected Areas (SWDTE & GWDTE)	Points
Within 50m of the waste body	3
Greater than 50m but less than250m of the waste body	2
Greater than 250m but less than 1km of the waste body	1
Greater than 1km of the waste body	0
Undesignated sites within 50m of the waste body	1
Undesignated sites greater than 50m but less than250m of the waste body	0.5
Undesignated sites greater than 250m of the waste body	0
3B	**3**

Table 3c LEACHATE MIGRATION: Receptors	
Aquifer Category (resource potential)	Points
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally Important Aquifers (Ll, Lm, Lg)	3
Poor Aquifer (Pl, Pu)	1
3C	**3**

Table 3d LEACHATE MIGRATION: Receptors	
Public Water Supplies (other than private wells)	Points
Within 100m of the site boundary	7
Greater than 100m but less than 300m or within the in inner SPA for GW supplies	5
Greater than 300m but less than 1km or within outer SPA for GW supplies	3
Greater than 1km (karst aquifer)	3
Greater than 1km (no karst)	0
3D	**0**

Table 3e LEACHATE MIGRATION: Receptors	
Surface Water Bodies	Points
Within 50 of the site boundary	3
Greater than 50m but les than 250m of the site boundary	2
Greater than 250m but less than 1km	1
Greater than 1km	0
3E	**3**

Table 3f LANDFILL GAS: Receptors	
Human Presence	Points
On site or within 50m of site boundary	5
Greater than 50 but less than 150m of site	3
Greater than 150m but less than 250m of the site	1
Greater than 250m of the site	0.5
3F	**5**

Risk Equation	SPR Values	Maximum Score	Linkages	Normalised Scores
SPR 1 = 1a x (2a + 2b + 2c) x 3e	18	300	Leachate →Surface Water	6%
SPR 1 = 1a x (2a + 2b + 2c) x 3b	18	300	Leachate →SWDTE	6%
SPR 3 = 1a x (2a + 2b) x 3a	8	240	Leachate → human presence	3.33%
SPR 4 = 1a x (2a + 2b) x 3b	12	240	Leachate → GWDTE	5%
SPR 5 = 1a x (2a + 2b) x 3c	12	400	Leachate → aquifer	3%
SPR 6 = 1a x (2a + 2b) x 3d	0	560	Leachate → surface water	0%
SPR 7 = 1a x (2a + 2b) x 3e	12	240	Leachate → SWDTE	5%
SPR 8 = 1a x 2c x 3e	6	60	Leachate → surface water	10%
SPR 9 = 1a x 2c x 3b	6	60	Leachate → SWDTE	10
SPR 10 = 1b x 2d x 3f	25	150	Landfill Gas → human presence	1.67%
SPR 11 = 1b x 2e x 3f	25	250	Landfill Gas → human presence	10%

Risk Classification	Score Range
High Risk (Class A)	**Greater than or equal to 70% for any individual SPR linkage**
Moderate Risk (Class B)	**Between 40% and 70% for any individual SPR linkage**
Lowe Risk (Class C)	**Less than or equal to 40% for any individual SPR linkage**

Overall Risk	**Low Risk (Class C)**