EPA COP MINIMUM REQUIRED PRELIMINARY & EXPLORATORY INVESTIGATIONS FOR ALL UNREGULATED WASTE DISPOSAL SITES

IMPORTANT NOTE: THIS IS THE INITIAL PHASE OF WORK IS CONSIDERED MANDATORY FOR ALL SITES IDENTIFIED AND SHOULD AIM TO COMPLETE A COMPREHENSIVE TIER 1 THE FINDING OF WHICH WILL BE CONFIRMED BY THE INITIAL TIER 2 WORKS. EACH PHASE OF ASSESSMENT WILL DEVELOP THE CONCEPTUAL SITE MODEL (CSM) AND SHOULD GUIDE THE DESIGN OF THE NEXT PHASE OF SI. THE APPLICATION OF THE SI PROCESS AND METHODOLOGIES SHOULD BE COMPLETED IN ACCORDANCE WITH THE RELEVANT STANDARDS/ EPA GUIDANCE DOCUMENTS AND UNDERTAKEN BY EXPERIENCED PRACTITIONERS.

AFTER TIER 1 INVESTIGATION, DEVELOP CONCEPTUAL SITE MODEL, DETERMINE RISK CLASSIFICATION & SCOPE EXPLORATORY INVESTIGATION

AFTER TIER 2 EXPLORATORY INVESTIGATION, REFINE CONCEPTUAL SITE MODEL, CONFIRM RISK CLASSIFICATION & SCOPE MAIN SITE INVESTIGATION AS REQUIRED

SPR LINKAGE	Clountreem Linkage Scores	SOURCE	PATHWAY	RECEPTOR	TIER 1: PRELIMINARY INVESTIGATION			TIER 2: EXPLORATORY INVESTIGATION & SAMPLING						
					DESK STUDY	WALKOVER SURVEY	CONCEPTUAL SITE MODEL (CSM)	TRIAL PITS & TRENCHES	WASTE TYPE	WASTE SAMPLING	LEACHATE TESTING	SOIL SAMPLING	Surface or Groundwater Sampling	TOPOGRAPHIC & GPS SURVEY
					Critical mandatory element of the SI process - includes gathering baseline site and local area data, history of landfill, waste types, volumes, age, presence and distance to potential receptors, etc.	Very important element of the SI process. Confirms physical conditions on site, desk study findings and examines access issues, visual assessment of pathways/receptors allows initial SPR linkage potential to be considered.	The development of the CSM is a critical aspect of the risk assessment and defining SPR linkages and therefore SI requirements.	JCB or tracked excavator - waste type assessment & classification - leachate/gas potential, limited depth, good bulk samples & visual assessment. Allows for sampling and possibly temporary standpipes (not best practice). Accurate logs and photographs important.	Assessment of waste type in terms of content and determining composition of C&D, Municipal, Industrial, Pre 1977 sites. Should confirm reported waste types deposited as identified in Tier 1.	Waste Sampling is primarily to enable leachability testing (if req.) of leachate emanating from waste mass.	List 1 & List 2 substances contamination - Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	Principle purpose of soil sampling at this stage is to assess permeability potential of surrounding materials (pathway assessment), composition of any cap and potential for local material to be used for remediation/capping. In some cases contamination assessment may be required.	Any obvious receptors should be considered for initial indicator parameter screening. Surface waters and/or existing boreholes can be sampled at this stage. Gas monitoring with hand held equipment can be completed. Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	Topographic modelling will enable waste extent & volume calculations, location of sampling points, surface drains/features. Topographic data & Well datum for flow direction mapping. GPS system will determine grid ref for SI works. Can be important for remediation/capping design.
								2 Days Trial Pitting	2 Days Site Engineer (See COC staff costs)	Waste Sampling	Leachate sampling, 1No. Full Suite, 2 No. minor suite	Soil Sample	1No. Down Stream Sample	Topographic Survey
SPR 1	42%	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body	M	M	M	M	M	R	R	R	R/S	R/S
SPR 2	14%	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	M	M	M	M	M	R	R	R	R/S	R/S
SPR 3	23	LEACHATE	Vertical & Horizontal Groundwater Migration	Human Presence (Private Well)	M	M	M	M	M	R	R	R	R/S	R/S
SPR 4	12	LEACHATE	Vertical & Horizontal Groundwater Migration	Groundwater Protected area (GWDTE)	M	M	M	M	M	R	R	R	R/S	R/S
SPR 5	21	LEACHATE	Vertical & Horizontal Groundwater Migration	Aquifer Category	M	M	M	M	M	R	R	R	R/S	R/S
SPR 6	0	LEACHATE	Vertical & Horizontal Groundwater Migration	Public Supply (Well) (includes Group Water Schemes)	M	M	M	M	M	R	R	R	R/S	R/S
SPR 7	35	LEACHATE	Vertical & Horizontal Groundwater Migration	Surface Water Body	M	M	M	M	M	R	R	R	R/S	R/S
SPR 8	70	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body	M	M	M	M	M	R	R	R	R/S	R/S
SPR 9	23	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	M	M	M	M	M	R	R	R	R/S	R/S
SPR 10	9	LANDFILL GAS	Lateral Migration (Subsoil)	Human Presence	M	M	M	M	M	R	R	R	R/S	R/S
SPR 11	8	LANDFILL GAS	Vertical Migration (Subsoil)	Human Presence	M	M	M	M	M	R	R	R	R/S	R/S
Source & Pathway & Receptor Parameters Targeted for CSM & Risk Screening					Research of all available published site information - Site history, waste type, extent and volumes, possible historic sources, local receptors, infrastructure etc. Interviews with previous site staff should be considered.	Walkover should confirm desk study data and investigate Source Pathway Receptor regimes being considered.	The CSM should graphically represent the relationship(s) and receptor(s), developed on the basis of hazard identification and refined during subsequent phases of assessment.	Waste type/composition, footprint, volume, depth & groundwater vulnerability, leachate & gas source & migration potential. Should assess nature and depth of any cap or underseals, if encountered.	Waste type, general composition and extent within the landfill area. leachate and gas source & migration potential.	Waste type, leachate potential	Waste type, leachate potential	ground vulnerability, horizontal or vertical pathway assessment & material use in remediation of site.	surface water or groundwater receptor and potential horizontal pathway information.	waste area & volume, site topography, layout(setting), access roads, surface features, accurate SI points, levels for groundwater flow direction, etc
General comments & COP Section Reference - Note: the development of the CSM and design of the site investigation should involve an experienced SI practitioner.					Critical first step in site and waste characterisation, all potential data sources should be considered. Note Section 3.2 of COP	allows visual assessment of site and local environs, important that walkover confirms findings of desk study and allows accurate CSM to be developed. Note Section 3.1 of COP	This is a fundamental part of the Risk Assessment exercise - the CSM information should be clearly documented and accessible in the form of text, figures and tables. Note section 3 of COP and reporting requirements in Chapter 6.	Trial pits and trenching is a very important phase of work to enable the potential sources and types of leachate & gas to be determined. Detailed logs and photographic records important. Note Section 5.3.2 of COP.	Characterises waste type and contamination potential. Note Section 4.3.1 of COP & Table 1a & Table 1b of Scoring Matrix.	Characterises waste type and contamination potential. Note Section 4.3.1 of COP & Table 1a & Table 1b of Scoring Matrix.	Characterises waste type and contamination potential, samples can be acquired during trial pitting or from existing borehole infrastructure, if present.	Characterises geology type and material strength, permeability	Should be completed as per best practice and relevant guidelines. Refer to COP 5.3.2 and EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Sections 4 and 5.	topographical surveys give base map for site layout, investigation points, sample and water level depths, groundwater flow direction etc recommended.
Provisional Guidance on Extent of Testing/Sampling - This will ultimately depend on the type of risk identified, size of site, extent & volume of waste, ground conditions, variability of the waste material, etc..					Office based assessment using all available existing site data that is vital in assessing the initial risk level and conceptual model for the site. Sites may have GIS data available.	Locations and access issues for sampling and site suitability should be assessed at this stage.	A good conceptual site model will facilitate an initial risk classification for the site and guide future works.	Typically 7 to 10 trial pits are completed to 3 to 5m per day. Initial two days of trial pitting should be undertaken on and around the waste body to confirm extent and composition. Initial gas monitoring can be by hand held gas and volatile monitors & based on physical observations. Further Trial Pits & Trenching can be completed as part of the Main SI if required.	Each trial pit should be logged as per BS 5930:1999 and nature of waste and composition recorded. Photographic records important. Potential to cause source of contamination to be assessed.	Leachability testing of waste should be completed once if not C&D type - minimum of two samples should be acquired for the NRA Leachability test and comparison to the relevant guidelines such as, EPA groundwater Interim Guideline Values (IGVs).	Will depend on nature and composition of the waste and number of investigation points. Initially one to three samples should be taken with one full screen as per Table C.2 of EPA Landfill Monitoring Manual 2003, and at other locations for six indicator parameters such as ph Conductivity, temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium.	Will depend on nature and variability of soil material around waste body and number of investigation points. Initially three disturbed samples should be taken and tested for soil type, particle size, permeability and strength, refer to BS 5930 standard.	Nearest or local downgradient locations should be considered for exploratory sampling. Basic indicator parameters such as ph Conductivity, temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium should be completed as a minimum.	A topographical survey should be considered for the site area and immediate environs of low risk sites and is recommended for all moderate and high risk sites. GPS survey locations as required.

M = Mandatory and should be completed as thoroughly as possible for each site.

R = Recommended technique assuming site conditions allow.

S = Should be considered but is dependent on site suitability for that methodology.

ISSUED WORKING DRAFT

DATE:17th September 2009

COMPILED by [illegible]

Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites

CLOUNTREEM
TIER II SITE INVESTIGATION REPORT

Landfill Site:	**Clountreem**
Site Reference:	**07/W**
Division:	**West Cork**
Area Office:	**Castletownbere**

QRA by: WYG Ireland
August 2010

Report by: Kieran Coffey
Environment Directorate
Cork County Council
December 2009

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APPENDICES

1.0 SITE SUMMARY

Cork County Councils Environment Directorate completed a Tier I report and risk assessment on Clountreem Landfill in July 2008. The Tier I assessment was completed in accordance with the EPA CODE OF PRACTICE Environmental Risk Assessment for Unregulated Waste Disposal Sites. The Tier I Report showed Clountreem Landfill to be a **"High Risk"** site (see Appendix 1).

A Tier II Exploratory Investigation was organised for this site in October 2009. The purpose of the Exploratory Investigation was to confirm the initial conceptual site model (CSM) prior to the designing of the Main Investigation programme (in accordance with 5.3.2 of the Code of Practice). Following the Exploratory investigation a main investigation was designed and completed in accordance with the EPA Matrix (see Appendix 2) in November 2009.

2.0 SITE INTRODUCTION

Clountreem Landfill is located approximately 1km North North East of Castletownbere (GIS Coordinates E68,880, N47,310). This landfill covers an area of approximately 1.16 Ha.

Location of Clountreem Landfill (07/W)

2.1 Surrounding Land Use

The site is located approximately 150m off a minor road. The surrounding land is mountainous and is grazed by sheep. There is one house approximately 200m North West of the site. A mountain stream flows through a concrete pipe under the landfill.

2.2 Site History

This landfill site was bought by the Cork County Council in the summer of 1975. The landfill site closed on the 26th February 1999. It was the main municipal landfill in this region for over 20 years. Once a year the site was fully levelled and soil capping placed on all the waste.

2.3 Tier I SPR Linkage Score

The table below shows the Tier I linkage scores for Clountreem.

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	126	300	Leachate => Surface water	42%
SPR 2 =	42	300	Leachate => SWDTE	14%
SPR 3 =	56	240	Leachate => human presence	23%
SPR 4 =	28	240	Leachate => GWDTE	12%
SPR 5 =	84	400	Leachate => Aquifer	21%
SPR 6 =	0	560	Leachate => Surface Water	0%
SPR 7 =	84	240	Leachate => SWDTE	35%
SPR 8 =	42	60	Leachate => Surface Water	70%
SPR 9 =	14	60	Leachate => SWDTE	23%
SPR 10 =	14	150	Landfill Gas => Human Presence	9%
SPR 11 =	21	250	Landfill Gas => Human Presence	8%

Table 2.1: Tier I Source Pathway Receptor Linkage Scores

The Tier I linkages of concern are SPR 1 Leachate to Surface water (Via groundwater and drainage/surface water runoff) and SPR 8 Leachate to Surface water (Leachate to surface water drainage).

2.4 Tier I Conceptual Site Model

The diagram below shows the Tier I Conceptual Site Model for Clountreem.

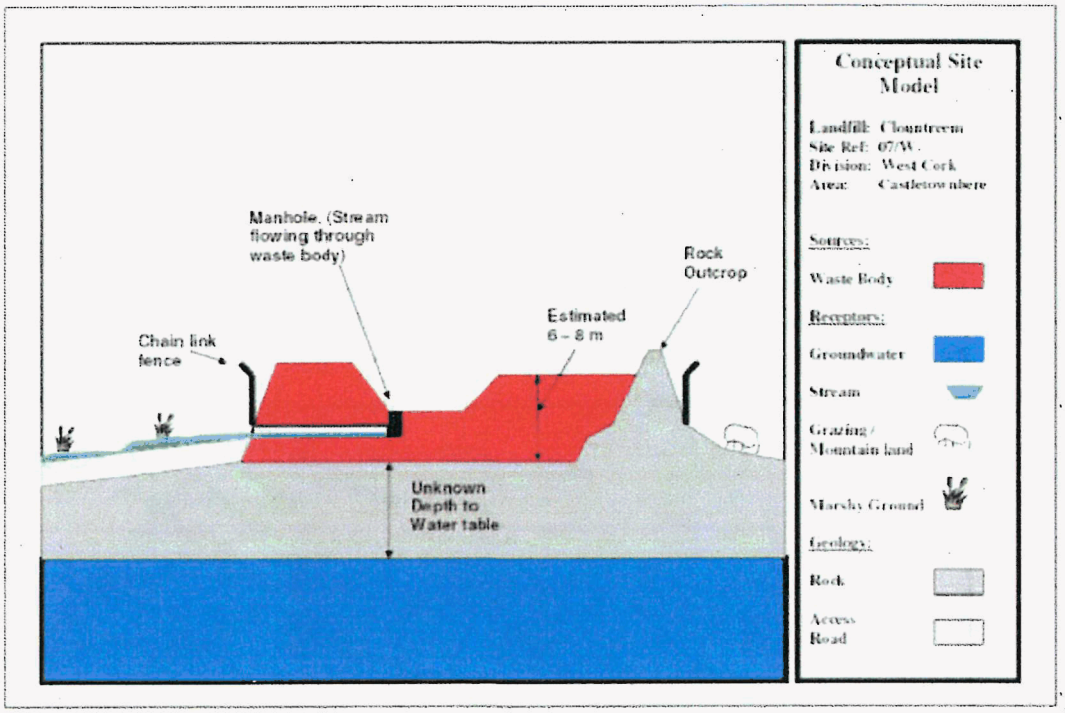


Fig 2.1: Clountreem CSM

3.0 TIER II SITE INVESTIGATION

3.1 OBJECTIVES

The main objective of the investigation was to collect sufficient information to confirm the Tier I conceptual site model.

The objectives are summarised as follows:

- Characterise the waste on site
- Delineate the lateral and vertical extent of the waste
- Determine the depth and composition of any capping layer
- Determine the subsoil type, thickness and permeability
- Confirm if the Tier I Conceptual Site Model is valid (and adjust if required)
- Show if there is evidence of the landfill causing any environmental impacts
- Use the information gathered to design the Main Tier II Investigation

3.2 SITE INVESTIGATION METHODOLOGY

The site investigation included the following elements:

- Excavation of Trial Pits throughout the site
- Collection and Analysis of Surface Water Samples

- Collection and Analysis of Leachate Samples
- Collection and Analysis of the Waste
- Installation of Groundwater Wells
- Collection and Analysis of Groundwater
- Completion of a Site Survey
- Completion of a CCTV Survey on the pipe under the Landfill
- Ecology Survey

3.3 ON SITE INVESTIGATIONS

The site investigation comprised the use of 20Tonne Tracked Excavator to dig 15No. Trial Pits throughout the site. The excavations were supervised and logged by an O'Callaghan Moran Geologist and a Cork County Council Engineer. Each Trial Pit was logged in accordance with BS5930. Trial Pit locations can be seen below.

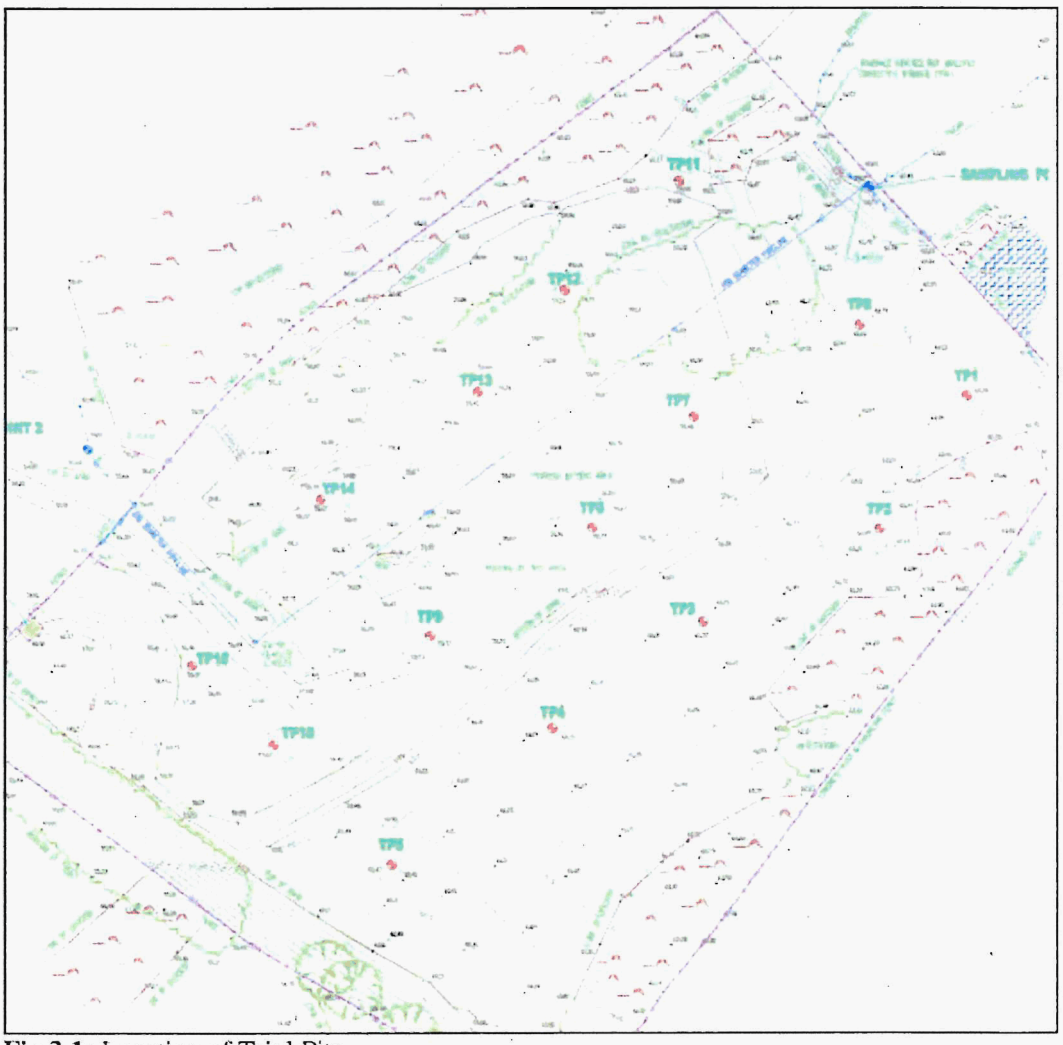


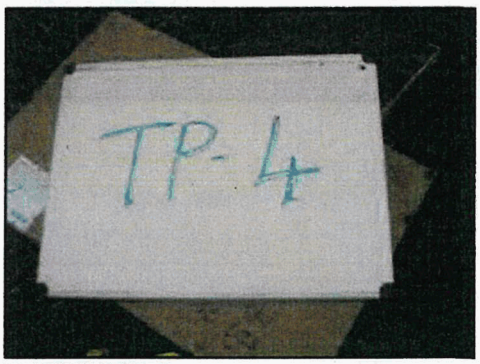
Fig 3.1: Location of Trial Pits

3.4 ON-SITE OBSERVATIONS

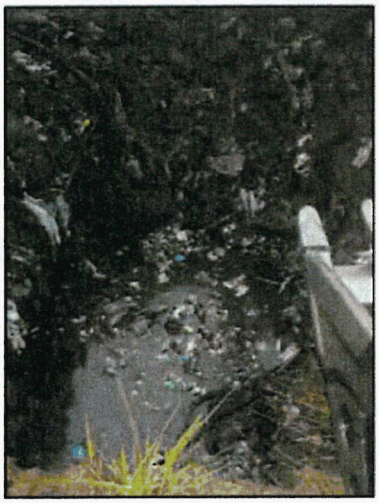
3.4.1 Waste Characterisation

Waste was found in all areas of the site. The majority of the waste comprised of domestic waste including plastics, textiles, glass, papers, steel roof sheeting, steel pipes, concrete, fishing nets, ropes, radiators, tyres, car and truck batteries, timber, blocks etc. (See Trial Pit Logs in Appendix 3). Some Trial Pit photos can be seen below:

Trial Pit No.3



Trial Pit No.4



Trial Pit No.7

Trial Pit No.13

Trial Pit No.13

Trail Pit No.15

3.4.2 Lateral and Vertical Extent of the Waste

Lateral: The trial pitting confirmed that the waste was located up to most of the boundaries around the site (except where there was rock outcropping). The Tier I boundary showed the true and accurate extent of the waste (i.e. therefore there was no change in risk rating due to an increase or decrease in waste area).

Vertical: The depth of the waste varied from approximately 1m (near the sides of the site where rock outcropping was prominent) to generally between 4 and 6.5m in all other areas of the site. A brown sandy gravely clay covers most of the site with a coverage of only 200 to 300mm in most areas. A "Peaty Material with rootlets" was found under the majority of the waste on the site and this material was not saturated in areas that it was found (indicating that it is providing an effective barrier between the waste and the groundwater). In other areas of the site (mainly where the depth of waste was between 1-2m and beside rock outcropping) the waste was sitting directly on weathered rock (broken green sandstone). Water entry into the trail holes was found to be generally between 2m and 3m below ground level (bgl) at both sides of the landfill (TP1 – TP5 and TP11 –TP15) and between 1m and 2m bgl around the middle of the site (TP6 – TP10) where the site was generally wetter under foot.

3.5 SAMPLING AND ANALYSIS

3.5.1 Surface Water

A small mountain stream flows beneath the landfill in a North East to South West direction (see CSM Plan below). The stream is piped through the landfill in a 600mm concrete pipe.

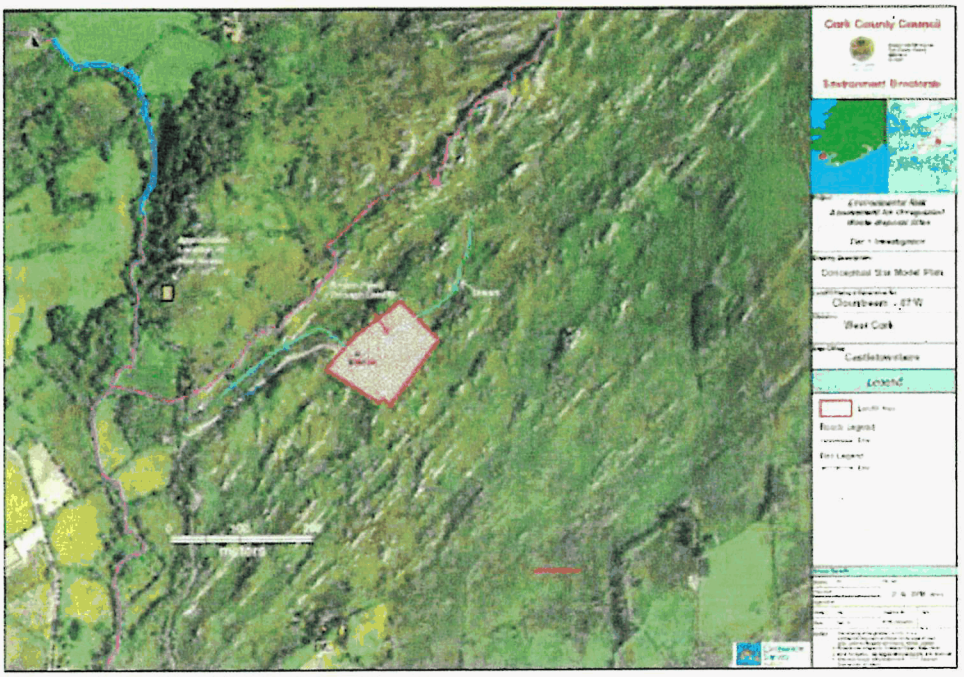


Fig 3.2: Conceptual Site Model Plan

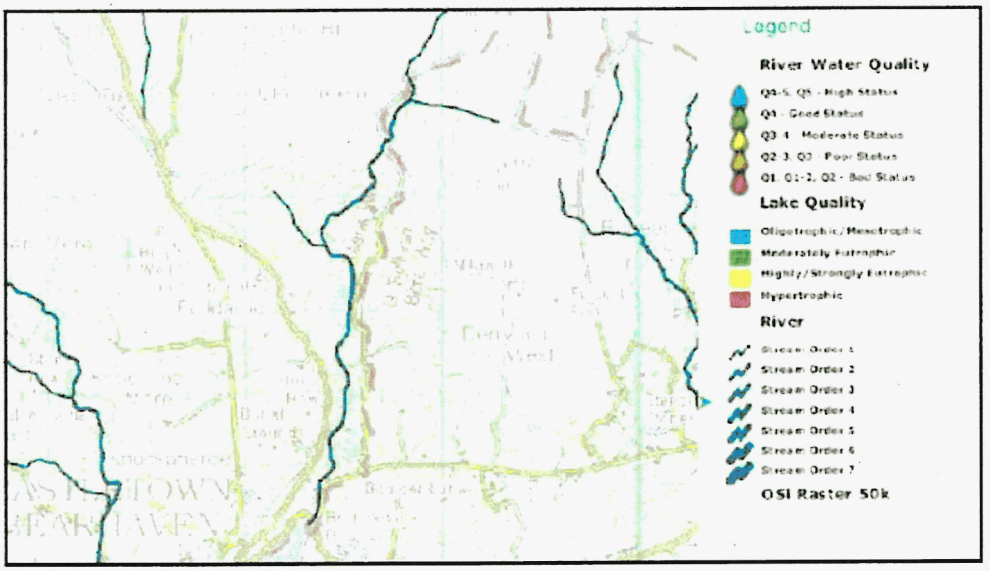


Fig 3.3: EPA River Q-Rating Map

The Stream that flows through Clountreem landfill flows into the Aghakista River (approximately 300m from the landfill). This river does not have a Q rating but according to the EPA Status Report 2009 this river is regarded as having Good Status (approximately a Q4).

3.5.2 Surface Water Samples

3No. Surface Water samples were taken from the stream running through Clountreem Landfill on 30th October 2009. Samples were collected and stored in accordance with BS 6068 – 6.6 Guidance on sampling of rivers and streams. Full laboratory chain of custody documentation was completed and samples dispatched to the chosen laboratory (Certificates of Analysis can be seen in Appendix 4). Samples were tested for major and minor suites in accordance with the EPA Guidance Matrix (See Appendix 2).

See sample locations below:

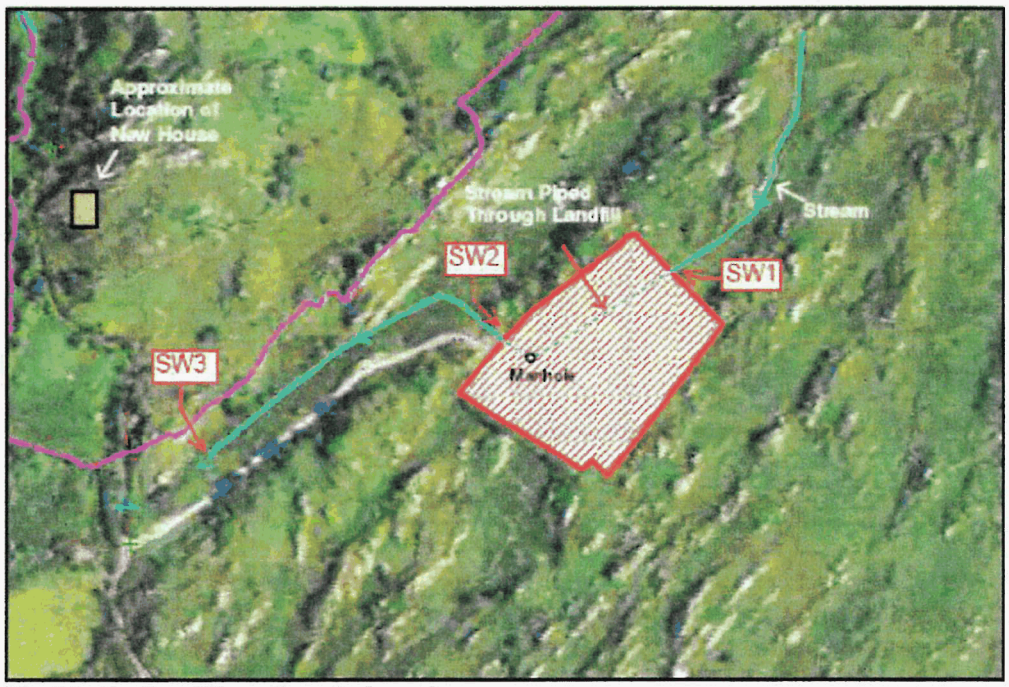


Fig 3.3: Surface Water Sample Locations

Surface water samples for Clountreem Landfill					
Parameter	Units	SW1	SW2	SW3	EQS Values
pH (Surface Water)	pH Units	7	6.9	7.5	6.5 - 9.5
Conductivity (Surface Water)	uscm -1@25C	84	258	217	1000
Solids (Total Suspended)	mg/L			5	-
Solids (Total Dissolved)	mg/L			109	-
Ammonia (Surface Water)	mg/L as N	0.03	2.74	1.3	0.02 mg/L
Nitrogen (Total Oxidised) (Surface Water)	mg/L as N			0.7	-
Total Organic Carbon	mg/L			5.6	-
BOD (Surface Water)	mg/L	<2	<2	<2	-
COD (Surface Water)	mg/L			14	-
Calcium	mg/L	6.8	27.5	22.3	-
Magnesium	mg/L	2.4	4.7	4.1	0.3 mg/L
Sodium	mg/L	8.9	10.9	11.1	-
Potassium	mg/L	0.3	2.4	1.9	-
Iron (Surfacewater)	ug/L	231	9130	2841	1000 ug/L
Manganese (Surface Water)	ug/L	22	337	256	-
Cadmium (Surface Water)	ug/L	<0.1	<0.1	<0.1	5 ug/L
Chromium (Surface Water)	ug/L	< 1	< 1	< 1	30 ug/L
Copper (Surface Water)	ug/L	0	0	0	30 ug/L
Nickel (Surface Water)	ug/L	2	3	3	50 ug/L
Lead (Surface Water)	ug/L	2	2	1	10 ug/L *
Zinc (Surface Water)	ug/L	5	7	4	100 ug/L *
Arsenic (Surface Water)	ug/L	<0.2	<0.2	<0.2	25 ug/L *
Boron (Surface Water)	ug/L	70	180	60	2000 ug/L *
Mercury	ug/L	<0.02	<0.02	<0.02	1 ug/L *
Alkalinity (Surface Water)	mg/L CaCO3			62	-
Sulphate	mg/L as SO4	<1.39	<1.39	<1.39	200 mg/L
Chloride (Surface Water)	mg/L	18.44	22.28	21.75	250 mg/L
Phosphate (Ortho) Surface Water	mg/L as P			0.008	-
Cyanide	ug/L				10 ug/L #
Fluoride (Surface Water)	mg/L			0.15	5 mg/L #
Atrazine	ug/L			<0.01	1 ug/L
Dichloromethane	ug/L			<1	10 ug/L
Simazine	ug/L			<0.01	1.0 ug/L
Toluene	ug/L			<0.28	10 ug/L
Tributyltin*	ug/L as Sn			<0.03	-
Xylene (Total)	ug/L			< 1	10 ug/L
Coliforms (Faecal)	no/ 100ml			71	-
Coliforms (Total)	no/ 100ml			72	-

Note:
* Standard where hardness of water is > 100mg/L $CaCO_3$

Table 3.1: Surface Water Results

3.5.3 Interpretation of Surface Water Results

Noticeable increases in Ammonia, Magnesium and Iron above the Environmental Quality Standards are indicated in the above table. Increases in Conductivity, Calcium, sodium and Manganese are also evident. The levels of contaminants in the stream as it exits the landfill are the highest (SW2) and there is a dilution effect when the surface water was tested approximately 200m downstream of the landfill.

It is apparent from the above results that the landfill is having some impact on the water quality of the stream.

3.5.4 Flow Survey

A flow survey was completed on the stream. The flow varied between a maximum of 496m^3/Hr down to 3.82m^3/Hr with an average flow of 37.5m^3/Hr. A rain gauge was installed along with the flow meter. The survey showed that the rain and flow curves

matched each other closely. This indicated that the catchment responds rapidly to rainfall and the flow in the stream slows significantly only hours after the rain ceases. It is concluded that the volumes in the stream would be very low during any extended dry spells (a copy of flow survey can be seen in Appendix 8).

3.5.5 Leachate Sample Results

3No. Leachate samples were taken from trial pits on the 29nd and 30th October 2009. Leachate samples were taken from the following locations:

Leachate 1	-	Trial Pit No.5
Leachate 2	-	Trial Pit No.7
Leachate 3	-	Trial Pit No.8

Leachate was tested as per table C2 of the EPA Landfill Monitoring Manual 2003 for Leachate 3 and a minor suite and metals for all other locations (as per EPA Matrix, Appendix 2)

Parameter	Leachate 1	Leachate 2	Leachate 3	Units
pH	6.9	6.6	12.2	pH Units
Conductivity	1030	350	567	uscm -1@25C
Ammonia	84.79	5.17	11.3	mg/L as N
Nitrogen (Total Oxidised)			<0.03	mg/L as N
BOD	15	7	20	mg/L
COD			1510	mg/L
Sulphate	7.31	<1.39	5.3	mg/L as SO4
Chloride	55.35	29.06	51.42	mg/L
Phosphate (Ortho)			0.76	mg/L as P
Cyanide			20	ug/L
Fluoride			0.35	mg/L
Atrazine			<0.01	ug/L
Dichloromethane			<1	ug/L
Simazine			<0.01	ug/L
Toluene			<0.28	ug/L
Tributyltin*			<1.5	ug/L as Sn
Xylene (Total)			<1	ug/L
Calcium	82	42.6	61.1	mg/L
Magnesium	18.6	6.5	9.1	mg/L
Sodium	40.4	12.2	16.5	mg/L
Potassium	24.6	4.2	8	mg/L
Iron (Total)	13.95	17.69	19.42	mg/L
Manganese	1.87	0.96	1.84	mg/L
Cadmium	2	<0.1	2	ug/L
Chromium	10.5	8.2	8.5	ug/L
Copper	<0.2	<0.2	<0.2	ug/L
Nickel	13.9	9.5	16.3	ug/L
Lead	148	106	293	ug/L
Zinc	509	533	895	ug/L
Arsenic	6.2	4.6	6.1	ug/L
Boron	540	260	360	ug/L
Mercury	0.2	0.1	0.1	ug/L

Table 3.2: Leachate Results

3.5.6 Interpretation of Leachate Results

When comparing the above Leachate results to leachates sampled from other landfills (i.e. Table 7.1 & 7.2 EPA Landfill Site Design, 2000) 96% of the values are below

Median values for the landfills that are in Stage III and Stage IV of the degradation process. It is concluded that Clountreem landfill is likely to be in late stages of Stage IV or in Stage V (Aerobic Stage) of the biodegradation process. The low recorded ratio between BOD and COD (0.01) supports the above view.

3.6 CONCLUSIONS AND RECOMMENDATIONS FOLLOWING EXPLORATORY INVESTIGATION

Conclusions: Waste throughout the site was consistent in nature and was mainly composed of mixed domestic and commercial (fishing nets) waste. The waste footprint of the site defined in the Tier I report was correct and is estimated to be 1.16Ha. An organic layer was found at the base of most of the waste. This layer was unsaturated and seemed to provide a good barrier between the waste and the groundwater. Where the waste was shallow (1-2m) and close to the rock outcrops there was in some cases no organic layer between the waste and the rock.

Groundwater / Leachate was found in most trial pits (14No. of 15No.). Leachate was encountered close to the surface near the middle of the landfill (where the landfill is shallowest). Based on the observations and knowledge obtained in the exploratory investigation it was concluded that the higher Risk SPR linkages in the Tier I were valid and the focus of the main investigations was on these SPR linkages. i.e. SPR No.1 and SPR No.8 (e.g. Leachate to surface water via Groundwater and Leachate to surface water via drainage/runoff).

Recommendations: There was a reduced need for a Geophysical Survey of the site as the excavator was able to reach the base of the waste in all of the trial holes and so a very good picture of both the waste types and waste boundaries were obtained during the Exploratory Investigation. As there is no human presence near to landfill and the gas risk was deemed to be low there was no need for the installation of Gas Wells during the main investigation (and in accordance with the EPA matrix guidance, Appendix 2).

4.0 TIER II MAIN INVESTIGATION

4.1 Tier II Main Investigation Scope

2No. Groundwater Wells were installed outside the waste mass to confirm if the landfill was affecting the groundwater quality as well as forming a pathway to the surface water. It was intended to install 1No. Groundwater Well up gradient of the landfill also but due to difficult terrain and waterlogged conditions on site the drill rig did not gain access to the upper part of the site. As this is a mountainous area and there is no development up-gradient of the landfill it is assumed that any contamination found in the down gradient wells could be attributed to the landfill.

An Ecology Study was also completed on the landfill, stream and the area surrounding the landfill.

A CCTV survey was conducted on the concrete pipe under the landfill.

4.2 Groundwater Investigation

See drawing below for well locations:

Groundwater Wells were placed in down gradient locations from the landfill. GW1 is approximately 50m from the landfill and between the landfill and the flow of the stream. This was installed to determine if the groundwater was acting as a contaminant pathway to the surface water. It was impossible to place a Groundwater Well directly below the landfill due to the terrain. A groundwater well (GW2) was placed approximately 300m below the waste mass (in line with the rock outcrops) to determine if contaminants were migrating from the landfill to the groundwater.

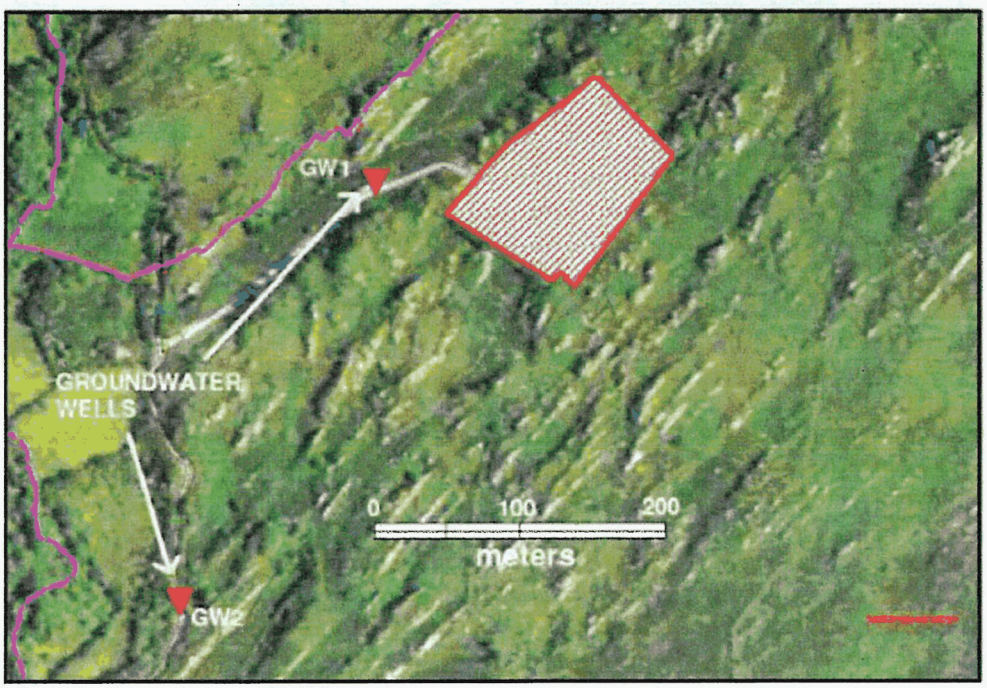


Fig 4.1: Groundwater Well Locations

Installation of GW1

Groundwater sample results can be seen below. Groundwater samples were taken using an ISCO peristaltic pump. 3No. well volumes were removed prior to the samples being taken.

Samples were collected and stored in accordance with BS 6068 – Guidance on sampling of groundwaters. Full laboratory chain of custody documentation was completed and samples dispatched to the chosen laboratory (Certificates of Analysis can be seen in Appendix 4). Samples were tested for major suites in accordance with the EPA Guidance Matrix (See Appendix 2).

Parameter	GW1	GW2	*Interim Guideline Values*	Units
pH	6.2	6.6	≥6.5 and ≤ 9.5	pH Units
Conductivity	151	286	1000	uscm -1@25C
Ammonia	<0.01	0.244	0.15	mg/L as N
Nitrogen (Total Oxidised)	0.35	<0.28	No abnormal change	mg/L as N
BOD	<2	<2	-	mg/L
COD	25	<5	-	mg/L
Sulphate	11.80	8.12	200	mg/L as SO4
Chloride	31.96	32.11	30	mg/L
Phosphate (Ortho)	0.008	<0.005	-	mg/L as P
Cyanide			0.01	ug/L
Fluoride	0.21	0.14	1	mg/L
Atrazine	<0.01	<0.01	1	ug/L
Dichloromethane	<1	<1	0.04	ug/L
Simazine	<0.01	<0.01	1	ug/L
Toluene	<0.28	<0.28	10	ug/L
Tributyltin*	<0.02	<0.02	-	ug/L as Sn
Xylene (Total)	<1	<1	10	ug/L
Calcium	7.75	14.02	200	mg/L
Magnesium	1.74	4.08	50	mg/L
Sodium	14.12	18.60	150	mg/L
Potassium	0.97	4.18	5	mg/L
Iron (Total)	0.77	0.296	0.2	mg/L
Manganese	0.26	6.13	0.05	mg/L
Cadmium	0.2	<0.09	5	ug/L
Chromium	2.3	<2.14	30	ug/L
Copper	9.6	10.4	30	ug/L
Nickel	4.4	1.7	20	ug/L
Lead	1.5	0.9	10	ug/L
Zinc	20.9	15.7	100	ug/L
Arsenic	0.9	1	10	ug/L
Boron	101.3	173.6	1000	ug/L
Mercury	<0.03	<0.03	1	ug/L

Table 4.1: Groundwater Results

4.2.1 Interpretation of Groundwater Sample Results

4No. parameters have shown up as being above the *"Interim Guideline Values"* for Groundwater. Two of these (Iron and Manganese) are naturally occurring in the groundwater in the Castletownbere area.

Chloride levels slightly above interim guideline values appeared in both wells. Groundwater results from the nearby groundwater supply of Cahermore (the same geology and distance from the sea) have shown Chloride levels of 54mg/L. It is concluded that the chloride levels detected are naturally occurring.

Ammonia levels above *Interim Guideline Values* were detected in GW2. The level detected was below the Drinking Water Standards (0.30mg/L) however. This elevated ammonia level may be due to the landfill or from the adjacent agricultural activities (silage storage and sheep feeding area).

4.3 Ecology Study

An Ecology Survey was conducted by Mr Patrick Doherty MSc, MIEEM of Doherty Environmental. A copy of the completed report can be found in Appendix 6.

The Summary findings are as follows: The habitats occurring within the site are considered to be of low ecological value (E). The bare ground supports little vegetation cover and does not function as a habitat for faunal species such as mammals and birds. The remaining scrub habitat occurring within the site is degraded and provides limited shelter for fauna species. The willow scrub along the southern boundary of the site has the potential to support a limited population of bird species. The wet grassland occurring within the site is dominated by soft rush and is not representative of the naturally occurring wet grassland habitats in this area.

Overall the site is considered to be of low ecological value and low conservation importance.

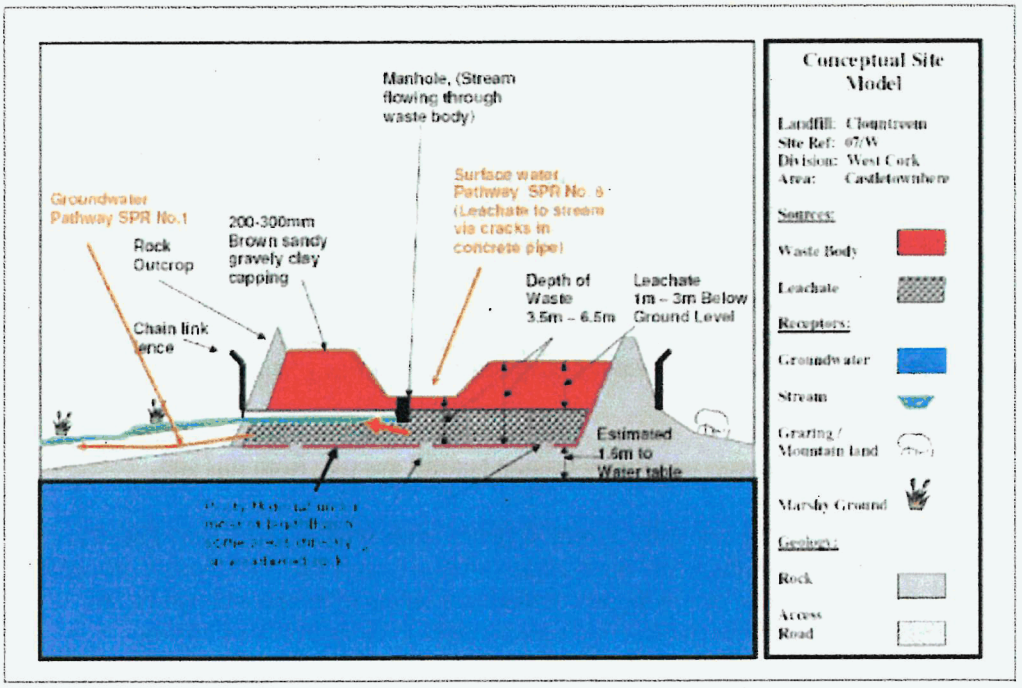
A Biological Water Quality Assessment (Kick samples) was conducted on stream running through the landfill. The results showed that the stream had a Q 4-5 value (High Status) upstream of the landfill, Q2-3 (poor status) just below the landfill and Q4 (High status) approximately 200m below the landfill. The results of the biological water quality assessment are in line with the findings of the physico-chemical surface water analysis (see table 3.1).

4.4 CCTV Survey

A CCTV Survey was completed on the 600mm concrete pipe which conveys a mountain stream under the landfill (See fig 3.2 CSM Plan). There are two sections of pipe that were surveyed. The first was up-stream of the manhole. Only 46.7m of the c100m length of pipe could be surveyed before the camera encountered a blockage. Many of the pipe joins were found to be leaking leachate into the stream. At 46.7m up the pipe a 60% blockage was encountered and cracks (which were leaking) in the pipe noticed.

No leaks or defects were found in the downstream section of pipe.

5.0 RE-ASSESSMENT OF TIER I CONCEPTUAL SITE MODEL



The CSM was revised following the Tier II Exploratory and Main Investigations. The trial pits showed a low permeability organic clay layer under most areas of the landfill. Some of the shallower waste areas were directly on weathered rock. Where the organic layer was encountered it was unsaturated in all cases indicating that it was providing a barrier between the waste and the rock.

The CSM was revised to show that the waste is cradled between two areas of rock outcrop (rock outcrop only shown on one side previously) indicating that leachate migration is likely to be limited to the South West direction as well as towards the stream.

There was leachate found in nearly all areas (except TP14) of the site and it is indicated as being approximately 3m deep in the revised CSM.

Based on the findings from the Groundwater Well Drilling (GW1) it is estimated that the water table is approximately 1.6m below the rock surface.

The Major leachate pathway is identified as being through the concrete pipe to the stream (confirmed by CCTV survey) with a possible minor pathway to surface water via groundwater (but inconclusive).

6.0 CONCLUSIONS AND RECOMMENDATIONS FOLLOWING TIER II MAIN INVESTIGATION

6.1 CONCLUSIONS

Risk Category –The Tier II Exploratory Investigation showed that there is an impermeable organic layer under most of the landfill. The results from the groundwater showed that there are no major impacts on groundwater quality. For the above reasons the "Leachate Migration Pathways" in the Risk Screening & Prioritisation calculations have been reduced from an "Extreme Vulnerabilty" to a "Moderate Vulnerability". This resulting change reduces SPR No. 1 (i.e. Leachate to Surface Water) to a low risk (28%). SPR No.8 remains as a "High Risk Linkage" (see Appendix 7).

Landfill Gas – There is no or very limited landfill gas risk from this site.

Groundwater – The risk to the groundwater is confirmed as being low. The dry organic layer under the waste mass is providing a barrier between most of the waste and the groundwater. Some minor contaminant levels were encountered in the Groundwater but these in most cases are thought to be naturally occurring.

SPA, SAC, NHA - There are no local protected areas near to this site.

Surface Water - The adjacent surface water is being impacted by the landfill. The cracks and leakage in the pipe joins are responsible for the majority of the leachate migration to the stream.

6.2 RECOMMENDATIONS

- Prevent leachate migration off site by breaking the main *"Source Pathway Receptor"* Linkage (i.e. SPR No. 8 Leachate to Surface Water).
- Prevent as far as possible the Leachate Generation on site
- Complete a Quantitative Risk Assessment on the Site

Comments: The main recommendation is to stop/prevent leachate migration from the landfill to the local stream. This can be achieved by either repairing the concrete pipe (possible re-lining) or diverting the stream. The latter solution would be preferable.

Currently there is only a thin capping layer over the landfill. To reduce the surface water seepage into the landfill a remediation strategy plan/report should be prepared. The report should use guidance provided in EPA Landfill Manuals: Landfill Site Design (EPA 2000) and restoration and Aftercare (EPA, 1999). The likely solutions available will be to place a low permeability layer (geo-membrane or low permeability soil) over the landfill with appropriate surface water drainage installed (to limit leachate volumes).

The landfill should be planted with different varieties of vegetation/trees as recommended in the Ecology Survey to increase the biodiversity of the site and reduce nutrient runoff.

A Quantitative Risk Assessment should be completed on the site to quantify the pollution risk to the local stream and once this has been done a remediation plan should be prepared outlining how best the main pollution linkage can be broken.

Appendix 1

Clountreem 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:	**Clountreem**
Site Reference:	**07/W**
Division:	**West Cork**
Area Office:	**Castletownbere**

OVERALL RISK RATING	HIGH

Report by: Kieran Coffey
Environment Directorate
Cork County Council
February 2008

Contents

Site Summary

Clountreem Landfill is located approximately 1km North North East of Castletownbere (GIS Coordinates E68,880, N47,310). This landfill covers an area of approximately 1.16 Ha. It is estimated that the site is approximately 6 - 8 m deep.

Location of Clountreem Landfill (07/W)

This landfill site was bought by the Cork County Council in the summer of 1975[1]. It is unclear if there had been some private dumping at this site before that time. The site closed on the 26th February 1999[2]. It was the main dump in this region for over 20 years. Waste was delivered mainly by council vehicles but the general public had access to the site also (without paying any fee).

In the early years waste was dumped on the peaty soil and piled high. In later years to make more space the peat was dug out and the waste placed on top of the rock. The excavated peat was then used as a capping layer. It is thought that the site is between 6 and 8 meters deep. The majority of waste deposited here was municipal but some end of life vehicles and small quantities of wastewater sludges were also placed here. Small quantities of asbestos roofing and slate may have been deposited here also. Over the years there were a number of oil spills in the bay. The most significant of these being the Whiddy Island disaster in 1979. During shore cleanup operations waste oil (heavy oil) mixed with straw and seaweed was deposited at this site.

It was also reported that waste was regularly burned on this site[3]. Fish waste was banned at in the early eighties as large amounts were being deposited every year. It was reported also that approximately 1,330 tonnes of waste were deposited at this site every year (850 tonnes of which was collected by Cork County Council)

During the life of this landfill a machine would regularly level the waste and put some soil capping over it. The frequency of these visits increased to once per week in the later years. Once a year the site was fully levelled and soil capping placed on all the waste.

Walkover Survey

The site is located approximately 150m off a minor road. The site is now capped and is covered in scrub (heather & reeds). It is surrounded by chain link fencing and an access gate. The surrounding land is mountainous and is grazed by sheep. A stream is close to the entrance to the site. There is one new house approximately 180m to the west of the landfill and north of the stream. The site itself is undulating with the sides built up to approximately 8m. The middle of the site is lower (5-6m deep). There is a rocky outcrop on the eastern boundary of the site. There are some small amounts of surface waste visible as well as some trees/bushes that have been deposited near the entrance. The base of the stream has significant red deposits along the bottom but the water itself was clear. There is a pungent smell from the stream and a mild smell near the entrance to the site.

Geology:

The site is shown in subsoil maps to be on an area of rock. It is on top of a Locally Important aquifer and is in an area of Extreme groundwater vulnerability. During the Tier 1 risk screening this site has been identified as having a 70% risk rating for leachate migration to the local stream.

Risk Rating: HIGH

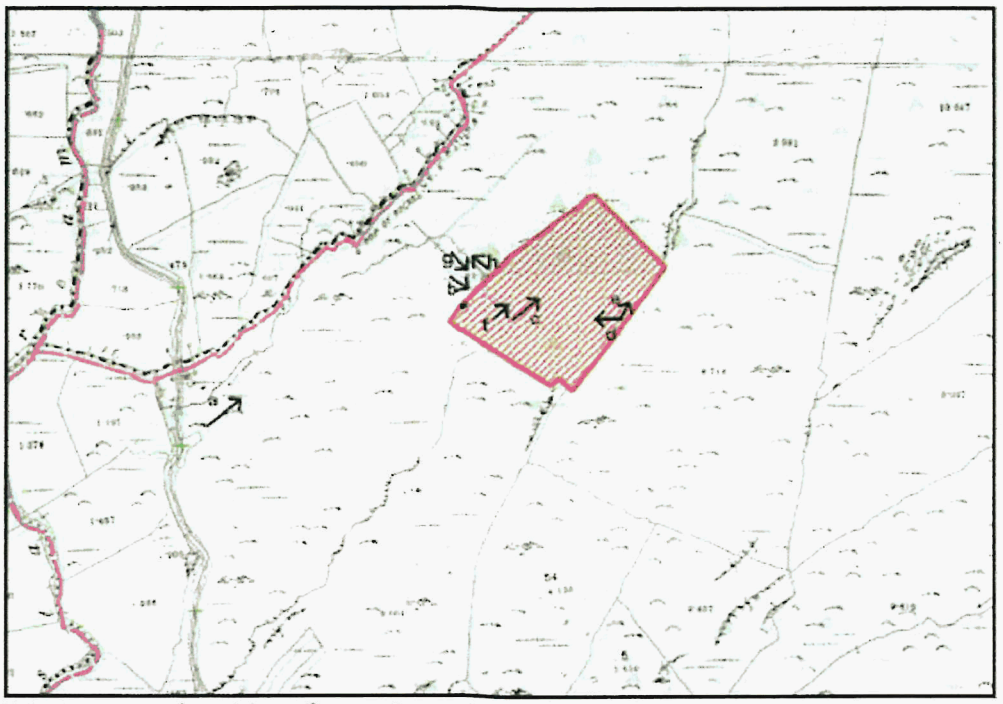
Recommendations:

Proceed to Tier 2 – Site Investigation and Testing. Confirm that no leachate risk remains from this site and check water quality data that may be available for the stream to see if there is any evidence of pollution.

References:

1. **Letter from County Solicitor to Housing & Sanitary Department in Clonakilty**
2. **Closure notice of landfill site (Signed by County Secretary).**
3. **West Cork Waste Report by Jerome O'Sullivan, SEO (1985/86).**

4. Site Photos & Layout Map



Layout map of positions from where photos were taken

a) Entrance road

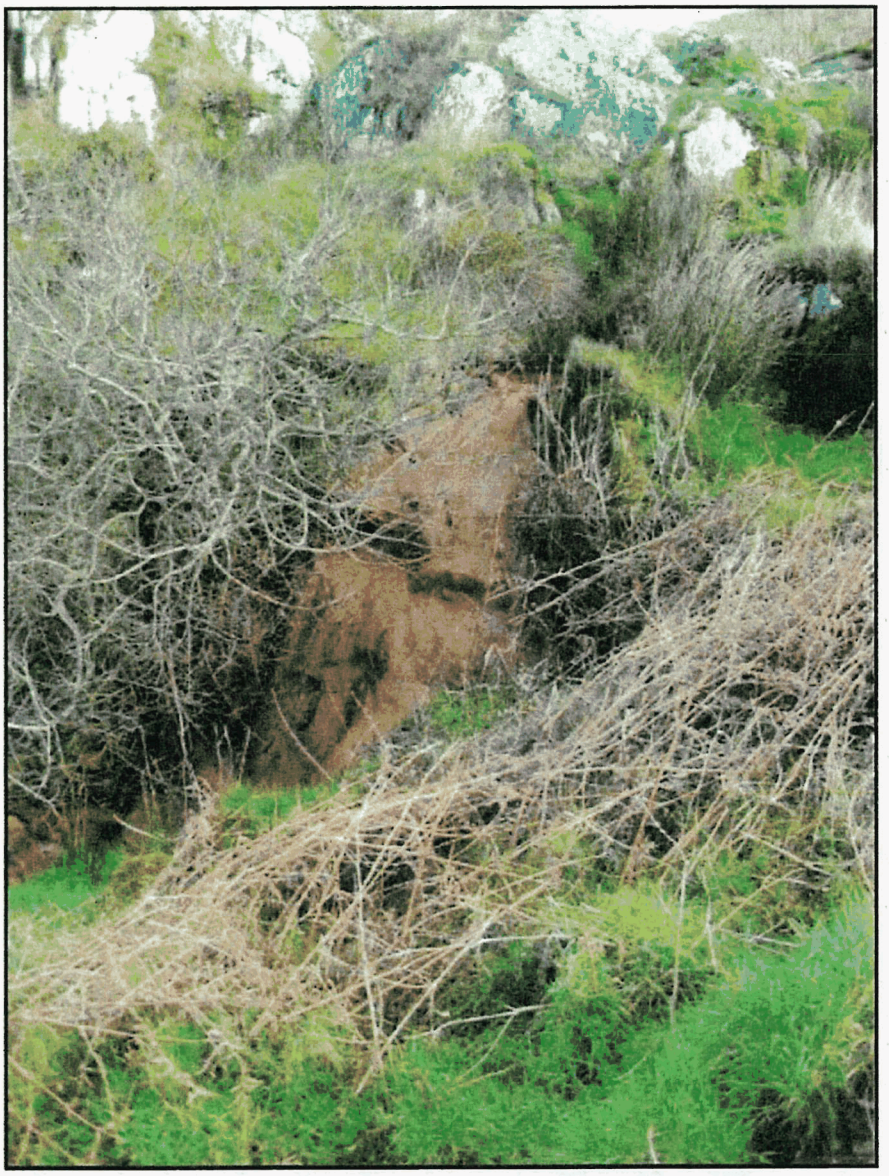
b) Entrance

c) Middle of site facing North East (Waste banked on either side)

d) Panoramic of site facing West

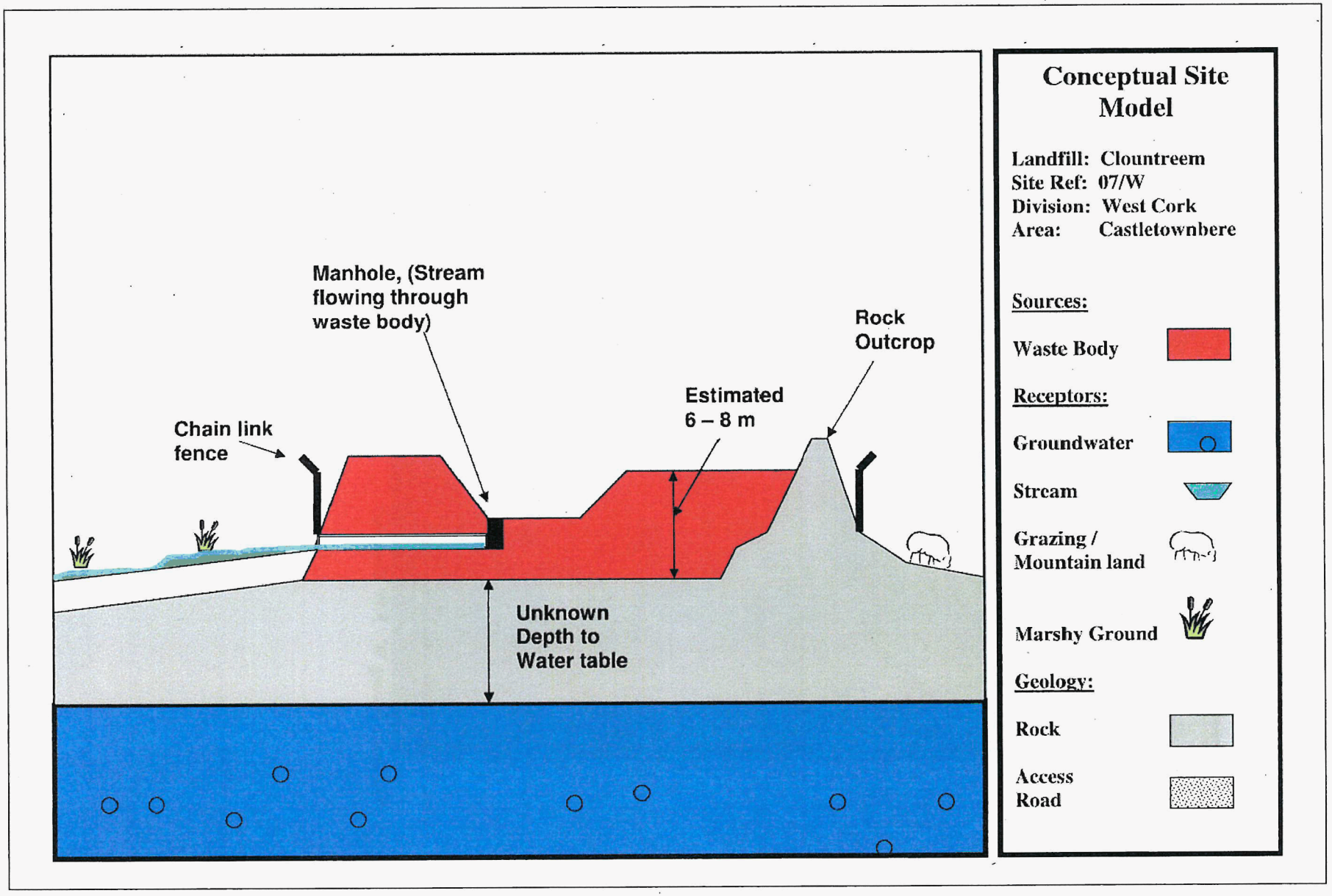
e) Facing North East

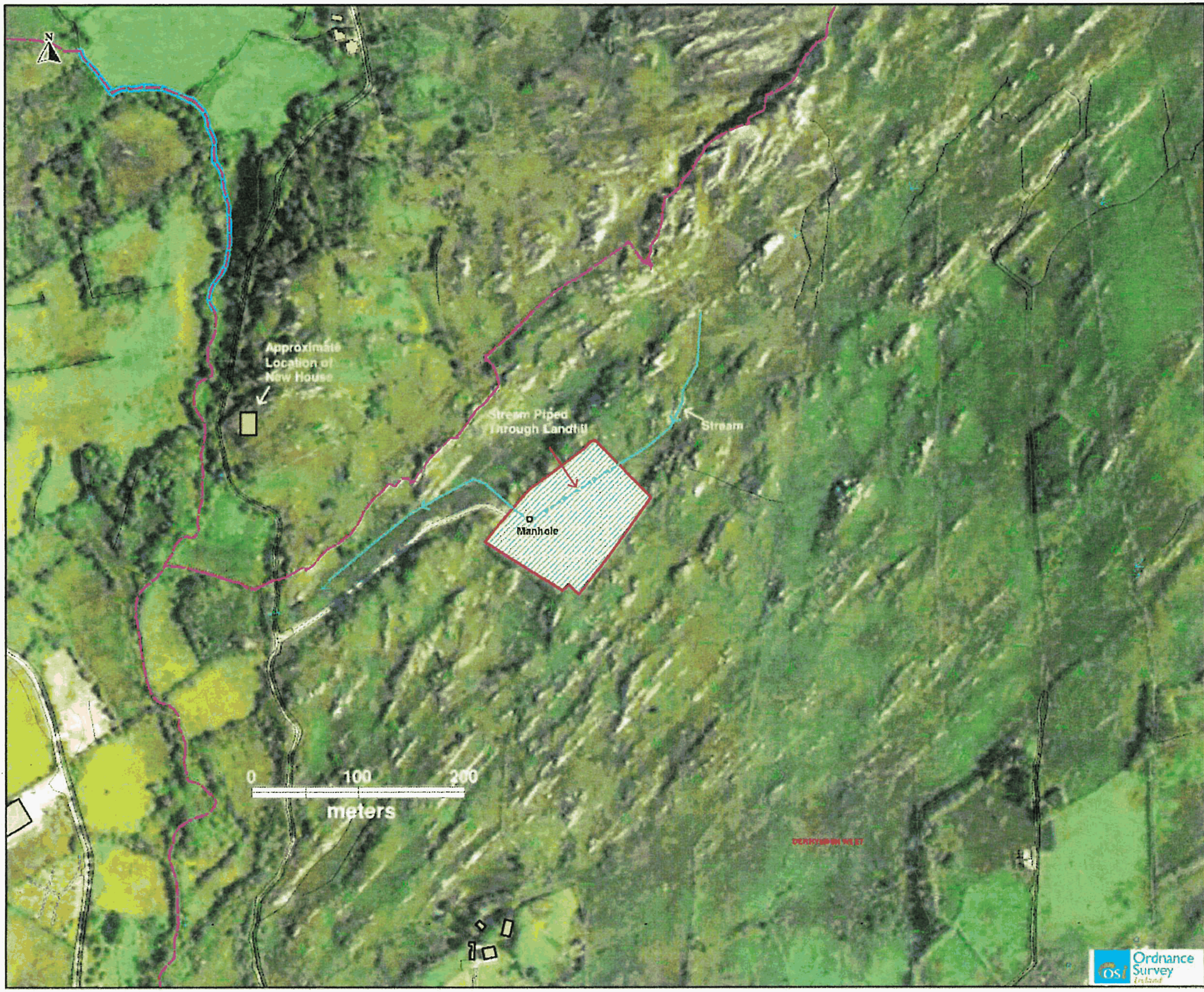
f) Manhole



g) Stream near site entrance (red deposits on base of stream)

h) Steam facing W / NW direction


Manhole, (Stream flowing through waste body)
Rock Outcrop
Estimated 6 – 8 m
Chain link fence
Unknown Depth to Water table
Conceptual Site Model
Landfill: Clountreem
Site Ref: 07/W
Division: West Cork
Area: Castletownbere
Sources:
Waste Body
Receptors:
Groundwater
Stream
Grazing / Mountain land
Marshy Ground
Geology:
Rock
Access Road



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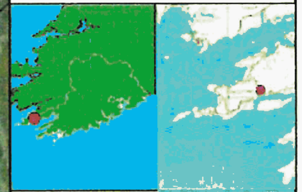


Project: *Environmental Risk Assessment for Unregulated Waste disposal Sites*

Tier 1 Investigation

Drawing Description: **Conceptual Site Model Plan**

Landfill Name & Reference No: **Clountreem - 07/W**

Division: **West Cork**

Area Office: **Castletownbere**

Legend

Landfill Area

Roads Legend
Line

Rail Legend
Line

Issue Details

File Ref.: 07-W_GVM_rev0

4. Risk Screening & Prioritisation Calculations

Landfill SiteName: Clountreem
Landfill Ref. No. : 07/W

Tier 1 Study

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 =	7

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 =	7

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

Landfill SiteName: Clountreem
Landfill Ref. No. : 07/W

Tier 1 Study

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 =	2

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 =	3

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 =	1

Table 3c : LEACHAGE MIGRATION: *RECEPTORS*	
AQUIFER CATEGORY (resource potential)	Points
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally Important Aquifers (Ll, 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: Clountreem
Landfill Ref. No. : 07/W

Tier 1 Study

Risk Screening/ Prioritisation

Table 3f : LEACHAGE MIGRATION: *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 =	1

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

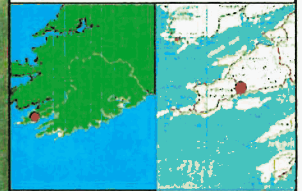
Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	126	300	Leachate => surface water	42%
SPR 2 =	42	300	Leachate => SWDTE	14%
SPR 3 =	56	240	Leachate => human presence	23%
SPR 4 =	28	240	Leachate => GWDTE	12%
SPR 5 =	84	400	Leachate => Aquifer	21%
SPR 6 =	0	560	Leachate => Surface Water	0%
SPR 7 =	84	240	Leachate => SWDTE	35%
SPR 8 =	42	60	Leachate => Surface Water	70%
SPR 9 =	14	60	Leachate => SWDTE	23%
SPR 10 =	14	150	Landfill Gas => Human Presence	9%
SPR 11 =	21	250	Landfill Gas => Human Presence	8%

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	HIGH

Cork County Council

Environment Directorate



Project: *Environmental Risk Assessment for Unregulated Waste disposal Sites*

Tier 1 Investigation

Drawing Description: Protected Areas Map

Landfill Name & Reference No: Clountreem - 07/W

Division: West Cork

Area Office: Bantry

Legend

- Landfilled Area
- SPA
- NHA
- SAC

Issue Details

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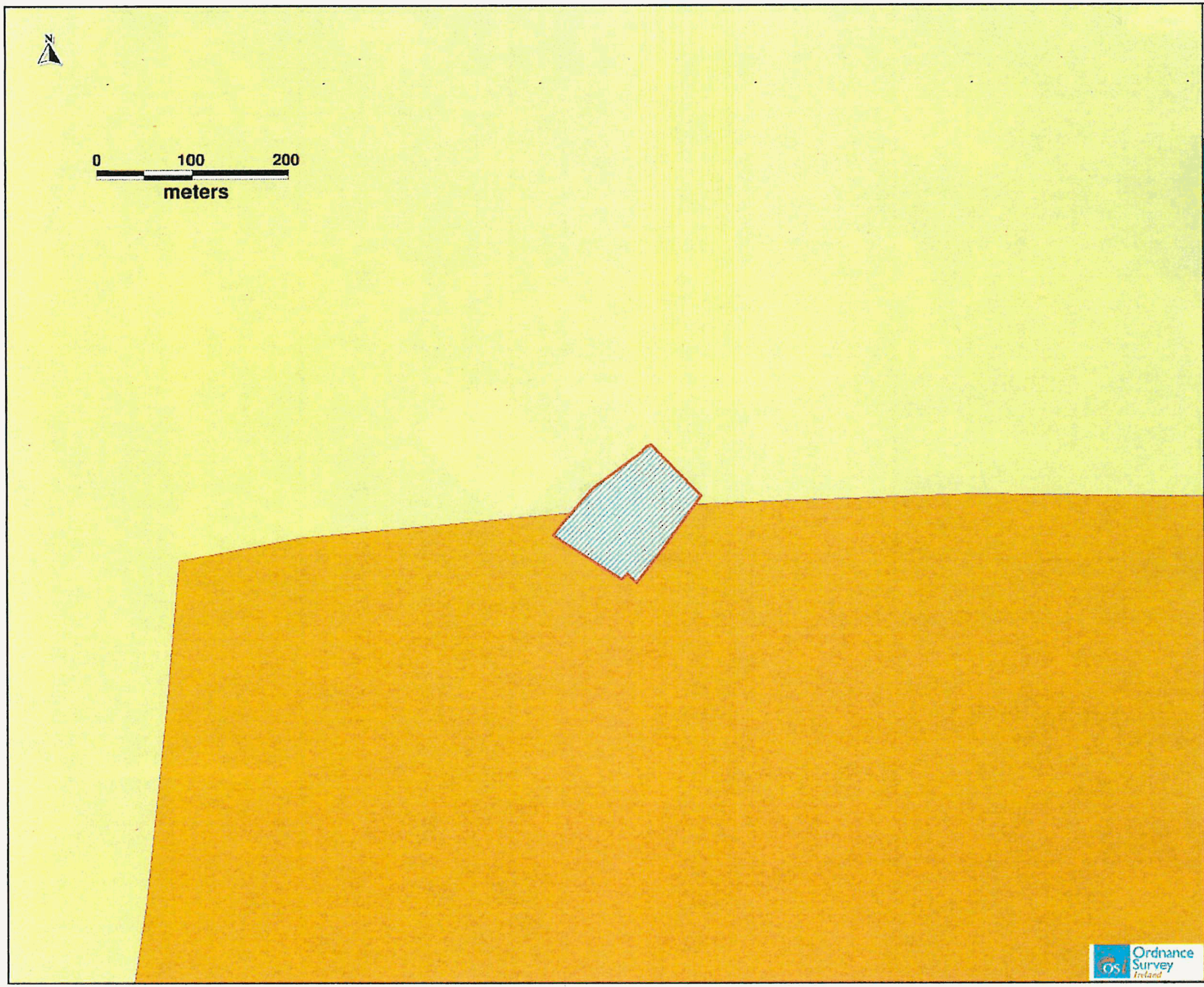
Checked:			
Approved:			
Scale:		Drawing No. 07/W_PA	Rev. 1
Date:			

Notes:



Cork County Council

Environment Directorate

Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description: Aquifer Map

Landfill Name & Reference No: Clountreem - 07/W

Division: West Cork

Area Office: Castletownbere

Legend

Landfilled Area

AQUIFER CATEGORY

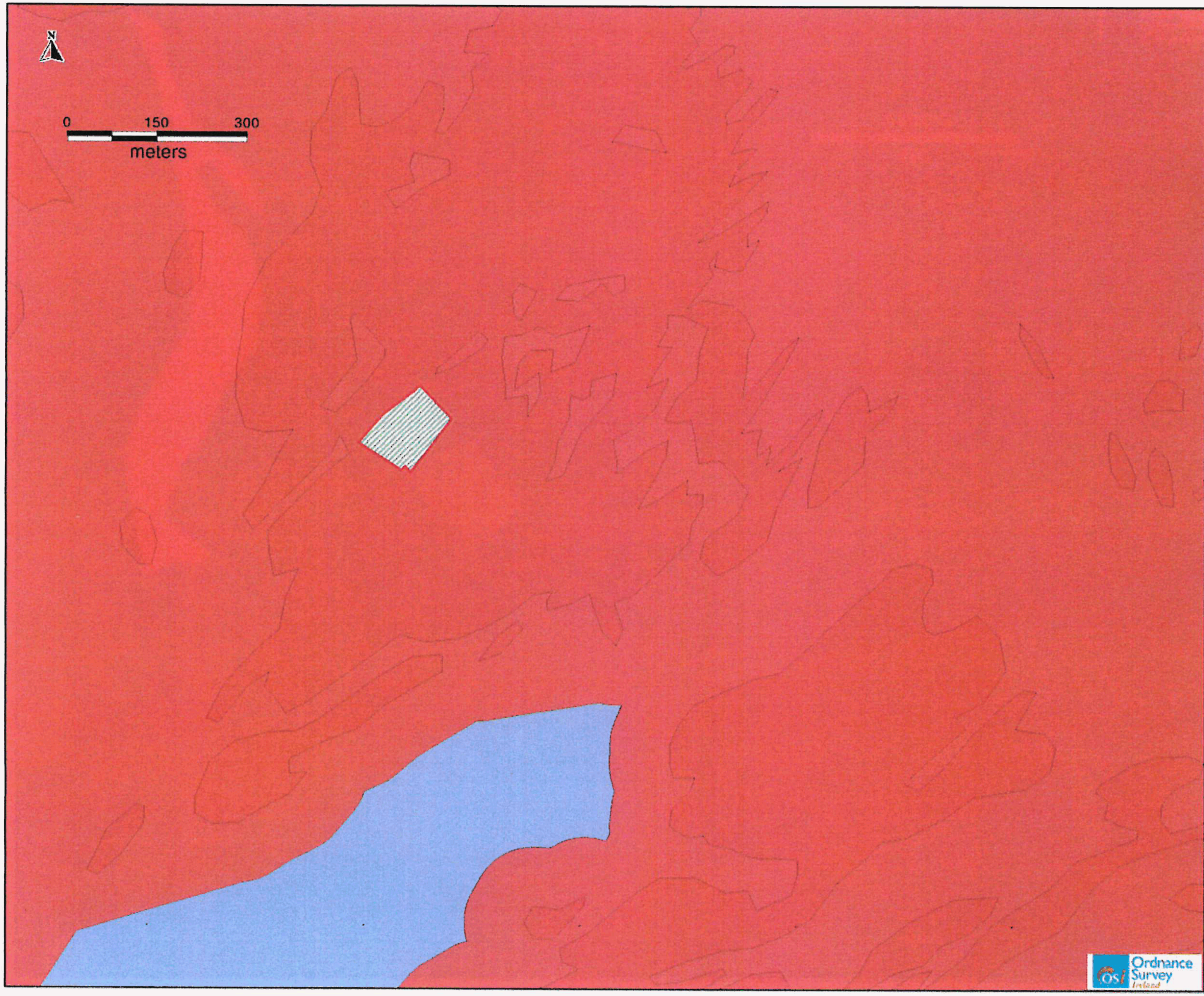
- Ll - Locally Important Aquifer
- Pending Classification
- Pl - Poor Bedrock Aquifer
- Pu - Poor Bedrock Aquifer
- Rf - Regionally Important Fissured Aqu.
- Rkd - Regionally Important Karst Aquifer

River

Issue Details

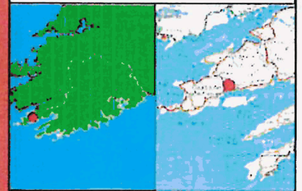
Drawn: AC	File Ref.		
Checked:			
Approved:			
Scale:	Drawing No. 07/W_AQ_1	Rev. 0	
Date: Feb 2006			

Notes
1. This drawing is the property of C.C.C. & is a confidential document and must not be copied, used or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE, use figured dimensions only, if in doubt ask.
4. Ordnance Survey Ireland Licence No. [illegible] Copyright Government of Ireland.



Cork County Council

Environment Directorate



Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:
Groundwater Vulnerability Map

Landfill Name & Reference No:
Clountreem - 07/W

Division:
West Cork

Area Office:
Castletownbere

Legend

Landfilled Area

SWRBD Groundwater Vulnerability

- X - Extreme (rock <1m from surface)
- E - Extreme (rock close to surface)
- H - High
- M - Moderate
- L - Low
- HL - High-Low
- Water

Issue Details

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Checked:			
Approved:			
Scale:		Drawing No. 07-W_GVM	Rev. 0
Date:			

Notes

Ordnance Survey Ireland

Cork County Council

Environment Directorate

Project: *Environmental Risk Assessment for Unregulated Waste disposal Sites*

Tier 1 Investigation

Drawing Description: **Subsoils Map**

Landfill Name & Reference No: **Clountreem - 07/W**

Division: **West Cork**

Area Office: **Castletownbere**

Legend

Subsoil Type

Alluvium	Mbs
AcEsk	Mesc
BktPt	MGs
Cut	Msi
FenPt	Rck
GDCSs	Scree
GDSs	TDCSsS
GLs	TolMr
GNSSs	TDSs
IrSTDSs	TLPSsS
KaRck	TLs
L	TNSSs
Made	Water
Marsh	Ws

Issue Details

Drawn: AC		File Ref.: 07/W_SS_1	
Checked:			
Approved:			
Scale:		Drawing No.: 07-W_SSM_1	Rev.: 0
Date: Feb 2006			

Notes

EPA COP MAIN SITE INVESTIGATION REQUIREMENTS FOR MODERATE RISK (CLASS B 40% TO 69%) AND HIGH RISK (CLASS A > 70%) FOR UNREGULATED WASTE DISPOSAL SITES.

IMPORTANT NOTE: THIS IS A GENERAL GUIDE TO IDENTIFY SUITABLE SITE INVESTIGATION (SI) METHODS FOR MODERATE & HIGH RISK WASTE SITES, AS IDENTIFIED BY THE EPA COP RISK CLASSIFICATION FROM THE COMPLETED TIER 1 & INITIAL TIER 2 EXPLORATORY INVESTIGATIONS. EACH PHASE OF INVESTIGATION WILL DEVELOP THE CONCEPTUAL SITE MODEL (CSM) AND SHOULD GUIDE THE DESIGN OF THE NEXT PHASE OF INVESTIGATION & ULTIMATELY THE REMEDIATION. THE APPLICATION OF THE INVESTIGATION PROGRAM AND METHODOLOGIES SHOULD BE COMPLETED IN ACCORDANCE WITH THE RELEVANT GUIDANCE DOCUMENTS AND STANDARDS AND BE UNDERTAKEN BY EXPERIENCED PRACTITIONERS.

The selection of site investigation techniques should be focused on what SPR Linkage is being examined & the site/ground conditions - in some cases a combination of techniques may be required and/or additional trial pitting considered necessary

SPR LINKAGE	SOURCE	PATHWAY	RECEPTOR	TIER 2: MAIN INVESTIGATION					TIER 2 PROBE AND/OR BOREHOLE SAMPLING						TIER 2 SPECIALIST SURVEYS		
				SHALLOW PROBES/HAND AUGERS	GEOPHYSICS/ INFRA RED SURVEYS	WINDOW SAMPLING	CABLE PERCUSSION BORING	AIR ROTARY OPEN OR CORED HOLE	GAS SAMPLING	LEACHATE SAMPLING	SOIL SAMPLING	SURFACE WATER SAMPLING	GROUNDWATER SAMPLING	PUMPING TEST	ECOLOGICAL SURVEYS	SURFACE WATER SURVEYS	ODOUR/DUST or ASBESTOS SURVEYS
SPR LINKAGE	SOURCE	PATHWAY	RECEPTOR	Manual or mechanical installation of temporary probes for gas monitoring (typically 1m-6m) & use of landfill gas analyser and/or FID to determine concentrations - may give limited soil profile and strength information.	Range of techniques for waste extent, depth, plumes & anomalies - can be influenced by power cables, unsuitable ground conditions, poor interpretation, needs ground proofing.	Continuous/semi-continuous shallow soil sampling, permeability testing & standpipe installation for GW monitoring & gas taps. Ground conditions can limit depth.	Also called Shell & Auger (S&A) drilling - deeper soil sampling, permeability testing & standpipe installation for GW monitoring & gas taps. Can be limited by boulders/obstructions. No bedrock penetration.	Destructive drilling, chip sampling & standpipe installation for GW monitoring, permeability testing & gas taps. Very limited subsoil or waste sampling. Coring used for bedrock logging, rock quality/fracture logging.	Gas Sampling using taps, Gresham Tubes etc.	Sampling main boreholes in waste and giving data on List I & List II substances contamination - Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	Soil sampling to assess permeability potential of surrounding materials (leachate or gas pathway assessment). Soil contamination assessment may be required and assessment potential for local material to be used for remediation/capping. Detailed borehole logs should be completed.	List I & List II substances contamination assessment in SW & seepage locations. Sampling locations for surface water discharges from shallow GW wells and surface water courses (SPR 6). Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	List I & List II substances contamination assessment GW flow direction. Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	Enables GW sampling for List I & List II substances contamination assessment, relevant water standards & GW flow regime & direction.	Habitat assessment, surface water Q quality rating, ecological significance - surveys should be risk specific.	Water levels, flow rates, assimilative capacity, hydrology studies	Only required if odours, dust and asbestos are identified as potential problem during Tier 1 and Tier 2 works.
SPR LINKAGE	SOURCE	PATHWAY	RECEPTOR		The necessity for a Geophysical survey will be assessed following the trial pit survey	The requirement for window sampling will be assessed following trial pit survey	Not suitable for this site.	Estimated Price for 3No. 20m borewells. Access to the top of the site will be assessed.	No gas sampling is required although it will be tested.	1No. Leachate sample full suite and 2No. Minor suite.	No soil sample as completed in trial pit survey	1No. Major Suite, 2No. Minor suite	1No. Major suite	Requirement for Pump test will be assessed during the Investigation.	CCC Staff will cary out an ecological survey on the stream.	Basic Surface water test. Weir Carried out by CCC staff.	Asbestos survey will be dependant on what is found during the trial pit survey
SPR 1	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body	N	S	R/S	R/S	R/S	N	R	R	R	R/S	S	S	S	N
SPR 2	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	N	S	R/S	R/S	R/S	N	R	R	R	R/S	S	R/S	R	N
SPR 3	LEACHATE	Vertical & Horizontal Groundwater Migration	Human Presence (Private Well)	N	S	N	S	R	N	S	S	N	R	S	N	N	N
SPR 4	LEACHATE	Vertical & Horizontal Groundwater Migration	Groundwater Protected Area (GWDTE)	N	S	N	S	R	N	S	S	S	R	S	R	N	N
SPR 5	LEACHATE	Vertical & Horizontal Groundwater Migration	Aquifer Category	N	S	N	S	R	N	R	R	N	R	R/S	N	N	N
SPR 6	LEACHATE	Vertical & Horizontal Groundwater Migration	Public Supply (Well) (includes Group Water Schemes)	N	S	N	S	R	N	R	R	S	R	R/S	N	S	N
SPR 7	LEACHATE	Vertical & Horizontal Groundwater Migration	Surface Water Body	N	S	S	S	R	N	R	R	R	R	S	S	R	N
SPR 8	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body	N	S	R/S	R/S	N	N	R	R	R	N	N	S	R	N
SPR 9	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	N	S	R/S	R/S	N	N	R	R	R	N	N	R	R	N
SPR 10	LANDFILL GAS	Lateral Migration (Subsoil)	Human Presence	R	S	S	S	S	R/S	N	N	N	N	N	N	N	S
SPR 11	LANDFILL GAS	Vertical Migration (Subsoil)	Human Presence	R	S	S	S	S	R/S	N	N	N	N	N	N	N	S
Source & Pathway & Receptor Parameters Targeted for CSM & Risk Screening & Remediation.				waste type, footprint, soil type, thickness, strength. Suitable for gas monitoring and gas migration potential.	waste type/volume, waste footprint, depth to bedrock, groundwater vulnerability, horizontal pathway - plume migration.	waste type, groundwater vulnerability/level, gas migration potential	waste type, groundwater vulnerability/level, flow direction & resource potential, horizontal pathway, gas migration potential.	groundwater vulnerability/level & flow direction & resource potential, horizontal pathway, gas migration potential.	waste type, gas migration potential	waste type, leachate potential and gas migration potential.	soil type, permeability, leachate & gas migration potential, ground vulnerability, horizontal pathway. May also assist in assessing reuse of material for remediation.	surface water receptor and pathway information.	groundwater receptor and horizontal pathway information.	groundwater resource potential, flow direction, horizontal pathway	surface water pathway, groundwater vulnerability & horizontal pathway	surface water pathway	Air Pathway
General comments regarding techniques & COP Section Reference - Note: the development of the CSM and design of the site investigation should involve an experienced SI practitioner.				Gas monitoring should be considered if trial pit phase identifies gas potential, thin/no capping and human presence exists. Section 5.5.3 of COP.	Geophysics should be considered for areas where extent of waste is unclear and where shallow plumes may be impacting on surface waters. Advantage of covering large areas and is not intrusive. Needs ground proofing. Section 5.5.1.2 of COP.	Window sampling option should be considered for shallow boreholes in ground without obstructions (as identified from Trial Pit Survey). Use boreholes for sampling, water/leachate & gas monitoring.	S&A drilling can be completed after or instead of window sampling if more accessible or deeper depth required. Use boreholes for sampling water/leachate & gas monitoring. Section 5.5.2 of COP.	Aquifer category work based on GSI well survey data & rotary drilling. Recommend minimum of three GW level locations are available for flow direction calculation - use of data loggers to confirm levels and/or possible linkage. Core drilling rarely used unless RQD needed. Design and proper grouting of wells is important. Use boreholes for sampling water/leachate & gas monitoring. Section 5.5.2 of COP.	Should be considered where landfill gas identified as risk to receptors. Complete as per best practice and relevant guidelines. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Section 7.	Characterise waste type and leachate to evaluate the migration potential. Complete as per best practice and relevant guidelines. Section 5.5.3 of COP. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Section 6.	Characterise soil type and if contamination present, characterise geology and permeability. Refer to relevant guidelines and Standards. Section 5.5.3 of COP.	Should be completed as per best practice and relevant guidelines. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Section 4.	Should be completed as per best practice and relevant guidelines. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Section 5.	Generally step test should be followed by longer CRT test to determine aquifer characteristics and potential linkages. Level loggers should be used.	Should be considered for SAC/SPA, wetlands and surface waters - if surface water body is part of salmonid (Q Index) or riverine catchment then ecology survey should be considered. Consultation with NPWS may be required. Where applicable use existing data from EPA/NPWS or local authority sources. Refer to Section 5.5.1.3 and Appendix 4 of COP.	Catchment assessment, hydrology works, flow studies should all be considered. Consultation with Fisheries may be beneficial.	Standard dust/gas & specific odour surveys should be considered. Complete as per best practice and relevant guidelines. Refer to EPA Landfill Monitoring Guidelines 2nd Edition 2003, especially Sections 8 and 10.
Provisional Guidance on Minimum Extent of Testing/Sampling - (sampling totals will depend on the type of risk identified, size of site, extent & volume of waste, ground conditions, variability of the waste material, etc.)				Number of probes will depend on extent of survey and depth of probe.	Will depend on the nature and extent of the waste and type of survey being undertaken. Needs to be site specific assessment scoped and completed by experienced and qualified contractors.	Number of probes will depend on survey area, ground conditions and depth of completion. If suitable ground exists typically, three-five metre boreholes are possible per day.	Number of boreholes will depend on survey area, ground conditions and depth of completion. Rough average 15m of drilling typically completed per day.	Number of boreholes will depend on extent of waste and location of receptors. Completion rate will be impacted by installations and grouting. Approximately 75m of drilling and coring can be completed per day.	Will depend on extent and nature of gases and receptors. Should be decided on a site specific basis.	Will depend on nature and composition of the waste and number of investigation points. Full screen testing as per Table C.2 of EPA Landfill Monitoring Manual 2003, indicator parameters include pH, Conductivity, Temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium.	Will depend on the variability of the soil and geology. Ground variability will require more sampling. In-situ permeability and strength (SPT) tests and soil assessment for remediation use should be considered.	Sample upstream and downstream locations as per Table C.2 of EPA Landfill Monitoring Manual 2003. Basic indicator parameters include pH, Conductivity, Temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium.	Sample at all borehole locations. Full screen as per Table C.2 of EPA Landfill Monitoring Manual 2003. Basic indicator parameters include pH, Conductivity, Temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium.	Pumping tests are important for assessing pathways and confirming linkages and should be completed if possible.	Quantified on a site specific basis. For high risk sites functional values for the habitat may need to be assessed.	Quantified on a site specific basis.	Quantified on a site specific basis.
MODERATE RISK SITES				Initial one day probe survey should be considered for moderate gas risk sites.	Less coverage and survey duration would be expected for moderate risk sites when compared to high risk sites.	Minimum of one day should be considered.	Minimum three to five locations should be considered.	Minimum of one down gradient borehole required for moderate risk sites.	Less gas monitoring locations would be expected to be required for moderate risk sites when compared to high risk sites.	One full suite and indicator parameters at a minimum of three locations.	The No. of samples should be determined by the site specific requirements.	Full suite on downstream locations and indicator parameters at upstream location.	Full suite on nearest down gradient borehole and indicator parameters at all other relevant groundwater locations.	Step test and minimum of 72 hour test should be ideally considered.	Surveys should be determined by the site specific requirements. In general moderate risk sites would be expected to require a less extensive scope of works to be completed.	Quantified on a site specific basis. In general moderate risk sites would be expected to require a less extensive scope of works to be completed.	Quantified on a site specific basis. In general moderate risk sites would be expected to require a less extensive scope of works to be completed.
HIGH RISK SITES				Initial two day probe survey should be considered for moderate gas risk sites.		Minimum of two days should be considered.	Minimum three to five locations should be considered.	Minimum of three boreholes are required for high risk sites.		Minimum of two full suite and indicator parameters at all other suitable locations.		Full suite on up and down stream locations and indicator parameters at any other relevant surface locations.	Full suite on up gradient and down gradient boreholes and indicator parameters at all other relevant groundwater locations.	Step test and 5 to 7 day test should be ideally be completed.			

AFTER TIER 2 MAIN INVESTIGATION, REFINE CONCEPTUAL SITE MODEL, CONFIRM RISK CLASSIFICATION & PROGRESS TO QRA & REMEDIATION PHASE

R = Recommended technique assuming site conditions allow.

S = Should be considered but is dependent on site suitability for that methodology.

N = Not recommended, but may occasionally be suitable.

RQD = Rock Quality Designation	BGL = Below Ground Level	GSI = Geological Survey of Ireland
CSM = Conceptual Site Model	SI = Site Investigation	CRT = Constant Rate Test
NPWS = National Parks and Wildlife Service	GW = Groundwater	QRA = Quantitative Risk Assessment

ISSUED: WORKING DRAFT

DATE: 17 Sep 09

COMPILED BY: [illegible]

Appendix 3

Trial Pit and Groundwater Well Logs

Borehole Log

PRELIMINARY

CLOUNTREEM GROUNDWATER WELL NO.1 (GW1)

GEOTECH

Drilled MN Logged Checked	Start 20/11/2009 End 20/11/2009	Equipment, Methods and Remarks Casagrande C6 Rotary Open Hole 175mm diameter from 0.00m to 10.50m. 50mm standpipe with filter wrap installed	Depth from 0.00m to 10.50m	Diameter 175mm	Casing Depth 4.00m

Ground Level -
Coordinates -
National Grid -
Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Driller Reports: BOULDERS.	(0.60)		
Driller Reports: CLAY / BOULDERS.	0.60 (0.70)		
Driller Reports: Broken ROCK.	1.30 (1.20)		1
Driller Reports: ROCK with CLAY bands.	2.50 (0.60)		
Driller Reports: ROCK.	3.10 (7.40)		
Stratum continues to 10.50 m			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	1.60	-	-

Depth Related Remarks

From	to (m)	
0.00	10.50	Flush type: Air.

Chiselling

Depths (m) | Time | Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Landfill SI at Dunmanway & Clonakilty
Project No.: KC9075
Carried out for: Cork County Council

Borehole
BH01 - C
Sheet 1 of 2

PRELIMINARY

Borehole Log

GEOTECH

Drilled MN	Start 20/11/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	End	Casagrande C6	0.00m	10.50m	175mm	4.00m	Coordinates	-
Checked	20/11/2009	Rotary Open Hole 175mm diameter from 0.00m to 10.50m 50mm standpipe with filter wrap installed					National Grid	-
							Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
			20/11/2009 4.00	1800

Strata

Description (Continued from Sheet 1)	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Driller Reports: ROCK.			SP
EXPLORATORY HOLE ENDS AT 10.50 m	10.50		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	Landfill Sf at Dunmanway & Clonakilty
Project No.	KC9075
Carried out for	Cork County Council

Borehole

BH01 - C

Sheet 2 of 2

Borehole Log

PRELIMINARY

CLOUNTREEM GROUNDWATER WELL NO.1 (GW2)

GEOTECH

Drilled MN Logged Checked	Start 24/11/2009 End 24/11/2009	**Equipment, Methods and Remarks** Casagrande C6 Rotary Open Hole 175mm diameter from 0.00m to 3.00m. 50mm standpipe installed.	**Depth from / to / Diameter / Casing Depth** 0.00m / 3.00m / 175mm / 3.00m	Ground Level - Coordinates - National Grid - Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
			24/11/2009 3.00	1800 0.20

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Driller Reports: MADE GROUND - Fill.	(0.60)		
Driller Reports: MADE GROUND - Waste landfill.	0.60		1
	(2.40)		
EXPLORATORY HOLE ENDS AT 3.00 m	3.00		SP

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	0.70	-	-

Depth Related Remarks

From	to (m)	
0.00	3.00	Flush type. Air.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	Landfill SI at Dunmanway & Clonakilty
Project No.	KC9075
Carried out for	Cork County Council

Borehole

BH02 - D

Sheet 1 of 1

PRELIMINARY

Borehole Log

Drilled MN Logged Checked	Start 23/11/2009 End 23/11/2009	Equipment, Methods and Remarks Casagrande C6 Rotary Open Hole 175mm diameter from 0.00m to 10.50m. 50mm standpipe with filter wrap installed	Depth from 0.00m, to 10.50m, Diameter 175mm, Casing Depth 2.50m	Ground Level - Coordinates - National Grid - Chainage

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
					Driller Reports: MADE GROUND - CLAY / Fill.	(0.80) 0.80		
					Driller Reports: Weathered ROCK.	(0.30) 1.10		
					Driller Reports: ROCK.	(9.40)		
Depth	Type & No	Records	Date Casing	Time Water	Stratum continues to 10.50 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	2.50	-	-
2	3.50	-	-

Depth Related Remarks

From	to (m)	
0.00	10.50	Flush type: Air.

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Landfill SI at Dunmanway & Clonakilty

Project No.: KC9075

Carried out for: Cork County Council

Borehole **BH02 - C**

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

Trial Pit Number: TP-1

Project: 09-039-01 | Completion Depth: 3.5m

Client: Cork Co. Co. | Groundwater entry: 2.1m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising plastics, textiles, glass, papers, steel roof sheeting, steel pipes, concrete and fishing nets. Water entry to hole at 2.1m		Composite Sample	0ppm
1				
2	***Clay*** Orange and grey gravelly Clay.			
3	***Rock*** Weathered and broken green sandstone.			
4				

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 29/10/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-2

Project: 09-039-01

Client: Cork Co. Co.

Location: Cloontreem

Completion Depth: 1.2m

Groundwater entry: -

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising plastics, papers, rocks, blocks, glass, fishing nets, timber.		Composite Sample	0ppm
1	***Rock*** Weathered and broken green sandstone.			

Excavation Method: 20 Tonne Track Mounted Excavtor

Geologist: B. Sexton

Excavation Date: 29/10/2009

Sheet: 1 of 1

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

Trial Pit Number: TP-3

Project: 09-039-01 | Completion Depth: 6.3m

Client: Cork Co. Co. | Groundwater entry: 2.8m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising plastic bags, timber, glass, wiring, steel pipes, plastic pipes and bottles, ropes, concrete, empty plastic drums, radiators, tyres and a car/truck battery. Water entry to hole at 2.8m		Composite Sample	0ppm
6	***Peat*** Peaty material with rootlets. Original ground. Material was not saturated.			
7				

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 29/10/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-4

Project: 09-039-01 | Completion Depth: 6.8m

Client: Cork Co. Co. | Groundwater entry: 2.9m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
1	**Clay** Brown stiff sandy gravelly Clay with minor amounts of waste including timber and concrete.			
2	**Waste** Waste comprising plastic bags and bottles, glass, steel, radiators, empty plastic drums, rope, fishing nets, steel rods and wiring, car battery, a washing machine. Water entry to hole at 2.9m			
3			Composite Sample	0ppm
4				
5				
6				
7	**Peat** Peaty material with rootlets. Original ground. Material was not saturated.			

Excavation Method: 20 Tonne Track Mounted Excavtor

Geologist: B. Sexton

Excavation Date: 29/10/2009

Sheet: 1 of 1

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

Trial Pit Number: TP-5

Project: 09-039-01

Client: Cork Co. Co.

Location: Cloontreem

Completion Depth: 5.4m

Groundwater entry: 1.8m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
1	***Waste*** Waste comprising plastic bags, bottles and drums, concrete, ropes, fishing nets, rocks, timber, steel piping, steel tubing, radiators, steel roof sheeting. Water entry to hole at 1.8m		Composite Sample	15ppm
2				
3				
4				
5	***Rock*** Green Sandstone.			
6				

Excavation Method: 20 Tonne Track Mounted Excavtor

Geologist: B. Sexton

Excavation Date: 29/10/2009

Sheet: 1 of 1

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

Trial Pit Number: TP-6

Project: 09-039-01 | Completion Depth: 4.9

Client: Cork Co. Co. | Groundwater entry: 2.4m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising plastic wraping, sheets, bottles and bags, glass, timber, fishing nets, ropes, steel pipes, empty steel drums. Water entry to hole at 2.4m.		Composite Sample	0ppm
5	***Rock*** Green Sandstone.			

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 29/10/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-7

Project: 09-039-01

Client: Cork Co. Co.

Location: Cloontreem

Completion Depth: 3.6m

Groundwater entry: 1.4m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising plastic bags wrapping, bottles and empty drums, glass, timber, steel cable, steel sheeting, ropes and tyres.			
1	Water entry to hole at 1.4m			
			Composite Sample	0ppm
2				
3				
	Peat Peaty material with rootlets. Original ground. Material was not saturated.			
4				

Excavation Method: 20 Tonne Track Mounted Excavtor

Geologist: B. Sexton

Excavation Date: 29/10/2009

Sheet: 1 of 1

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

Trial Pit Number: TP-8

Project: 09-039-01 | Completion Depth: 4.1m

Client: Cork Co. Co. | Groundwater entry: 1.1m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Clay Brown stiff sandy gravelly Clay with minor amounts of waste including timber and concrete.			
1	***Waste*** Waste comprising plastics, blocks, concrete, steel, fishing nets, ropes, radiators, truck wheel rims and tyres. Water entry to hole at 1.1m		Composite Sample	0ppm
2				
3				
4	***Peat*** Peaty material with rootlets. Original ground. Material was not saturated.			

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 29/10/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-9

Project: 09-039-01 | Completion Depth: 5.4m

Client: Cork Co. Co. | Groundwater entry: 1.3m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising plastic bags, bottles and wrapping, glass, fishing nets, car parts, ropes, blocks and papers.			
1	Water entry to hole at 1.3m		Composite Sample	0ppm
2				
3				
4				
5	***Peat*** Peaty material with rootlets. Original ground. Material was not saturated.			
6				

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 30/11/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-10

Project: 09-039-01 | Completion Depth: 4.5m

Client: Cork Co. Co. | Groundwater entry: 1.9m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising fishing nets, plastic bags, wrapping and bottles, tibmber, steel fragments, car parts, tyres, glass bottles, concrete, blocks and bricks, empty steel drums and radiators. Water entry to hole at 1.9m		Composite Sample	0ppm
1				
2				
3				
4				
	Peat Peaty material with rootlets. Original ground. Material was not saturated.			
5				

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 30/11/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-11

Project: 09-039-01 | Completion Depth: 1.8m

Client: Cork Co. Co. | Groundwater entry: 0.9m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising fishing nets, plastic bags, wrapping and bottles, tibmber, concrete, blocks and bricks.			
	Water entry to hole at 0.9m		Composite Sample	0ppm
1				
	Rock Weathered and very broken green sandstone.			
2				

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 30/11/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-12

Project: 09-039-01 | Completion Depth: 3.1m

Client: Cork Co. Co. | Groundwater entry: 1.4m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising fishing nets, plastics bags and wrapping, ropes, timber, papers, glass bottles, wiring, steel pipes and steel cables. Water entry to hole at 1.4m		Composite Sample	0ppm
1				
2				
3	***Peat*** Peaty material with rootlets. Original ground. Material was not saturated.			

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 30/11/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-13

Project: 09-039-01

Client: Cork Co. Co.

Location: Cloontreem

Completion Depth: 4.8m

Groundwater entry: 2.1m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising plastic bags, wrapping and bottles, fishing nets, rpoes, timber, glass bottles, steel pipes, car parts, tyres, plastic pipes, concrete pipe, car wheels, steel roof sheeting.			
1	Water entry to hole at 2.1m		Composite Sample	0ppm
2				
3				
4				
	Peat Peaty material with rootlets. Original ground. Material was not saturated.			
5				

Excavation Method: 20 Tonne Track Mounted Excavtor

Geologist: B. Sexton

Excavation Date: 30/11/2009

Sheet: 1 of 1

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

Trial Pit Number: TP-14

Project: 09-039-01 | Completion Depth: 4.1m

Client: Cork Co. Co. | Groundwater entry: -

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising steel roof sheeting, empty steel drums, car parts, plastic bags, empty plastic drums, car chassis, ropes, glass bottles, fishing nets, concrete and tyres. No water entry noted in hole.		Composite Sample	0ppm
4	***Peat*** Peaty material with rootlets. Original ground. Material was not saturated.			

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 30/11/2009 | Sheet: 1 of 1

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

Trial Pit Number: TP-15

Project: 09-039-01 | Completion Depth: 3.7m

Client: Cork Co. Co. | Groundwater entry: 1.4m

Location: Cloontreem | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Topsoil Brown sandy gravelly Clay.			
	Waste Waste comprising plastic and glass bottles, steel fragments, car parts, truck tyres, timber and concrete. Water entry to hole at 1.4m.		Composite Sample	0ppm
3	***Peat*** Peaty material with rootlets. Original ground. Material was not saturated.			
4				

Excavation Method: 20 Tonne Track Mounted Excavtor | Geologist: B. Sexton

Excavation Date: 30/11/2009 | Sheet: 1 of 1

Appendix 4

Full Laboratory Reports

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Unit 35,
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Co Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email: info@euroenv.ie

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Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Inniscarra Co Cork	*Lab Report Ref. No.*	1128/025/06S
		Date of Receipt	31/10/2009
		Date Testing Commenced	31/10/2009
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	16/12/2009
Customer Ref	Clountream SW 3 30/10/09	*Sample Type*	Surface Water

CERTIFICATE OF ANALYSIS - Supplementary

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Alkalinity (Surface Water)	102	Colorimetry	62	mg/L CaCO3	UKAS
Ammonia (Surface Water)	114	Colorimetry	1.30	mg/L as N	UKAS
Arsenic (Surface Water)	177	ICPMS	<0.2	ug/L	UKAS
Atrazine	191	HPLC	<0.01	ug/L	
BOD (Surface Water)	113	Electrometry	<2	mg/L	UKAS
Boron (Surface Water)	177	ICPMS	60	ug/L	UKAS
Cadmium (Surface Water)	177	ICPMS	<0.1	ug/L	UKAS
Calcium	184	ICPMS	22.30	mg/L	
Chloride (Surface Water)	100	Colorimetry	21.75	mg/L	UKAS
Chromium (Surface Water)	177	ICPMS	<1	ug/L	UKAS
COD (Surface Water)	107	Colorimetry	14	mg/L	UKAS
Coliforms (Faecal)	140	Filtration/ Incubation 44C/ 24	71	no/ 100ml	
Coliforms (Total)	140	Filtration/ Incubation 37C/ 24	72	no/ 100ml	
Conductivity (Surface Water)	112	Electrometry	217	uscm -1@25C	UKAS
Copper (Surface Water)	177	ICPMS	0	ug/L	UKAS
Cyanide	138	Colorimetry	<5	ug/L	
Dichloromethane	154	GCMS	<1	ug/L	
Fluoride (Surface Water)	115	Colorimetry	0.15	mg/L	UKAS
Iron (Surfacewater)	177	ICPMS	2841	ug/L	
Lead (Surface Water)	177	ICPMS	1	ug/L	UKAS
Magnesium	184	ICPMS	4.10	mg/L	
Manganese (Surface Water)	177	ICPMS	256	ug/L	UKAS
Mercury	178	ICPMS	<0.02	ug/L	
Nickel	177	ICPMS	3.0	ug/L	
Nitrogen (Total Oxidised) (Surface	151	Colorimetry	0.70	mg/L as N	UKAS

Signed : D Heslin *Date :* 16/12/09

Donna Heslin - Laboratory Manager

Acc Accredited Parameters by ISO 17025:2005

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Web: www.euroenv.ie
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Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/025/06S
		Date of Receipt	31/10/2009
		Date Testing Commenced	31/10/2009
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	16/12/2009
Customer Ref	Clountream SW 3 30/10/09	*Sample Type*	Surface Water

CERTIFICATE OF ANALYSIS - Supplementary

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
pH (Surface Water)	110	Electrometry	7.5	pH Units	UKAS
Phosphate (Ortho) Surface Water	117	Colorimetry	0.008	mg/L as P	UKAS
Potassium	184	ICPMS	1.90	mg/L	
Simazine	191	HPLC	<0.01	ug/L	
Sodium	184	ICPMS	11.10	mg/L	
Solids (Total Dissolved)	105	Filtration/ Evaporation @ 180	109	mg/L	
Solids (Total Suspended)	106	Filtration/ Drying @ 104C	5	mg/L	
Sulphate	119	Colorimetry	<1.39	mg/L as SO4	
Toluene	179	GCMS	<0.28	ug/L	
Total Organic Carbon	316	TOC analyser (NPOC)	5.60	mg/L	
Tributyltin	0	GCMS	<0.03	ug/L as Sn	
Xylene (Total)	179	GCMS	<1	ug/L	
Zinc (Surface Water)	177	ICPMS	4	ug/L	UKAS

Signed : DHeslin *Date :* 16/12/09.

Donna Heslin - Laboratory Manager

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		Date of Receipt	31/10/2009
		Date Testing Commenced	31/10/2009
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	12/11/2009
Customer Ref	Clountream Leachate 1 30/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia	114	Colorimetry	84.79	mg/L as N	
Arsenic	177	ICPMS	6.2	ug/L	
BOD	113	Electrometry	15	mg/L	
Boron	177	ICPMS	540.0	ug/L	
Cadmium	177	ICPMS	2	ug/L	
Calcium	184	ICPMS	82.00	mg/L	
Chloride	100	Colorimetry	55.35	mg/L	
Chromium	177	ICPMS	10.5	ug/L	
Conductivity	112	Electrometry	1030.0	uscm -1@25C	
Copper	177	ICPMS	<0.2	ug/L	
Iron (Total)	177	ICPMS	13950.0	ug/L	
Lead	177	ICPMS	148.0	ug/L	
Magnesium	184	ICPMS	18.60	mg/L	
Manganese	177	ICPMS	1865.0	ug/L	
Mercury	178	ICPMS	0.2	ug/L	
Nickel	177	ICPMS	13.9	ug/L	
pH	110	Electrometry	6.9	pH Units	
Potassium	184	ICPMS	24.60	mg/L	
Sodium	184	ICPMS	40.40	mg/L	
Sulphate	119	Colorimetry	7.31	mg/L as SO4	
Zinc	177	ICPMS	509.0	ug/L	

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

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		Date Testing Commenced	31/10/2009
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	12/11/2009
Customer Ref	Clountream Leachate 2 30/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia	114	Colorimetry	5.17	mg/L as N	
Arsenic	177	ICPMS	4.6	ug/L	
BOD	113	Electrometry	7	mg/L	
Boron	177	ICPMS	260.0	ug/L	
Cadmium	177	ICPMS	<0.1	ug/L	
Calcium	184	ICPMS	42.60	mg/L	
Chloride	100	Colorimetry	29.06	mg/L	
Chromium	177	ICPMS	8.2	ug/L	
Conductivity	112	Electrometry	350.0	uscm -1@25C	
Copper	177	ICPMS	<0.2	ug/L	
Iron (Total)	177	ICPMS	17690.0	ug/L	
Lead	177	ICPMS	106.0	ug/L	
Magnesium	184	ICPMS	6.50	mg/L	
Manganese	177	ICPMS	960.0	ug/L	
Mercury	178	ICPMS	0.1	ug/L	
Nickel	177	ICPMS	9.5	ug/L	
pH	110	Electrometry	6.6	pH Units	
Potassium	184	ICPMS	4.20	mg/L	
Sodium	184	ICPMS	12.20	mg/L	
Sulphate	119	Colorimetry	<1.39	mg/L as SO4	
Zinc	177	ICPMS	533.0	ug/L	

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		Date Testing Commenced	31/10/2009
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	12/11/2009
Customer Ref	Clountream Leachate 3 30/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia	114	Colorimetry	11.30	mg/L as N	
Arsenic	177	ICPMS	6.1	ug/L	
Atrazine	191	HPLC	<0.01	ug/L	
BOD	113	Electrometry	20	mg/L	
Boron	177	ICPMS	360.0	ug/L	
Cadmium	177	ICPMS	2	ug/L	
Calcium	184	ICPMS	61.10	mg/L	
Chloride	100	Colorimetry	51.42	mg/L	
Chromium	177	ICPMS	8.5	ug/L	
COD	107	Colorimetry	1510	mg/L	
Conductivity	112	Electrometry	567.0	uscm -1@25C	
Copper	177	ICPMS	<0.2	ug/L	
Cyanide	138	Colorimetry	20	ug/L	
Dichloromethane	154	GCMS	<1	ug/L	
Fluoride	115	Colorimetry	0.35	mg/L	
Iron (Total)	177	ICPMS	19420.0	ug/L	
Lead	177	ICPMS	293.0	ug/L	
Magnesium	184	ICPMS	9.10	mg/L	
Manganese	177	ICPMS	1838.0	ug/L	
Mercury	178	ICPMS	0.1	ug/L	
Nickel	177	ICPMS	16.3	ug/L	
Nitrogen (Total Oxidised)	151	Colorimetry	<0.03	mg/L as N	
pH	110	Electrometry	12.2	pH Units	
Phosphate (Ortho)	117	Colorimetry	0.760	mg/L as P	
Potassium	184	ICPMS	8.00	mg/L	

Signed : DHeslin *Date :* 12/11/09

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		Date of Receipt	31/10/2009
		Date Testing Commenced	31/10/2009
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	12/11/2009
Customer Ref	Clountream Leachate 3 30/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Simazine	191	HPLC	<0.01	ug/L	
Sodium	184	ICPMS	16.50	mg/L	
Sulphate	119	Colorimetry	5.30	mg/L as SO4	
Toluene	179	GCMS	<0.28	ug/L	
"Tributyltin"	0	GCMS	<1.50	ug/L as Sn	
Xylene (Total)	179	GCMS	<1	ug/L	
Zinc	177	ICPMS	895.0	ug/L	

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

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		Date of Receipt	31/10/2009
		Date Testing Commenced	31/10/2009
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	12/11/2009
Customer Ref	Clountream SW 1 30/10/09	*Sample Type*	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia (Surface Water)	114	Colorimetry	0.03	mg/L as N	UKAS
Arsenic (Surface Water)	177	ICPMS	<0.2	ug/L	UKAS
BOD (Surface Water)	113	Electrometry	<2	mg/L	UKAS
Boron (Surface Water)	177	ICPMS	70	ug/L	UKAS
Cadmium (Surface Water)	177	ICPMS	<0.1	ug/L	UKAS
Calcium	184	ICPMS	6.80	mg/L	
Chloride (Surface Water)	100	Colorimetry	18.44	mg/L	UKAS
Chromium (Surface Water)	177	ICPMS	<1	ug/L	UKAS
Conductivity (Surface Water)	112	Electrometry	84	iscm -1@25C	UKAS
Copper (Surface Water)	177	ICPMS	0	ug/L	UKAS
Iron (Surfacewater)	177	ICPMS	231	ug/L	UKAS
Lead (Surface Water)	177	ICPMS	2	ug/L	UKAS
Magnesium	184	ICPMS	2.40	mg/L	
Manganese (Surface Water)	177	ICPMS	22	ug/L	UKAS
Mercury	178	ICPMS	<0.02	ug/L	
Nickel (Surface Water)	177	ICPMS	2	ug/L	UKAS
pH (Surface Water)	110	Electrometry	7	pH Units	UKAS
Potassium	184	ICPMS	0.3	mg/L	
Sodium	184	ICPMS	8.90	mg/L	
Sulphate	119	Colorimetry	<1.39	mg/L as SO4	
Zinc (Surface Water)	177	ICPMS	5	ug/L	UKAS

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

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		Date of Receipt	31/10/2009
		Date Testing Commenced	31/10/2009
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	12/11/2009
Customer Ref	Clountream SW 2 30/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia (Surface Water)	114	Colorimetry	2.74	mg/L as N	UKAS
Arsenic (Surface Water)	177	ICPMS	<0.2	ug/L	UKAS
BOD (Surface Water)	113	Electrometry	<2	mg/L	UKAS
Boron (Surface Water)	177	ICPMS	180	ug/L	UKAS
Cadmium (Surface Water)	177	ICPMS	<0.1	ug/L	UKAS
Calcium	184	ICPMS	27.50	mg/L	
Chloride (Surface Water)	100	Colorimetry	22.28	mg/L	UKAS
Chromium (Surface Water)	177	ICPMS	<1	ug/L	UKAS
Conductivity (Surface Water)	112	Electrometry	258	uscm -1@25C	UKAS
Copper (Surface Water)	177	ICPMS	0	ug/L	UKAS
Iron (Surfacewater)	177	ICPMS	9130	ug/L	
Lead (Surface Water)	177	ICPMS	2	ug/L	UKAS
Magnesium	184	ICPMS	4.70	mg/L	
Manganese (Surface Water)	177	ICPMS	337	ug/L	UKAS
Mercury	178	ICPMS	<0.02	ug/L	
Nickel (Surface Water)	177	ICPMS	3	ug/L	UKAS
pH (Surface Water)	110	Electrometry	6.9	pH Units	UKAS
Potassium	184	ICPMS	2.40	mg/L	
Sodium	184	ICPMS	10.90	mg/L	
Sulphate	119	Colorimetry	<1.39	mg/L as SO4	
Zinc (Surface Water)	177	ICPMS	7	ug/L	UKAS

Signed : DHeslin *Date :* 12/11/09

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Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/031/02
		Date of Receipt	30/11/2009
		Date Testing Commenced	30/11/2009
		Received or Collected	Courier: K&L
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	21/12/2009
Customer Ref	Cloumtreem GW2 26/11/09	*Sample Type*	Groundwater

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Alkalinity (Ground Water)	102	Colorimetry	91	mg/L CaCO3	UKAS
Ammonia (Ground Water)	114	Colorimetry	0.244	mg/L as N	UKAS
Arsenic (Ground Water)	177	ICPMS	1	ug/L	UKAS
Atrazine	191	HPLC	<0.01	ug/L	
BOD (Ground Water)	113	Electrometry	<2	mg/L	UKAS
Boron (Ground Water)	177	ICPMS	173.6	ug/L	UKAS
Cadmium (Ground Water)	177	ICPMS	<0.09	ug/L	UKAS
Calcium	184	ICPMS	14.02	mg/L	
Chloride (Ground Water)	100	Colorimetry	32.11	mg/L	UKAS
Chromium (Ground Water)	177	ICPMS	<2.14	ug/L	UKAS
COD (Ground Water)	107	Colorimetry	<5	mg/L	UKAS
Coliforms (Faecal)	140	Filtration/ Incubation 44C/ 24	0	no/ 100ml	
Coliforms (Total)	140	Filtration/ Incubation 37C/ 24	52	no/ 100ml	
Conductivity (Industrial Eff.)	112	Electrometry	286	uscm -1@25C	UKAS
Copper (Ground Water)	177	ICPMS	10.4	ug/L	UKAS
Dichloromethane	154	GCMS	<1	ug/L	
Fluoride (Ground Water)	115	Colorimetry	0.14	mg/L	UKAS
Iron (Ground Water)	177	ICPMS	296.1	ug/L	UKAS
Lead (Ground Water)	177	ICPMS	0.9	ug/L	UKAS
m-& p-Xylene	179	GCMS	<0.73	ug/L	
Magnesium	184	ICPMS	4.08	mg/L	
Manganese (Ground Water)	177	ICPMS	6130	ug/L	
Mercury	178	ICPMS	<0.03	ug/L	
Nickel (Ground Water)	177	ICPMS	1.7	ug/L	UKAS
Nitrogen (Total Oxidised) (Ground	151	Colorimetry	<0.28	mg/L as N	UKAS

Web Certificate ***Date : 21/12/2009***

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

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Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/031/02
		Date of Receipt	30/11/2009
		Date Testing Commenced	30/11/2009
		Received or Collected	Courier: K&L
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	21/12/2009
Customer Ref	Clountreem GW2 26/11/09	*Sample Type*	Groundwater

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
o-Xylene	179	GCMS	<0.35	ug/L	
pH (Ground Water)	110	Electrometry	6.6	pH Units	UKAS
Phosphate (Ortho) Ground Water	117	Colorimetry	<0.005	mg/L as P	UKAS
Potassium	184	ICPMS	4.18	mg/L	
Simazine	191	HPLC	<0.01	ug/L	
Sodium	184	ICPMS	18.60	mg/L	
Solids (Total Dissolved)	105	Filtration/ Evaporation @ 180	215	mg/L	
Solids (Total Suspended)	106	Filtration/ Drying @ 104C	100	mg/L	
Sulphate	119	Colorimetry	8.12	mg/L as SO4	
Toluene	179	GCMS	<0.28	ug/L	
Total Cyanide	0	Spectrometry	<0.02	mg/L	
Total Organic Carbon	316	TOC analyser (NPOC)	3.29	mg/L	
Tributyltin*	0	GCMS	<0.02	ug/L as Sn	
Xylene (Total)	179	GCMS	<1	ug/L	
Zinc (Ground Water)	177	ICPMS	15.7	ug/L	UKAS

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Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/031/01
		Date of Receipt	30/11/2009
		Date Testing Commenced	30/11/2009
		Received or Collected	Courier: K&L
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	21/12/2009
Customer Ref	Cloumtreem GW1 26/11/09	*Sample Type*	Groundwater

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Alkalinity (Ground Water)	102	Colorimetry	20	mg/L CaCO3	UKAS
Ammonia (Ground Water)	114	Colorimetry	<0.01	mg/L as N	UKAS
Arsenic (Ground Water)	177	ICPMS	0.9	ug/L	UKAS
Atrazine	191	HPLC	<0.01	ug/L	
BOD (Ground Water)	113	Electrometry	<2	mg/L	UKAS
Boron (Ground Water)	177	ICPMS	101.3	ug/L	UKAS
Cadmium (Ground Water)	177	ICPMS	0.2	ug/L	UKAS
Calcium	184	ICPMS	7.75	mg/L	
Chloride (Ground Water)	100	Colorimetry	31.96	mg/L	UKAS
Chromium (Ground Water)	177	ICPMS	2.3	ug/L	UKAS
COD (Ground Water)	107	Colorimetry	25	mg/L	UKAS
Coliforms (Faecal)	140	Filtration/ Incubation 44C/ 24	1	no/ 100ml	
Coliforms (Total)	140	Filtration/ Incubation 37C/ 24	140	no/ 100ml	
Conductivity (Industrial Eff.)	112	Electrometry	151	uscm -1@25C	UKAS
Copper (Ground Water)	177	ICPMS	9.6	ug/L	UKAS
Dichloromethane	154	GCMS	<1	ug/L	
Fluoride (Ground Water)	115	Colorimetry	0.21	mg/L	UKAS
Iron (Ground Water)	177	ICPMS	770.6	ug/L	UKAS
Lead (Ground Water)	177	ICPMS	1.5	ug/L	UKAS
m-& p-Xylene	179	GCMS	<0.73	ug/L	
Magnesium	184	ICPMS	1.74	mg/L	
Manganese (Ground Water)	177	ICPMS	259.5	ug/L	UKAS
Mercury	178	ICPMS	<0.03	ug/L	
Nickel (Ground Water)	177	ICPMS	4.4	ug/L	UKAS
Nitrogen (Total Oxidised) (Ground	151	Colorimetry	0.35	mg/L as N	UKAS

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Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/031/01
		Date of Receipt	30/11/2009
		Date Testing Commenced	30/11/2009
		Received or Collected	Courier: K&L
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	21/12/2009
Customer Ref	Cloumtreem GW1 26/11/09	*Sample Type*	Groundwater

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
o-Xylene	179	GCMS	<0.35	ug/L	
pH (Ground Water)	110	Electrometry	6.2	pH Units	UKAS
Phosphate (Ortho) Ground Water	117	Colorimetry	0.008	mg/L as P	UKAS
Potassium	184	ICPMS	0.97	mg/L	
Simazine	191	HPLC	<0.01	ug/L	
Sodium	184	ICPMS	14.12	mg/L	
Solids (Total Dissolved)	105	Filtration/ Evaporation @ 180	190	mg/L	
Solids (Total Suspended)	106	Filtration/ Drying @ 104C	167	mg/L	
Sulphate	119	Colorimetry	11.80	mg/L as SO4	
Toluene	179	GCMS	<0.28	ug/L	
Total Cyanide	0	Spectrometry	<0.02	mg/L	
Total Organic Carbon	316	TOC analyser (NPOC)	7.12	mg/L	
Tributyltin*	0	GCMS	<0.02	ug/L as Sn	
Xylene (Total)	179	GCMS	<1	ug/L	
Zinc (Ground Water)	177	ICPMS	20.9	ug/L	UKAS

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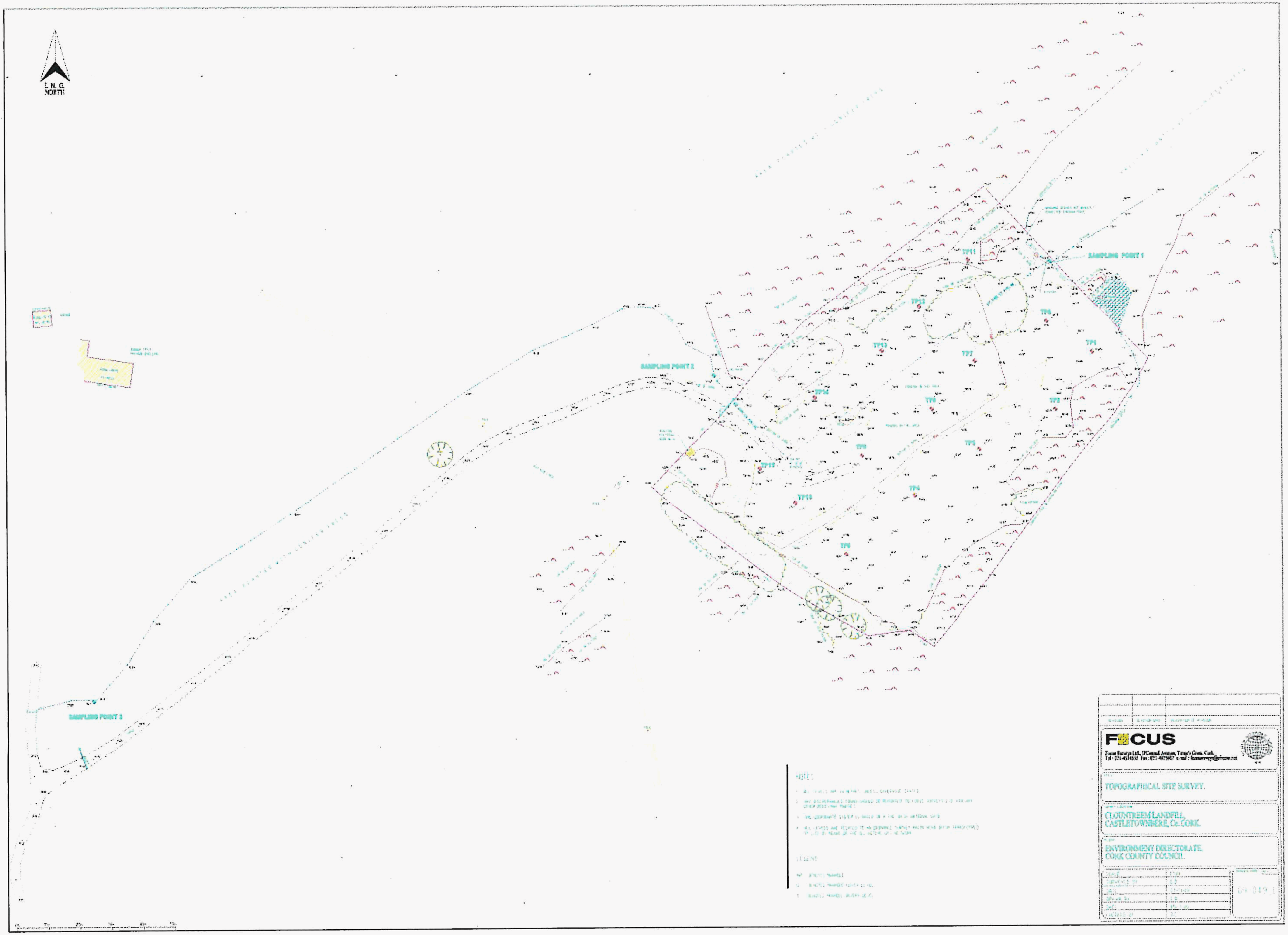
Appendix 5

Site Survey


I. N. G.
NORTH
SAMPLING POINT 1
SAMPLING POINT 2
SAMPLING POINT 3
TP1
TP4
TP6
TP7
TP11
TP13
TP14
FOCUS
TOPOGRAPHICAL SITE SURVEY.
CLOUNTREEM LANDFILL,
CASTLETOWNBERE, Co. CORK.
ENVIRONMENT DIRECTORATE,
CORK COUNTY COUNCIL.

Appendix 6

Ecology Survey for Clountreem

Habitat Assessment of Clountreem Landfill Site

Habitat assessment and biological water quality analysis of Clountream Landfill and Stream.

Doherty Environmental

December 2009

Table of Contents

Introduction

Doherty Environmental has been commissioned by Cork County Council to undertake a habitat assessment and biological water quality analysis of the Clountreem Landfill and Clountreem Stream at Clountream, Co. Cork. The purpose of this assessment is to provide baseline information on the habitats supported by the former landfill site and evaluate the water quality of the Clountream Stream with a view to identifying any potential adverse effects to the water quality arising from the disused landfill.

This report is presented in two sections. Section 1 presents the results of the baseline phase 1 habitat survey undertaken on site, while Section 2 outlines the results of the water quality analysis.

1 Section 1

The purpose of the habitat survey was to:

- review the site history and summarise the results of previous ecological studies/records undertaken at the site;
- identify the habitats supported by the site; and
- identify the existing fauna of the site.

The scope of the following assessment follows the guidance outlined in Appendix 4 of *Environmental Protection Agency's* (EPA) *Code of Practice for Environmental Risk Assessment for Unregulated Waste Disposal.*

1.1 Methodology

The basis for this assessment was a Phase 1 Habitat Survey, undertaken in accordance with the *Heritage Council's "A Guide to Habitats in Ireland"* (Fossit, 2000) and the *"Draft Habitat Survey Guidelines"* (Hertiage Council, 2002). The *Guide to Habitats in Ireland* classifies habitats according to a hierarchical framework with Level 1 habitats representing broad habitat groups, Level 2 representing habitat sub-groups and Level 3 representing individual habitats. The field survey focused on identifying Level 3 habitats. The DAFOR scale was also used to characterise the vegetation within each habitat. This scale refers to plant species in terms of dominance, abundance, frequency, occasional and rare (DAFOR). In addition any evidence or records of fauna activity within or adjacent to the site were also noted during the survey, which was undertaken in December, 2009.

1.1.1 Ecological Evaluation

The evaluation of the ecological resource was assessed according to the National Roads Authority's *Site Evaluation Scheme* (outlined in *Table 1* below) as described in the NRA's *Guidelines for the Assessment of Ecological Impacts of National Road Schemes*. These criteria evaluate the significance of an ecological resource within a defined geographical context. The Institute of Ecology and Environmental Management's (IEEM) *Guidelines for Ecological Impact Assessment* and the *Ratcliffe Criteria*, which also evaluate ecological resources according to a defined geographical context were also taken in account during the baseline ecological evaluation.

Table 1 *Site Evaluation Scheme*

Rating	Qualifying Criteria
A	**Internationally Important** Site designated (or qualifying for designation) as Special Area of Conservation (SAC) or Special Protection Area (SPA) under the EU Habitats or Birds Directives. Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive. Major salmon river fisheries. Major salmonid (salmon, trout or char) lake fisheries.
B	**Nationally Important** Sites or waters designated or proposed as an Natural Heritage Area (NHA) or statutory Nature Reserves. Undesignated sites containing good examples of Annex I habitats (under EU Habitats Directive). Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive or species protected under the Wildlife (Amendment) Act 2000. Major trout river fisheries. Water bodies with major amenity fishery value. Commercially important coarse fisheries.

Rating	Qualifying Criteria
C	**High Value, locally important** Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant populations of locally rare species. Small water bodies with known salmonid populations or with good potential salmonid habitat. Sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive. Large water bodies with some coarse fisheries value.
D	**Moderate Value, locally important** Sites containing some semi-natural habitat or locally important for wildlife. Small water bodies with some coarse fisheries value or some potential salmonid habitat.
E	Any water body with unpolluted water (Q-value rating 4-5). **Low Value, locally important** Artificial or highly modified habitats with low species diversity and low wildlife value. Water bodies with no current fisheries value and no significant potential fisheries value

1.2 Receiving Environment

The disused landfill site is located within the rural townland of Clountreem, approximately 1km to the north-northeast of Castletownbere, West Cork (G.R. V68880 47310). The site is located at approximately 70m OD Malin and is situated at the south western base of the Slieve Miskish Mountain. The majority of the land cover surrounding the site is characterised by low-activity land management regimes. Low intensity sheep grazing was noted in places. Recent planting of coniferous seedlings was noted to the west and north of the site. In general the land cover

consists of heath land and associated habitats with extensive areas of exposed surface bedrock. The soils are characterised by peaty podzols with peatlands occurring in more elevated areas to the northeast of the site. The bedrock is characterised by old red sandstone (ORS) and sandstone and siltstone conglomerate, much of which is outcropping at the surface surrounding the site.

The land cover within the site is dominated by spreading scrub habitats. An upland stream flowing east to west is culverted through the site. The previous deposition of waste within the site has changed the topography of the site with a steep embankment present towards the south of the site. To the south of the site the land cover is dominated by acid grassland and heath mosaics. Discrete areas characterised by Molinia meadows, which are a habitat listed on Annex 1 of the EU Habitats Directive were also noted to the south of the site. The land rises naturally to the north of the site.

1.3 Field Survey Results

The terrestrial habitats recorded within the survey area are presented in the Habitat Map, *Figure 1*. Three broad (Level 1) habitat groups were identified within the site area:

1. Freshwater;
2. Woodland & Scrub; and
3. Exposed Rock and Disturbed Ground.

Each of the broad habitats and the individual habitats (Level 3 habitats) making up these broad groups are described below. Habitats that represent a transition between two individual habitats will be described in the text below under the Level 3 habitat that they most resemble and details of such transitions will be outlined.

1.3.1 Freshwater

The freshwater habitats identified within the site have been classified as:

- Upland eroding stream (FW1)

The Clountreem stream which is culverted through the site is classified as an upland eroding stream. The baseline conditions of this stream with regard to habitats and fauna are outlined in *Section 2* of this report.

1.3.2 Woodland and Scrub

The woodland and scrub habitats identified within the site have been classified as:

- Scrub (WS1)

Immature scrub formerly dominated this site. Recent vegetation clearance has reduced the overall cover of this habitat. The remaining scrub is characterised by dense stands of gorse (*ulex europeaus*) and bramble (*Rubus fruticosa* agg.). A discrete area of willow (*Salix cinerea*) scrub is established along the south-facing slope towards the south of the site.

1.3.3 Exposed Rock and Bare Ground

The exposed rock and bare ground habitats identified within the site have been classified as:

- Spoil and bare ground (ED2)

Recent disturbance to the site has resulted in the removal of much of the site's vegetation, with resultant bare ground dominating areas of the site. No vegetation is associated with this habitat.

1.3.4 Grassland

The grassland habitat identified within the site have been classified as:

- Wet grassland

The wet grassland habitat occurring within the site is dominated by soft rush (*juncus effusus*). Other herbaceous species occurring in association within this habitat include creeping buttercup (*Ranunculus repens*), foxglove (*Digitalis purpurea*), broad leaved dock (*Rumex obtusifolius*), great willowherb (*Epilobium hirsutum*) and floating sweet-grass (*Glyceria fluitans*).

The site is surrounded to the south and west by wet grassland and wet heath mosaics. An area of wet grassland occurs in association with the willow scrub along the southern boundary of the site. The herb layer of this wet grassland habitat is dominated by nutrient-loving plant species such as nettles (*Urtica dioica*), creeping buttercup; meadow buttercup (*R. acris*); bulbous buttercup (*R. bulbosus*); broad-leaved dock; dandelion (*Taraxacum officinalis* agg.); soft rush; floating sweet grass; and bracken (*Pteridium aquilinum*). The presence of a nutrient-loving plant community at this location is indicative of eutrophic conditions. Further south from the boundary of the site the vegetation grades from a Glyceria and soft rush dominated herb layer to a typically nutrient-poor purple moor-grass meadow. This vegetation zonation may be related to excessive nutrient inputs derived from the landfill waste along the southern boundary of the site. The purple moor-grass dominated grassland to the south of the site corresponds with the EU Habitats Directive Annex I listed habitat *Molinia meadows on calcareous, peaty or clayey-silt laden soils (molinion caerulae)* (6410). A further example of this habitat type occurs to the west of the site adjacent to the Clountream Stream.

1.4 Site Evaluation

The habitats occurring within the site are considered to be of low ecological value (E). The bare ground supports little vegetation cover and does not function as a habitat for faunal species such as mammals and birds. The remaining scrub habitat occurring within the site is degraded and provides limited shelter for fauna species. The willow scrub along the southern boundary of the site has the potential to support a limited population of bird species. The wet grassland occurring within the site is dominated by soft rush and is not representative of the naturally occurring wet grassland habitats in this area.

Overall the site is considered to be of low ecological value and low conservation importance.

2 Section 2

2.1 Biological Water Quality Assessment

The biological water quality survey was based on the Biotic Index or Q-value system as outlined by the EPA (McGarrigle, 2002). The EPA Q-Value system is a listed criteria for calculating surface water ecological status as outlined in Schedule 5 of the Surface Water Regulations 2009 (SI No. 272 of 2009). A five minute kick sample was undertaken at each sample location using a kick-net (mesh size: 1mm). Each sample was transferred to a plastic bag at the sampling site. Sample processing was undertaken within 24 hours of sampling. Each sample was sieved using a 500µm sieve to remove mud while stones and other organic detritus (such as leaves, wood fragments etc.) were removed. Animals clinging to stones and leaves were washed into a white sorting tray along with the sieved sample. Each sample was sorted for one hour. Macroinvertebrates were identified to the level required by the EPA Q-rating system using both low and high powered microscopes where necessary. Based on the relative abundance of indicator taxa a biotic index (Q-value) was determined for each site. As different taxa show different levels of tolerance and sensitivity to pollution, the presence or absence of specific organisms in the water indicates the level of water quality in a watercourse. The Q-value system is base on a five-point biotic index as outlined in *Table 2.1*. The intermediate values i.e. Q1 -2, Q3 – 4 etc. denote transitional conditions. The Q-values listed in *Table 2.1* are assigned according to the abundance of different invertebrate groups.

For the purposes of assigning Q-values the EPA has divided macroinvertebrates into five arbitrary Indicator Groups. *Table 2.2* outlines the taxa associated with each group.

As mentioned above the abundance of each indicator group will determine the Q-value assigned. The abundance categories that apply when assigning Q-values are outlined in *Figure 2.3.*

Table 2-1: Q-Value system with Five Point Biotic Index and Intermediate Values (Source: EPA, 2006).

Biotic Index	Water Quality	Pollution Status
Q5	Good	Unpolluted
Q4 – 5	Fair – Good	
Q4	Fair	
Q3 – 4	Doubtful – Fair	Slight to moderate pollution
Q3	Doubtful	
Q2 – 3	Poor	
Q2	Poor	Serious pollution
Q1 – 2	Bad – Poor	
Q1	Bad	

Table 2-2: Macroinvertebrates grouped according to their sensitivity to organic pollution (Source: EPA, 2006).

Macroinvertebrates grouped according to their sensitivity to organic pollution					
Taxa	Group A	Group B	Group C	Group D	Group E

	Sensitive	Less Sensitive	Tolerant	Very Tolerant	Most Tolerant
Plecoptera	All except Leutra spp.	*Leutra spp.*			
Emphemeroptera	Heptageniidae Siphlonuriidae Emphemera danica	Baetidae (excl. *Baetis rhodani*) Leptophilebidae	*Baetis rhodani* Caeniddae Emphemerellidae		
Trichoptera		Cased spp.	Uncased spp		
Odonata		All taxa			
Megaloptera				Sialidae	
Hemiptera		*Aphelocheirus aestivalis*	All except *A. Aestivalis*)		
Coleoptera			Coleoptera		
Dipteral			Chironomidae (excl. *Chironomus* spp.) Simuliidae Tipulidae		*Chironomus* spp. *Eristalis* sp.
Hydracarina			Hydracarina		
Crustacea			*Gammurus* spp. *Austropotamobius pallipes*	*Asellus* spp. *Crangonyx* spp.	
Gastropoda			Gastropoda (excl.	*Lymnaea peregra* *Physa* sp.	
Lamellibranchiata	Margaritifera mrgaritifera				
Hirudinea					
Oligochaeta					Tubificidae

Platyhelminthes			All		

Figure 2-3: Abundance Values and Frequency of Occurrence for assigning Q-Values (Source: EPA, 2006)

Abundance Category	Approximate Percentage frequency of Occurrence
Present	1 or 2 individuals
Scarce/Few	<1%
Small numbers	<5%
Fair numbers	5 – 10%
Common	10 – 20%
Numerous	25 – 50%
Dominant	50 – 75%
Excessive	>75%

2.2 Clountreem Stream Habitat Assessment

A habitat assessment was undertaken at each sampling site. The habitats associated with each site were assessed in terms of:

- Stream width and depth;
- Instream habitats;
- Substrate type;
- Flow;
- Riparian vegetation, including a list of species noted and percentage bank side cover and degree of shading;
- Instream vegetation, including a list of species noted and percentage cover;
- General rating of habitat (fisheries perspective).

3 Results

3.1 Biological Water Quality Assessment

3.1.1 Site 1

Site 1 was located at GR V 68936 47365, upstream of the landfill site. The Clountreem Stream at this point is characterised by an upland eroding stream. The stream is approximately 30 to 50cm wide and 20cm deep. The stream is banked on both sides by wet grassland and wet heath habitat and no riparian vegetation occurs along the stream at this site. These habitats are characterised by low growing shrub species such as heathers and herbaceous vegetation, dominated by purple moor-grass. As no trees or shrubs border the stream at the location the degree of riparian cover and shading is low.

No instream vegetation was recorded at this survey site.

The river substrate along this site is characterised by 60% boulders, 30% stones and 10% gravel material. The instream habitats were characterised by 100% riffle.

The potential for this site to support fish species was considered to be low.

The results of the macroinvertebrate survey are provided in *Table 3.1*. The abundance of indicator taxa is also given in this table. The macroinvertebrate community recorded at this site is indicative of a Q-value of 4 - 5. This Q-value has been assigned at this site due to the dominance of Group A and B taxa, the numerous status of Group C taxa and the absence of Group D and E taxa. The high number of stoneflies (Plecoptera spp.) associated with this site is typical of an upland eroding stream.

Table 3-1: Results of Site 1 of Macroinvertebrate Survey

Indicator Group	Pollution Sensitivity/tolerance	Taxon	No. Recorded
A	Pollution Sensitive	Plecoptera	16
B	Less Pollution Sensitive	Emphemeroptera	3
		Cased Trichoptera	3
C	Pollution Tolerant	Hydrophilidae	2
		Simuliidae	5
		Tipulidae	3
		Baetis rhodani	2

		Gammurus duebeni Uncased Trichoptera Chironomidae (excluding Chironomus sp.)	4 2 3
D	Very Pollution tolerant	None present	
E	Most Pollution Tolerant	None present	

3.1.2 Site 2

Site 2 is located at GR V 68805 47339, immediately downstream of the landfill site. The Cloutreem Stream at this point is approximately 30 – 50cm in width and 15cm deep. Immediately upstream of the sample site the stream opens out into a pool. The riparian vegetation at the site is dominated by wet grassland habitats and no riparian cover was noted during the survey. Immediately upstream from the point a treeline dominates both bank sides.

No instream vegetation was noted during the survey.

The river substrate at this site was made up of 50% boulders, 40% stones and 10% gravel. Excessive yellow-ocre staining was noted on the stream bed. Noxious odours were noted during the kick samplings.

The instream habitats were characterised by 100% riffle. Immediately upstream of the site pools were noted. A waterfall is located upstream from the pools, adjacent to the stream outfall from the disused landfill site.

The potential for this site to support fish species was considered to be low.

The results of the macroinvertebrate survey for this site are provided in *Table 3.2*. The abundance of indicator taxa is also given in this table. The macroinvertebrate community recorded at this site is indicative of a Q-value of 2 - 3. This Q-value has been assigned at this site due to the absence of Group A the presence of one individual Group B taxon, the scarcity of Group C taxa and the low numbers of Group D and E taxa. Overall the occurrence of macroinvertebrates at this site was notably reduced when compared to the numbers recorded at Site 1.

Table 3-2: Results of Site 2 Macroinvertebrate Survey

Indicator Group	Pollution Sensitivity/tolerance	Taxon	No. Recorded
A	Pollution Sensitive	None present	

B	Less Pollution Sensitive	Leuctra spp.	1
C	Pollution Tolerant	Uncased trichoptera Chironomidae (excluding Chironomus sp.)	3 1
D	Very Pollution tolerant	None present	
E	Most Pollution Tolerant	Tubificidae	2

3.1.3 Site 3

Site 3 is located at V 68629 47224, approximately 200m southwest of the landfill site. The Cloutreem Stream at this point is approximately 60 – 70cm in width and 20 – 30cm deep. The riparian vegetation along the stream is dominated by purple moor-grass dominated wet grassland. Two willow trees were noted along the western side of the bank at the survey location. The riparian cover was estimated to be less than 10% at the survey site.

No instream vegetation was recorded at this site. The river substrate was made up of 40% boulders, 50% stones and 10% gravel. Yellow-ocre staining was also noted at this survey site but odours were not immediately noted during the kick sampling.

The instream habitats at the site were characterised by 100% riffle.

The potential for this site to support fish species was considered to be low.

The results of the macroinvertebrate survey for this site are provided in *Table 3.3*. The abundance of indicator species is also given in this table. The invertebrate community recorded at this site is indicative of a Q-value of 4. This Q-value has been assigned at this site due to the presence of Group A taxa; the dominance of Group B taxa; the presence of individual Group C taxon along with the common occurrence of Group D and E taxa. It is noted that, while the number of macroinvertebrates recorded at this sample location increased in comparison to the results of sampling at Site 2, they were still reduced when compared to Site 1.

Table 3-3: Results of Site 3 Macroinvertebrate Survey

Indicator Group	Pollution Sensitivity/tolerance	Taxon	No. Recorded
A	Pollution Sensitive	Plecoptera	2

B	Less Pollution Sensitive	Leutridae Cased trichoptera	6 1
C	Pollution Tolerant	Uncased trichoptera	1
D	Very Pollution tolerant	Glossiphonidae	2
E	Most Pollution Tolerant	Tubificidae	2

3.1.4 Site 4

Site 4 is located at V 68629 47224. The survey point was located on the Aghakista River to the south of the disused landfill site. At the survey point the Aghakista River is approximately 5m width and 20 – 25cm deep. Immediately upstream of the survey point the riparian vegetation is dominated by mature broadleaved tree species. The eastern river bank at the survey point does not support riparian vegetation. The riparian cover was estimated to be approximately 60% at the survey site.

No instream vegetation was recorded at this site. The river substrate was made up of 40% stones, 15% boulders and 45% sand and gravel.

The instream habitats at the site were characterised by 100% riffle.

The potential for this site to support fish species was considered to be high.

No macroinvertebrates were recorded from the samples taken at this site. The high sand content and excessive rainfall in the weeks preceding the survey are likely to have influenced the results of sampling at this site. The heavy rainfall is likely to have washed macroinvertebrates from the stream bed.

3.2 Physico-chemcial Analysis

The results of recent physico-chemical surface water analysis recorded increases in ammonia downstream of the landfill site (see Cork County Council's Tier II Exploratory Investigation Report). Under the Freshwater Fish Directive (78/659/EEC) the maximum admissible concentrations (I/MAC value) for ammonia (mg/l N) is 0.02. The concentrations recorded at SW2 and SW3 were 2.74 and 1.3 mg/l N respectively. The pH of both samples are 6.9 and 7.5 respectively. SW2 is located immediately downstream of the landfill site and the outfall of the Clountreem Stream from the culvert crossing the landfill site. SW3 is located approximately 200m to the southwest of the landfill site. The results of the analysis for (SW1) which is located upstream of the landfill site recorded levels of ammonia within the EQSs for Surface Waters.

In aqueous solutions ammonia comprises two discrete aqueous species: free ammonia or unionised ammonia (NH_3) and ionised ammonia or ammonium (NH_4). The relative concentrations of ionised and unionised ammonia in a given solution are a function mainly of pH, temperature and ionic strength of the aqueous solution. As pH increases, the equilibrium is shifted towards the un-ionised species and the concentration of NH_3 increases while that of NH_4 decreases. For example a pH increase from 7.0 to 8.0 in the temperature range 0°C to 30°C results in a nearly tenfold increase in the concentration of NH_3. It has been shown that the un-ionised species of ammonia is most harmful to freshwater aquatic life and to fish in particular (EPA, 1999). Acute exposure to elevated levels of NH_3 can cause gill ventilation, hyper-excitability and death to fish species. Chronic exposure can cause a decrease in growth, a decrease in reproductive capacity and an increased susceptibility to disease. Research data has indicated that ammonia can have adverse effects on aquatic life at relatively low concentrations. Chronic effects on the growth rate of Atlantic salmon were recorded when un-ionised ammonia exceeded 0.06 mg/NH_3 (Samylin, 1969).

The partitioning of NH_3 and NH_4 is critical for defining the ecotoxicological impact of any given ammonia concentration and, as such, a total ammonia reading in isolation provides only a generalised indicator of potential ecotoxicological risk. The partial contribution of un-ionised ammonia increases with increasing pH and temperature. The partitioning between the unionised ammonia and ammonium can be calculated once the pH and temperature values are known. However, as no values for temperature were provided for SW2 and SW3 at the time of writing, the level of un-ionised ammonia for these samples could not be calculated.

All other parameters recorded at the three sampling points were within the relevant EQSs for Surface Waters.

4 Conclusions and Recommendations

The results of the biological water quality analysis and the elevated levels of ammonia recorded from the physico-chemcial analysis indicates that the disused landfill site is adversely affecting the water quality of the Clountreem Stream and is the source of point source pollution to the stream.

The elevated ammonia levels, yellow-ocre staining on the stream-bed and the reduction in macroinvertebrate numbers are a likely result of leachate infiltrating the culverted section of the Clountreem Stream under the landfill site.

It is recommended that measures are taken to ensure that the integrity of the stream culvert under the landfill is fully sealed and impermeable to potential leachate infiltration.

It is also recommended that a habitat restoration and management plan be undertaken for the site. The restoration plan should aim to reinstate habitats in keeping with the heathland habitats occurring adjacent to the site.

5 Limitations

It is noted that the field assessment was undertaken in December. The optimal period for undertaking freshwater macroinvertebrate assessments is from June to September inclusive

(NRA, 2006). Therefore, the results of the field assessment may be limited by seasonal effects. Also it is likely that excessively high rates of precipitation prior to the field surveys influenced the results of the biological water quality assessment.

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