# **Exploratory Site Investigation Waterstown**

**South Dublin County Council** 





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#### 1.0 INTRODUCTION

Malone O'Regan (MOR) was appointed by South Dublin County Council (SDCC) to undertake a Tier II Risk assessment based on a exploratory site investigation of Waterstown Landfill in accordance with the Environmental Protection Agency's (EPA) published Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (2007) and Waste Management (Certificate of historic unlicensed waste disposal and recovery activity) Regulations, 2008 (S.I. No. 524 of 2008) which were published in December 2008.

Waterstown Landfill is a closed landfill located north of Palmerstown village approximately 10km west of Dublin City Centre (refer Drawing No. 1a). It is reported that the landfill was in operation from 1983 to 1987 and was used as a disposal facility for municipal waste as well as solid inert waste from commercial/industrial sources (SDCC, 2011). According to the Tier I Report prepared by SDCC the former landfill site covers an area of approximately 25 hectares (ha) to the south of the River Liffey and is currently in use as a public park (refer Drawing No. 1b).

#### 1.1 Project Understanding

In accordance with the Code of Practice, Waterstown Landfill can be classified as a Category 1 landfill as it was operated by SDCC without a waste licence in the period between 15<sup>th</sup> July 1977 and the introduction of the Waste Management Licensing Regulations in 1997 (without being in breach of national legislation). In this regard, SDCC has responsibilities under the Code of Practice and Waste Regulations to assess the intrinsic risk of the former landfill.

#### 1.2 Project Objectives

SDCC issued a brief for the appointment of consultants in June 2012 for an exploratory site investigation of the former landfill that outlined the following:

- Assessment of waste types /composition to confirm what is reported in the Tier I study through trial pitting.
- Waste sampling to determine leachability.
- Leachate testing for List 1 and List 2 substances.
- Soil sampling to assess permeability potential of surrounding materials, use of material for capping and for contamination.
- Surface and ground water sampling and analysis as per the suite of parameters identified in Table C2 of the EPA Landfill Monitoring Manual 2003.
- Topographical survey.
- Geophysical survey to determine waste extent, depth, plumes and any anomalies.
- Report preparation and interpretation.
- Using the finding of the exploratory site investigation and sampling, the scope of work for the main Tier 2 site investigation will be outlined in the report.

#### 1.3 Background Information Reviewed

A number of relevant documents were reviewed during this assessment that included the following:

- Waterstown Landfill Palmerstown: Report on Risk Assessment Methodology Tier 1: -Conceptual Site Model: Risk Screening and Prioritisation South Dublin County Council (October, 2011).
- Provision of Engineering Consultancy Services for the Implementation of the Tier 2
   Risk Assessment: Exploratory Site Investigation and Sampling Analysis at

Waterstown Landfill, Palmerstown Dublin 20. South Dublin County Council (June 2012).

#### 1.4 Disclaimer

The conclusions presented in this report are professional opinions based solely on the tasks outlined herein and the information made available to MOR. They are intended for the purpose outlined herein and for the indicated site and project. The report is for the sole use of the Client. This report may not be relied upon by any other party without explicit agreement from MOR. Opinions and recommendations presented herein apply to the site conditions existing at the time of the assessment. They cannot apply to changes at the site of which MOR is not aware of and has not had the opportunity to evaluate. This report is intended for use in its entirety; no excerpt may be taken to be representative of this assessment. All work carried out in preparing this report has utilised and is based on MOR professional knowledge and understanding of the current relevant Irish and European Community standards, codes and legislation.

#### 1.5 Difficulties Encountered

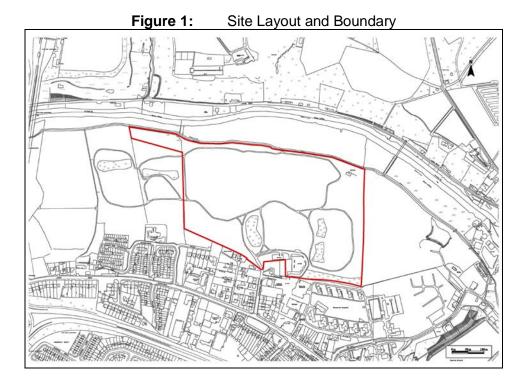
The southern and eastern boundary of the former landfill could not be fully delineated within the scope of this exploratory investigation due to a number of factors including but not limited to the presence of vegetation at the boundary and the presence of development outside of the park. However, due to the pre-existence of the residential properties on the southern boundary, it is likely that the road delineate the extent of the boundary albeit that was not proven.

The volumetric calculations of waste and capping are subject to interpretation given the size of the site and the limited number of investigations points that reached the base of the waste compared to the area in question. Therefore, this figure could vary and should be reviewed following receipt of any further site investigation data or records.

#### 2.0 SITE SETTING

#### 2.1 Site Location

The former landfill operated by SDCC during the 1980s is located in Palmerstown, Dublin 20. It has been developed over the last thirty years as a public park and ecological conservation area. The site, for the purpose of this exploratory investigation, is bordered to the north by a Mill Race, to the west by additional park area and the M50 Westlink toll bridge and to the south by primarily residential properties with some educational/community and commercial facilities and to the east by undeveloped greenfield land, residential properties and the River Liffey (Drawing No. 1b/Figure 1).



#### 2.2 Zoning Status

#### Zoning of the Landfill

In the current South Dublin County Development Plan (2010-2016), SDCC aim 'To protect and enhance the outstanding character and amenity of the Liffey Valley and to preserve its strategic importance as a green break between urban settlement areas', and thus SDCC have zoned the area as a green space. The section of the River Liffey from Lucan Bridge to Palmerstown, of which the site is within, falls under a Special Amenity Area Order (SAAO) which was confirmed by the Minister of the Environment in March 1990.

#### Surrounding Zoning

In the current SDCC Development Plan (2010-2016), the surrounding land has been zoned for a variety of uses including; areas to the south which have been zoned with the aim to 'provide, protect and/or improve local centre for facilities' and 'to protect and/or improve residential amenity'. There are a number of archaeological features on the North East of the site which SDCC have mapped as a record of protected structures while a corridor along the River Valley has been zoned as a pNHA – refer to section 2.6.2.

#### 2.3 Historic Site Development

It is known that quarrying activities were previously undertaken at the site. Historical information from reports, maps and aerial photographs were reviewed to provide information on the historical quarrying activities and the development of the former landfill. The historical maps and aerial photographs examined during this desk based study are presented in Table 1:

**Table 1: Historical Site Development** 

Date	Source	Development			
1843 Historic 6 inch	OSI Archives	Onsite: There is a small gravel pit present just south of the mill race (to the west of the old mill).			
		Offsite: There is 1No. structure located on the southern boundar of the site (Riversdale House) while several other structures a located further to the south and south east of the site Palmerstown village.			
1908 Historic 25 inch	OSI Archives	Onsite: The site has remained largely the same with the disappearance of two structures at the mill.			
		Offsite: Similar to 1843.			
1978	OSI Archives	Onsite: The gravel pit shown in previous mapping still remains. However, further excavations and mounding of spoil appears to have occurred across the northern section of the site from the western boundary to the west of the historical gravel pit.			
		Offsite: Not observed.			
circa 1978	SDCC Liffey Sandpit Company	Onsite: The gravel pit can be clearly seen.  Offsite: Not observed.			
1985	SDCC	Opoito, Oporational landfill Darma within the site boundary can			
1965	Aerial photo	Onsite: Operational landfill. Berms within the site boundary can be observed.			
		Offsite: A number of residential properties can be observed along the southern boundary.			
1995	OSI online Aerial Photos (reference only)	Onsite: The presence of a number of new footpaths/tracks as a result of the redevelopment of the site to incorporate its use as a public park and ecological area.			
	,	Offsite: A number of residential and commercial properties can be observed along the southern boundary from Riversdale House, located to the south west of the former landfill, to the south eastern site boundary.			
2000	OSI online Aerial Photos (reference	Onsite: As above.  Offsite: As above.			
2005	only)	Oppito: As above			
2005	OSI online Aerial Photos (reference only)	Onsite: As above.  Offsite: As above.			

Drawing No. 2a highlights what appears to be the extent of historic quarrying that took place at the site before any landfilling commenced; this is based on the OSI 1978 mapping data

and the Liffey Sandpit Company map (Refer Drawing No. 2b). An aerial photograph also presented on Drawing No. 2a and dated from 1985 indicates the possible locations and type of waste deposited onsite during the operational period. Berms can also be observed in this photograph. Drawing No. 2b illustrates a drawing from the Liffey Sandpit Company which identifies the boundary of the quarry (date unknown but given the similarity with the OSI 1978 drawing it may be circa that time). Following the completion of landfilling activities on site in 1987, SDCC completed capping works on the site and commenced work to develop the site as a public park.

#### 2.4 Geology

#### 2.4.1 Quaternary Geology

Based on the GSI/EPA Quaternary maps, the north west of the former landfill is underlain by alluvium and carboniferous glaciofluvial sands and gravels while the north east is classed as having bedrock within 1m of the surface (refer Drawing No. 3). The southern section of the site is largely underlain by limestone till. The land located between the northern site boundary i.e. the mill race, and the southern bank of the River Liffey is underlain by alluvial deposits. Land beyond and adjacent to the former landfill to the south and west can be predominantly characterised by limestone till; however the land to the east is a combination of limestone till, bedrock to within 1m of the surface and alluvial deposits.

#### 2.4.2 Bedrock Geology

Based on the GSI Bedrock maps the bedrock underlying the quaternary deposits is comprised of Calp (also known as the Lucan formation) which consists of dark grey massive limestones, shale limestones, while massive mudstones and cherts are common (refer Drawing No. 4). To the west of the site is a small section of the Tober Colleen formation.

#### 2.4.3 Subsoils

Based on the Teagasc subsoil maps the site is largely underlain by a rock outcrop and subcrop in the centre of the site where the bulk of the landfill materials were reportedly deposited (SDCC, 2011), with till derived chiefly from limestone along the southern boundary with made ground present beyond the southern boundary, glaciofluvial sands and gravels to the west and north of the site. Alluvium undifferentiated deposits are present between the mill race stream and River Liffey, (refer Drawing No. 5). Significantly, it is reported by SDCC (2011) that "bed rock at surface which might have been rock outcrop was also removed. Hence the waste is sitting directly on the bed rock."

#### 2.5 Hydrogeology

#### 2.5.1 Aquifer Classification

#### Bedrock Aquifer

The bedrock aquifer beneath the former landfill is classified by the GSI as a Locally Important Aquifer where the aquifer is moderately productive only in local areas (refer Drawing No. 6). The area surrounding the site (within 1km) is also largely classified as a Locally Important Aquifer with localised areas of Poor Aquifer classification to the west, north-west and north of the site.

#### Sand and Gravel Aguifer

According to the GSI database, the general site area is not underlain by a sand and gravel aquifer and there are no sand and gravel aquifers reported within a 2km radius of the former landfill site.

#### 2.5.2 Groundwater Vulnerability Rating (Vertical Pathway)

Groundwater vulnerability provides a measure of the ability of contaminants to migrate vertically to an aquifer and is a function of the subsoil permeability and its thickness (EPA, 2007). The GSI has assigned a groundwater vulnerability rating ranging from High to extreme with rock at/near the surface beneath the former landfill (refer Drawing No. 7).

#### 2.5.3 Groundwater Use and Protection

A search of the GSI groundwater well database was conducted to identify registered wells within a 2km radius of the former landfill (Drawing No. 8). Four wells were identified within the 2km zone, one industrial, one agricultural and two unknown. All four wells were located on the northern side of the River Liffey.

The Groundwater Protection Scheme provides a framework for the protection of groundwater source zones (e.g. areas of contribution to water supply bores). The GSI Source Protection Area data indicates that there are no designated Source Protection Zones in the immediate vicinity of the former landfill (GSI, 2010).

#### 2.6 Hydrology

#### 2.6.1 Hydrological Receptors

#### River Liffey

The River Liffey which flows into Dublin City Harbour is located to the north of the former landfill (refer Drawing No. 9) at distances ranging from approximately 30m to 150m from the site boundary. The nearest EPA sampling station, located approximately 1km downstream of the site, at Islandbridge, reports a 95<sup>th</sup> percentile (95%tile) of 2.29m³/s (estimated) with a dry flow of 2.05m³/s, while the hydrometric station 09022, located approximately 8km upstream of the former landfill at Leixlip Power Station, reports a 95%tile of 2.0m³/s with a dry flow of 2.0m³/s (ERBD, 2004).

The Q rating upstream (Lucan bridge) and downstream of the site (1km upstream of Chapelizod bridge) received a Q rating of '3' in 2005 which indicates a poor water quality status (Dart Underground, 2010). The 2009 data for the Eastern River Basin district indicates that surface water ecological status is 'poor' in the River Liffey up and downstream of the site, while surface water chemical status is 'moderate' up and downstream of the site.

#### Mill Race

A mill race forms the boundary of the northern section of the site from west to east. The chemical and ecological status of this water body is unknown. The Mill Race is located between the site and the River Liffey (refer Drawing No. 9).

#### 2.6.2 Protected Area Receptors – Surface Water Dependent Terrestrial Ecosystem

The section of the River Liffey from Lucan Bridge to Palmerstown, of which the site is within, falls under a Special Amenity Area Order (SAAO) which was confirmed by the Minister of the Environment in March 1990.

The site is also located south of the Liffey Valley proposed Natural Heritage Area (pNHA) (refer Drawing No. 10 and Appendix A), which has been designated by National Legislation under the remit of the National Parks and Wildlife Service (NPWS). It would appear based on available maps that the boundary of the pNHA may extend marginally beyond the Mill Race into the landfill footprint however, this may just be an anomaly with the maps.

#### 2.7 Infrastructure

Service ducts and infrastructure can provide a pathway for the migration of contaminants from the former landfill to identified receptors.

#### 2.7.1 Local and Landfill Infrastructure

Eircom, ESB Networks and Bord Gais provided information on service infrastructure (i.e. pipes, cables, etc.) as they have a number of service cables within the vicinity of the site (refer Appendix B). Details on the water supply infrastructure in the vicinity of the site are presented on Drawing No. 11 while details on storm drainage and foul drainage in the vicinity of the site are presented on Drawing No. 12.

SDCC facilities are also present onsite and consist of both a permanent structure and a steel container type cabin. The site also contains a car park for both the public and park staff in the southern portion of the site.

#### 3.0 TIER 1 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) was developed by SDCC (2011) for the former landfill and possible sources, pathways and receptors along each of the source-pathway-receptor (SPR) linkages were identified (Refer to Appendix C). MOR have revised the CSM as part of these works.

#### 3.1 Existing Site Conditions/Walkover Survey

A walkover survey was completed by a Principal MOR Environmental Consultant on the 31<sup>st</sup> October 2012. The purpose of this walkover survey was to establish the current landuse at the site and the surrounding area and to confirm information compiled as part of the desk based study. The site inspection examined each of the possible Source-Pathway-Receptor linkages and attempted to delineate, from visual inspection, the extent of the waste body.

The surface of the site is generally undulating with a downward slope towards the River Liffey. The vegetative cover of the landfill varies. The landfill is largely covered by grasses bisected by pedestrian/bicycle/vehicle access paths/tracks that are finished in tarmacadam. Large swathes of the former landfill have been deliberately left to grow naturally and include a variety of weeds, grasses, shrubs, bushes and trees. The park supports a wide range of native and non-native species as well as a number of protected species (Kingston. N. et al., 2003).

There was no evidence of landfill gas during the walkover survey (i.e. odour or vegetation die back).

#### 3.2 Source

The principal source of contamination in the case of a landfill can be considered to be the leachate and landfill gas produced as a result of the waste type, volumes and conditions present. Waste materials disposed at the former landfill between 1983 and when it closed in 1987 are considered to have the potential to generate landfill gas and leachate.

#### 3.2.1 Extent of Waste

The extent of the waste body encompasses the former quarry and the raised banks, and for the purpose of the Tier 1 assessment is delineated by the site boundary identified by SDCC.

#### 3.2.2 Type of Waste

The composition of the waste materials deposited at the former landfill is reported to be mixed. It is understood that the former landfill was used for the disposal of inert construction and demolition waste and municipal waste during its operational lifespan (SDCC, 2011). There are no records available regarding the volumes of waste disposed at the former landfill at Waterstown.

#### 3.2.3 Remediation Works

As part of the site redevelopment works as a public park, SDCC completed remedial works to cap the site to facilitate its redevelopment as an ecological amenity. In addition it is reported that gas boreholes were installed to facilitate the venting of landfill gas following a historical incident where gas built up resulting in a small explosion; however, only one gas vent was observed during the site walkover.

#### 3.3 Pathway

A pathway is a mechanism or route by which a contaminant comes into contact with, or otherwise, affects a receptor (BS10175:2011). The environmental setting described previously in Chapter 2 contains information on key parameters that have implications on the SPR linkages including geology, hydrogeology, etc.

#### 3.4 Receptor

"A receptor is a person, living organism (e.g. livestock, crops, pets or wildlife), ecological system, controlled waters, atmosphere, structures and utilities that could be adversely affected by the source" (EPA, 2007). A number of receptors have been identified that could be adversely affected by the former landfill.

#### 3.4.1 Human Health Receptors

#### Onsite

The site is currently used as a public park and is therefore accessed by members of the public and SDCC employees.

#### Offsite

There are a number of residential and educational/community facilities within 50m of the former landfill located along the southern site boundary (refer Drawing No. 1b).

#### 3.4.2 Environmental Receptors

A number of environmental receptors were identified including:

- Aquifer
- Surface water body; and
- Protected Area (Surface Water Dependent Terrestrial Ecosystem (SWDTE)).

#### 3.5 Preliminary Conceptual Site Model

A preliminary conceptual site model was prepared for the former landfill by the Waste Management, Environmental Services Section of SDCC and is documented in a report dated 2011 (See Appendix C). The preliminary conceptual site model was revised by MOR and the following source, pathways and receptors identified for the former landfill are summarised in Table 2.

Based on the Tier I conclusions it is considered that leachate and landfill gas production and migration represent a possible source of contamination at the former landfill and therefore require further assessment (SDCC, 2011).

 Table 2:
 Preliminary Conceptual Site Model Summary for Waterstown Landfill

Element	Description	Rationale
Source Pathway	Composition and extent of waste  Leachate Migration	<ul> <li>Unknown quantity of municipal waste/ C&amp;D Waste.</li> <li>Extent ~25 hectares (ha).</li> <li>Operational from 1983 until 1987.</li> <li>Evidence of landfill gas (historic explosion).</li> <li>Groundwater – High to extreme vulnerability.</li> </ul>
	Landfill Gas Migration	<ul> <li>Some of the area surrounding the former landfill consists of madeground.</li> <li>Service infrastructure present within the vicinity of site</li> </ul>

Receptors	Leachate Migration	<ul> <li>Human presence: residential properties and educational/community facilities located within 50m of the waste body therefore the potential for a drinking water supply – although unidentified to date.</li> <li>Aquifer</li> <li>Surface water bodies within 50m.</li> <li>SWDTE/ protected area located within 50m of the waste body.</li> </ul>
	Landfill Gas Migration	<ul> <li>Human presence: General Public Visiting the Park</li> <li>Human presence: SDCC Employees working in the Park</li> <li>Human presence: Residential and educational/community properties located within 50m of the waste body.</li> </ul>

#### 4.0 Tier 1 RISK SCREENING & PRIORITISATION

#### 4.1 Risk Screening

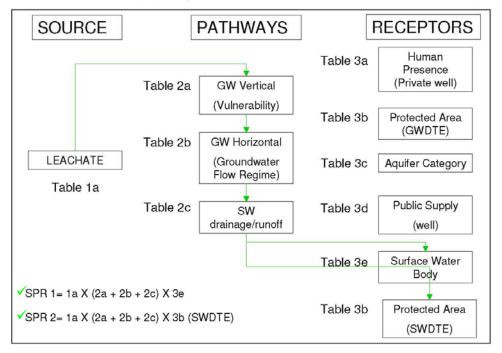
Risk screening represents an assessment of the SPR linkages in the conceptual model. Appendix D contains a copy of the risk screening exercise completed as part of this assessment of the former landfill.

#### 4.2 Risk Prioritisation

Risk prioritisation was completed for the former landfill in accordance with the Code of Practice. The risk prioritisation process assigns a score to each linkage where the overall site score is the maximum of the individual linkages. The scoring system allocates higher numbers for the higher risk elements and thus it allows a meaningful comparison to be made between different linkages (EPA, 2007).

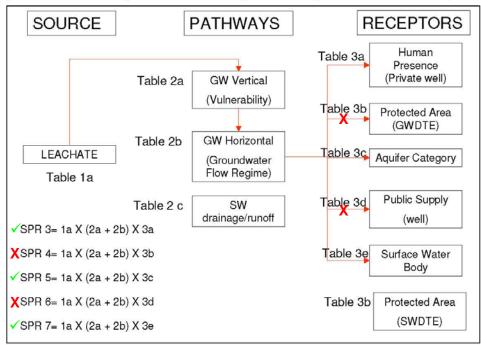
The following tables illustrate the 11 possible SPR linkages which were scored individually, if present. The result calculated provides an indication of the relative risk associated with the SPR linkage at the former landfill. For the former landfill, 9 No. of these SPR linkages were valid. It was determined from the desk based study that SPR4 which assesses the risk to groundwater dependent terrestrial ecosystems (GWDTE) and SPR6 which relates to a public supply well were not valid for this assessment as none were identified within the study area.

**Table 3:** Network Diagram for Leachate Migration through combined groundwater and surface water pathways (taken from Code of Practice (EPA, 2007))



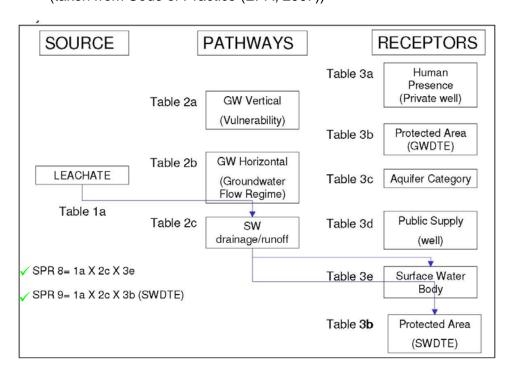
Surface water drainage to a surface water body and a protected area were identified and assessed.

**Table 4:** Network Diagram for Leachate Migration through Groundwater Pathway (taken from Code of Practice (EPA, 2007))



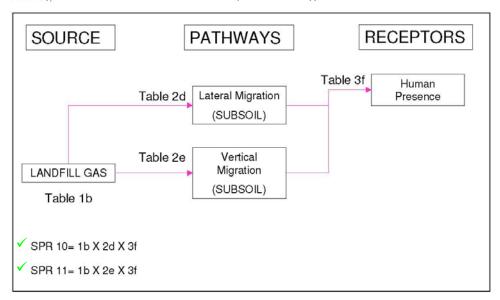
All of the SPR linkages identified in Table 4 have been included within this assessment with the exception of SPR 4 and SPR6. As discussed previously, these receptors have not been assessed as they were not identified within the study area.

**Table 5:** Network Diagram for Leachate Migration through surface water pathway (taken from Code of Practice (EPA, 2007))



All of the SPR linkages identified in Table 5 have been included within this assessment.

**Table 6:** Network Diagram for Landfill Gas Migration Pathways (Lateral and Vertical) (taken from Code of Practice (EPA, 2007))



All of the SPR linkages identified in Table 6 have been included within this assessment.

Using the methodology developed by the EPA, the individual linkages were normalised to a rating of 100. Table 7 contains a summary of the results from the site prioritisation exercise.

 Table 7:
 Site Prioritisation Summary

SPR Linkages		Pathway via		SPR	Maximum	Normalised	
				Value	Score	Score	
SPR1	Leachate ⇒Surface		Combined groundwater	120	300	40%	
	Water		and surface water				
SPR2	Leachate ⇒ SWDTE		Combined groundwater and surface water	120	300	40%	
SPR3	Leachate	ın	Groundwater Pathway	120	240	50%	
	Presence (private	well)					
SPR4	Leachate   GWD	TE	Groundwater Pathway	0	240	0%	
SPR5	Leachate   Aquife	er	Groundwater Pathway	120	400	30%	
SPR6	Leachate	;	Groundwater Pathway	0	560	0%	
	Supply						
SPR7	Leachate ⇒ Surfac	ce	Groundwater Pathway	120	240	50%	
	Water						
SPR8 Leachate ⇒ Surface			Surface Water Pathway	0	60	0%	
111	Water	11	////////	///		11111	
	SPR9 Leachate ⇒ SWDTE		Surface Water Pathway	0	60	0%	
SPR10	SPR10   Landfill Gas ⇒ Huma		Lateral and Vertical	150	150	100%	
	Presence – off-site						
SPR11	Landfill Gas ⇒ Hui	man	Lateral and Vertical	250	250	100%	
	Presence – onsite						
	LL RISK SCORE	_	(5:10		HIGH		
			e of Risk Scores	201.1		5 11 1	
			core greater than or equal to 70% for any individual SPR linkages				
`		Score	core between 40% and 70% for any individual SPR linkages				
B)							
LOW Ris	sk (Class C)	Score less than 40% for any individual SPR linkages					

From this exercise SPR 8 and 9 have also been removed as there was no identified drainage ditches associated with the waste body. Sites with a score greater than or equal to 70% for any of the site specific SPR linkages are considered to represent potential high risk or high uncertainty sites. The risk classification assigned to the former landfill at Waterstown is Class A (High Risk) and represents the intrinsic risk that the former landfill poses to the environment. The linkages of greatest concern include the risk of landfill gas to onsite receptors and its migration to off-site receptors, both with normalised scores of 100% indicating high risk.

From the risk prioritisation process four SPR linkages have been removed including:

- SPR 4 groundwater pathway GWDTE
- SPR 6 groundwater pathway public supply
- SPR 8 surface water pathway for leachate migration
- SPR 9 surface water pathway for leachate migration

#### 5.0 TIER 2 EXPLORATORY SITE INVESTIGATION – METHODOLOGY

#### **5.1 Non-Intrusive Site Works**

#### 5.1.1 Preparatory Works – Health and Safety

In advance of any site works commencing, a number of meetings took place with SDCC in order to plan the works properly and to ensure that all of the required health and safety procedures would be in place. Following these meetings detailed method statements and the relevant site safety documentation were prepared, all of which were signed off by SDCC.

#### 5.1.2 Geophysical Survey

A geophysical survey was completed during November 2012 at the former landfill by Apex Geoservices (refer Appendix E). The primary objective in undertaking this survey was to assess the subsurface conditions including the thickness and extent of waste.

The survey methodology included:

- EM31 ground conductivity surveying at nominal 10m line separations.
- Fifteen 2D electrical resistivity tomography (ERT) profiles were carried out in order to provide information on the thickness of the waste materials and to try to identify any possible areas of leachate.
- Four seismic refraction profiles were completed to provide information on the stiffness
  of the waste material and, combined with the resistivity data, provide information of
  the different strata underlying the site. In addition, multichannel analysis of the
  surface wave (MASW) processing was carried out to provide further information on
  the stiffness of the different layers and to provide Gmax and Shear wave velocity (Vs)
  values of the subsurface material.

#### 5.1.3 Topographical Survey

A topographical survey was completed of the former landfill during January 2013 by Focus Surveys Ltd. (refer Appendix F). A base station located onsite was setup to the national coordinate system, Irish transverse Mercator (ITM), and Malin head datum. The base station then used these co-ordinates to make corrections for points logged using a GPS receiver attached to a detail pole on a jeep to increase the survey accuracy. The points logged were given a field code to identify their physical appearance and were downloaded and processed using AutoCAD software for further editing.

#### 5.2 Intrusive Site Investigation and Monitoring

In addition to the EPA Code of Practice, the site investigation was undertaken by MOR personnel taking cognisance of Section 7.6.2 of BS10175 - 2011 "Investigation of Potentially Contaminated Sites – Code of Practice". The intrusive exploratory site investigation was carried out in December 2012. The scope of work completed is described in the following sections.

The identified potential contaminant sources associated with gas (risk to onsite and off-site human receptors) and leachate migration (risk to groundwater, surface water and protected areas) were determined to be linked to the deposition of waste at the site; therefore soil, leachate, groundwater, surface water and gas investigations or monitoring were completed to focus on these linkages.

#### 5.2.1 Underground Utility Identification

An underground utility identification and locating procedure was completed prior to initiating any ground disturbance activities at the site or in adjacent properties. This involved a review of any service drawings from Eircom, ESB Networks, Bord Gais and SDCC, as well as liaising with site personnel. All investigation locations were scanned for live underground utilities using a cable avoidance tool (CAT).

#### 5.2.2 Trial Pit Excavation

Six trial pits (TP1 to TP6) were excavated at the site on the 4<sup>th</sup> and 5<sup>th</sup> December 2012 using a tracked excavator (refer Drawing No. 13). Trial pits were excavated to depths ranging from 2.5 to 4.05 metres below ground level (mbGL). All trial pits were logged by a Senior MOR Environmental Consultant.

#### 5.2.3 Soil/Waste Sampling

Soil and waste logging and sampling was carried out by a Senior MOR Environmental Consultant in accordance with MOR Quality Management System (QMS) procedures which is certified to ISO 9001. Soil brought to the surface from the trial pits and boreholes was inspected and described according to BS5930 - 1999 'Code of Practice for Site Investigations'. Soil was inspected for visual and olfactory evidence of contamination. The subsurface conditions encountered including soil type, subsurface structures, any evidence of contamination and water ingress were recorded and used for monitoring well construction design (where applicable). This information is presented on logs included in Appendix G.

Samples were collected for field testing and laboratory analysis. All soil samples were collected from the trial pits using best practice methods including the decontamination of sampling equipment between sample locations in accordance with MOR QMS procedures. Soil samples (15No.) were collected and sealed in appropriate laboratory supplied containers; samples were stored in cool dark conditions for transfer to Jones Environmental Laboratory (UK), a UKAS accredited laboratory for analysis. Split samples collected were screened for the presence of volatile organic compounds (VOCs) using a portable Photoionisation detector (PID). PID results are included on the logs (Appendix G). Sample details including location and depth of samples were recorded on chain of custody records, copies of which are included in Appendix H.

#### 5.2.4 Borehole Drilling

A shell and auger drill rig was mobilised to site to drill 3No. combined gas/leachate monitoring wells (BH1 to BH3) at locations onsite between the 5<sup>th</sup> and 12<sup>th</sup> December 2012. The boreholes were advanced into made-ground/natural soil, where feasible, to depths ranging from 7.2m to 9.1mbGL.

A track-mounted air rotary rig was mobilised to the site to drill the 3No. groundwater monitoring wells (MW4 to MW6) at three locations between the 6<sup>th</sup> and 12<sup>th</sup> of December 2012. A cased rotary drilling method was utilised to advance all boreholes into gravel or bedrock to depths ranging from 8.7m to 14.5mbGL.

Details regarding the geological and hydrogeological conditions, including groundwater strikes encountered during drilling, were recorded by a Senior MOR Environmental Consultant and utilised in monitoring well construction design. Borehole records are included in Appendix G and their locations are shown on Drawing No. 13.

#### 5.2.5 Groundwater and Leachate Well Specification

Groundwater monitoring wells at the site were installed within the gravel layer/ limestone bedrock aquifer. Combined leachate/gas monitoring wells were installed within madeground (waste/capping layer). All monitoring wells were constructed with 50mm PVC casing and machine slotted screen and were finished with heavy-duty, flush-mount or upright covers depending on client requirements. Monitoring well installation was supervised by a Senior MOR Environmental Consultant. The groundwater monitoring wells were developed using a inertial pump following construction to ensure good hydraulic connection with the target aquifer and to remove excess suspended sediments. The combined leachate/gas wells were completed with a landfill gas cap. Monitoring well completion details are included in Appendix G. The monitoring well locations are shown on Drawing No. 13.

In order to ensure that leachate would not migrate from the waste body to the underlying aquifer during the drilling works a number of measures were employed including:

- Boreholes were cased off as the hole was advanced to the target depth. This method was employed for all boreholes drilled.
- Boreholes drilled within the waste body were advanced until the top of the native material was encountered or an obstruction.
- Combined leachate/gas wells were screened within the waste body. Where the
  borehole was advanced into the underlying clay the base of the borehole was sealed
  off with bentonite to ensure that a pathway from the waste body to groundwater was
  not provided.
- Groundwater monitoring wells were designed and constructed to ensure that wells
  were screened within the target zone and not screened across different water bearing
  units. The well annulus above the screen section was sealed with bentonite to ensure
  that a pathway from the waste body to groundwater within the overburden (sand &
  gravel) / bedrock aquifer was not provided.

#### 5.2.6 Photo-ionisation Detector (PID) Screening

A PID was utilised during the exploratory investigation to screen samples for the presence of volatile compounds.

#### 5.2.7 Landfill Gas Screening

A landfill gas meter, a Geotech GA2000 landfill gas analyser, was utilised during the site investigation works to screen for the presence of landfill gases such as carbon dioxide, methane and carbon monoxide.

#### **5.3 Site Investigation Location Survey**

All boreholes and trial pits installed as part of this exploratory site investigation were surveyed relative to Ordnance Datum. The top of the well casing of the installed groundwater and combined gas/leachate monitoring wells were surveyed to provide a fixed reference point (refer to Table No. 8).

#### 5.4 Environmental Monitoring

#### 5.4.1 Soil Laboratory Analysis

Of the 15No. samples collected and submitted to the laboratory 4No. were selected for soil and soil leachate laboratory analysis for specific compounds based on PID results, visual and olfactory observations, type of material (e.g. fill or native) and the depth of the sample. All of the samples were analysed for the waste acceptance criteria (WAC) analytical suite for inert, non-hazardous and hazardous licensed waste facilities as follows:

#### Soil:

- total organic carbon (TOC);
- Mineral oil;
- benzene, toluene, ethylbenzene and total xylenes (BTEX) and MTBE;
- polychlorinated biphenyls (PCBs); and,
- polycyclic aromatic hydrocarbons (PAHs).

#### Soil/Waste Leachate (CEN 10:1 and NRA):

- indicators and inorganics: chloride, fluoride, sulphate, dissolved organic carbon (DOC) and total dissolved solids (TDS);
- metals: antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium and zinc; and,
- phenol.

#### 5.4.2 Groundwater Level Monitoring

Gauging of groundwater levels in the monitoring wells was completed on the 20<sup>th</sup> December 2012 using a Solinst water level meter. Data from these water level monitoring events are included in Table 9. Continuous monitoring of groundwater levels was also carried out for BH2, MW4 and MW5 between the 20<sup>th</sup> December 2012 and the 9<sup>th</sup> January 2013 using submersible data loggers corrected for barometric pressure (Appendix I). BH2, installed in the made ground (waste) layer, is located in the centre of the site. MW4, installed in the limestone bedrock aquifer, is located in the southern portion of the site. MW5, installed in the sand and gravel material, is located downgradient of these wells in the northern portion of the site, adjacent to the River Liffey. All measurements were taken relative to the top of the well casing, therefore results are reported as meters below top of casing (mbtoc) and meters above ordnance datum (maOD).

#### 5.4.3 Groundwater Monitoring

Groundwater samples were collected from monitoring wells MW4, MW5 and MW6 (Drawing No. 13) on the 13<sup>th</sup> December 2012. Static groundwater levels were measured at each monitoring well using a Solinst<sup>®</sup> water level meter prior to purging. In order to ensure extraction of samples representative of formation water, and prior to sampling, three well volumes were purged from each well using an inertial pump with dedicated tubing and a footvalve to prevent cross-contamination between wells. Field measured water quality parameters using calibrated equipment (YSI water quality meter) including measurements of pH, electrical conductivity (EC), temperature, dissolved oxygen (DO) and oxidation reduction potential (ORP), together with observations on the physical appearance of purged water were recorded at the time of sampling.

After purging, the groundwater samples were decanted into labelled containers supplied by the laboratory, Jones Environmental Laboratory. Due to the use of dedicated or disposable sampling equipment at each well, cross contamination was avoided. The sample containers

were kept cool and in darkness and were sent to the laboratory for analysis. In order to maintain sample integrity, a chain of custody record (Appendix J) was completed to track sample possession from time of collection to time of analysis.

Groundwater samples were analysed in the laboratory for a broad range of potential contaminants. The groundwater analytical suite closely followed the parameters as set out in Table C.2 for the EPA Landfill Monitoring Manual (2003) for 'Groundwater Baseline'. The groundwater analytical suite for this site included the following parameters:

- indicators and inorganics: sulphate, chloride, fluoride and total cyanide;
- ammonia;
- total oxidised nitrogen (TON);
- molybdate-reactive phosphorus (MRP);
- metals including arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc, calcium, magnesium, potassium and sodium;
- volatile organic compounds (VOCs) including dichloromethane;
- semi-volatile organic compounds (SVOCs) including Polycyclic Aromatic Hydrocarbons (PAHs), phenols and phthalates;
- pesticides: atrazine and simazine, organophosphorus pesticides, organochlorine pesticides and acid herbicides;
- total and faecal coliforms;
- total dissolved solids;
- alkalinity as CaCO<sub>3</sub>; and,
- total organic carbon (TOC).

#### 5.4.4 Leachate Monitoring

Leachate sampling was carried out on the 13<sup>th</sup> December 2012. As BH1 and BH3 were dry at time of sampling, a sample was collected from BH2 only (Drawing No. 13) and field parameters measured. The sample was collected using a disposable bailer and decanted into labelled containers supplied by Jones Environmental Forensics Ltd. Due to the use of disposable sampling equipment, cross contamination was avoided. During sample collection, water quality measurements of pH, EC, temperature, DO and ORP were taken as well as notes on the physical appearance of the leachate sample.

The sample containers were kept cool and in darkness and were sent to the laboratory for analysis. In order to maintain sample integrity, a chain of custody record (Appendix J) was completed to track sample possession from time of collection to time of analysis.

The leachate sample was analysed for a broad range of potential contaminants. The leachate analytical suite closely followed the parameters as set out in Table C.2 for the EPA Landfill Monitoring Manual (2003) for 'Leachate Characterisation'. The leachate analytical suite for this site included the following parameters:

- indicators and inorganics: sulphate, chloride, fluoride and total cyanide;
- ammonia;
- TON;
- MRP;
- metals including arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc, calcium, magnesium, potassium and sodium;
- VOCs including dichloromethane;
- SVOCs including PAHs, phenols and phthalates;
- pesticides: atrazine and simazine, organophosphorus pesticides, organochlorine pesticides and acid herbicides; and,
- biological oxygen demand (BOD) and chemical oxygen demand (COD).

#### 5.4.5 Surface Water Monitoring

The tender documents required one full screen and one indicator suite from both the River Liffey and the mill race. Surface water monitoring was conducted at 6No. locations (SW1 to SW6) on the 12<sup>th</sup> December 2012 in order to compile representative data from both upstream and downstream of the former landfill.

- Two surface water samples were collected upstream of the site from the River Liffey and mill race (SW2 and SW1) respectively.
- Two surface water samples were collected at the downstream boundary of the site from the River Liffey and mill race (SW4 and SW3) respectively.
- Two surface water samples were collected further downstream of the site from the River Liffey and mill race (SW6 and SW5) respectively.

The 6No. surface water monitoring locations are shown on Drawing No. 13.

During sample collection, water quality measurements of pH, EC, temperature, DO and ORP were taken for all samples as well as notes on the physical appearance of the water samples. Surface water samples were collected and decanted into labelled containers supplied by the laboratory, Jones Environmental Forensics Ltd. The sample containers were kept cool and in darkness and were sent to the laboratory for analysis. In order to maintain sample integrity, a chain of custody record (Appendix J) was completed to track sample possession from time of collection to time of analysis.

A summary of the additional lab analysis completed is as follows:

- The upstream samples, SW1 and SW2, were analysed for indicator parameters.
- SW5 and SW6, were analysed for a broad range of potential contaminants set out in Table C.2 for the EPA Landfill Monitoring Manual (2003) for 'Surface Water Baseline'. The surface water analytical suite included the following parameters:
  - o indicators and inorganics: sulphate, chloride, fluoride and total cyanide;
  - o ammonia;
  - o TON;
  - o EPH (C8-C40)
  - o MRP;
  - metals including arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc, calcium, magnesium, potassium and sodium:
  - VOCs including BTEX, MTBE and dichloromethane;
  - SVOCs including PAHs, phenols and phthalates;
  - pesticides: atrazine and simazine, organophosphorus pesticides, organochlorine pesticides and acid herbicides;
  - total suspended solids;
  - o alkalinity as CaCO<sub>3</sub>; and,
  - BOD and COD.

#### 5.4.6 Landfill Gas Monitoring

Landfill gas was monitored on the 20<sup>th</sup> December 2012 and again on the 16<sup>th</sup> May 2013 at the newly installed landfill gas wells, BH1, BH2 and BH3. Readings were collected using a Geotech GA2000 landfill gas analyser with flow measurement capabilities. The landfill gas monitoring locations are shown on Drawing No. 13.

The following parameters were recorded during the monitoring event:

- Stable and peak methane;
- Carbon dioxide;

- Oxygen;
- Hydrogen sulphide;
- Carbon monoxide;
- Barometric pressure;
- Relative pressure;
- Balance of gases; and,
- Flow.

#### **6.0 TIER 2 RESULTS**

#### 6.1 Geophysical Survey

The geophysical survey indicates that material containing waste extends across an area of approximately 570m x 350m however the extent of the waste adjacent to the southern and eastern boundaries were not fully delineated by the survey (refer to Section 1.5).

The waste material was generally identified to be within a matrix of silty gravelly clay and gravelly clay and was interpreted to comprise of the following three waste types:

- Category 1: Mainly gravelly clay and municipal and C&D waste;
- Category 2: Mainly municipal and C&D waste and clay; and,
- Category 3: Mixed municipal and C&D waste.

The area interpreted as mainly municipal waste i.e. Category 3 measures approximately 380m x 200m in the south-centre of the waste body. The thickest zones of waste are interpreted to be approximately 17.0m thick, with the lower parts of these thicker zones comprising native material that may have been impacted by the waste. The geophysical survey results indicate that in general leachate does not extend into the bedrock beneath the waste body. Refer to Section 3.4 of the Geophysical Report (Appendix E) for more detail.

The overburden material generally comprises of clayey/gravel in the western portion of the site and generally silt/clay/silty gravelly clay in the northern portion of the site adjacent to the River Liffey. The remaining areas were generally interpreted as silty gravelly clay/gravelly clay.

Bedrock identified beneath the site has been interpreted as Calp limestone & shale, and has generally been interpreted to be at depths ranging from 10 to 20metres below ground level (mbGL) beneath the waste body. The shallowest depth to bedrock was interpreted to be 2.0mbGL in the southwest portion of the site. The results also indicate the location of an old quarry face in the northern portion of the site.

The geophysical report is included in Appendix E.

#### 6.2 Topographical Survey

The mapping output from the topographical survey is included in Appendix F. As expected the lowest point recorded in the survey was 9.28maOD (ground level) in the north-eastern corner of the site close to the River Liffey and Mill Race, and the highest point recorded was 44.83maOD located by the main gates into the park.

#### 6.3 Visual and Olfactory Observations

#### 6.3.1 Surface

No evidence of surface contamination was observed within the former landfill site.

#### 6.3.2 Subsurface Material

The subsurface profile encountered within the landfill and outside of the landfill area consisted of made ground above the waste body (i.e. capping layer) generally comprising of sandy/gravelly clay, and sandy/gravelly silt/clay with some brick, charcoal, ceramics, timber, wood, metal and plastic inclusions.

In the trial pits, the municipal waste was encountered beneath the madeground at depths ranging from 0.5 mbGL (TP2) to 3.5mbGL (TP6) and generally consisted of mixed municipal waste with some demolition waste (C&D) including brick, concrete, plastic, glass, metal, fabric, rubber (e.g. tyres) timber, paper, ashy material and refuse bags with decomposed waste. In addition some containers of paint were encountered (TP3). Waste was encountered at all trial pits (TP2 – TP6) and borehole locations (BH1 to BH3) installed within the former landfill. The base of the waste during the exploratory works was encountered at depths ranging from 7.0 mbGL (BH3) and 7.4 mbGL (BH1). BH2 terminated at 7.1mbGL due to an obstruction although it was considered that native material had been reached.

Native soil encountered beneath the madeground outside of the former landfill was encountered at depths ranging from 1.5mbGL (MW5) to 5.7mbGL and generally consisted of silty/gravelly sand, sandy gravel, sandy/gravelly clay and sandy/gravelly silt. Within the landfill; native material consisted of sandy/gravelly clay and silt/clay was encountered beneath the waste at depths ranging from 7.0 mbGL (BH3) to 7.4 mbGL (BH1).

Limestone bedrock was encountered beneath the gravel at a depth of 10.4mbGL (MW4) in the southern portion of the site.

Perched water/leachate seepages were encountered at discrete locations within the waste at TP2, TP5, BH2 and BH3 at depths ranging between 1.1 mbGL (BH3) and 6.5mbGL (BH2). Groundwater strikes were encountered in the bedrock at 11.3mbGL (MW4) and within the sand and/or gravel at depths ranging between 2.4mbGL (TP1) and 7.2mbgl (MW6).

#### 6.3.3 Vertical Extent of Waste

The maximum vertical extent of waste observed during trial pitting and borehole installation was 7.4 mbGL (BH1). Estimates identified in the SDCC Tier I report of 9mbGL are consistent. Although the geophysical survey indicated maximum depths of 17mbGL these conditions were not identified during the intrusive works.

The landfill cap thickness encountered in trial pits and boreholes ranged from 0.5m (TP2) to 3.5m (TP6).

A schematic cross section has been completed (refer to Drawing No. 14a).

#### 6.3.4 Horizontal Extent of Waste

The exact boundary of the original landfill, which dates back to 1983, and the phases of filling are unclear from the maps and aerial photographs reviewed. The horizontal extent of waste materials has been approximated from the geophysical survey. The area of the site believed to be underlain by waste is approximately 20ha. The northern extent of the waste was delineated however due to the presence of dense vegetation and adjoining properties and the scope of work the southern and eastern boundary of the landfill has not been fully delineated by the geophysical survey. However, it is likely that the southern boundary is the roadway given the pre-existence of residential properties on the southern boundary as visible on the 1985 aerial photograph. The main area of waste is estimated be 7.6ha (380x200m) and is located in the south-central area of the former landfill (refer to drawing No. 14b).

#### 6.3.5 Volume of Waste

Volumetric calculations of waste were completed using measurements of the thickness of waste from the investigation locations on site and geophysical survey data. Based on conservative calculations, the volume of waste material within the former landfill could be in the region of 1,250,000m<sup>3</sup>.

The quantity of capping material placed onsite was estimated from the geophysical survey and logs and could be in the region of 300,000m<sup>3</sup>.

However, given the small number of investigations points that reached the base of the waste compared to the area in question, this figure could vary and should be reviewed following receipt of any further site investigation data or records.

#### 6.4 Groundwater Levels

#### 6.4.1 Datalogger Results

The groundwater level data for the two week monitoring period shows that the perched water in the made ground material (BH2), the sand and gravel sediments adjacent to the river (MW5) and the limestone bedrock aquifer beneath the site (MW4) respond quickly to rainfall. Refer to Graphs 1 to 4 in Appendix I.

#### 6.4.2 Inferred Groundwater Flow Direction

The groundwater contour diagram (refer Drawing No. 15) indicates that the groundwater flow is, as expected, to the north-northeast towards the River Liffey.

#### 6.5 Soil, Groundwater, Leachate and Surface Water Analytical Results

#### 6.5.1 Photo-ionisation Detector (PID) Screening

PID screening results are presented on the borehole and trial pit logs (Appendix G). PID readings for all samples were 0ppm.

#### 6.5.2 Soil Results

Soil analytical results were assessed relative to the criteria for landfills outlined in the document 'Establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (2003/33/EC)'. The criteria used were as follows:

- Criteria for landfills for inert waste.
- Criteria for landfills for non-hazardous waste.
- Criteria for landfills for hazardous waste.

Analytical results together with the relevant waste assessment criteria (WAC) are presented in Table 10.

#### Total Organic Carbon (TOC)

Reported concentrations of TOC ranged from 1.6% (TP2) to 12.9% (TP4). TP4 exceeded the WAC for landfills for Inert and hazardous waste values of 3% and 6% respectively. However, the Dissolved Organic Carbon (DOC) value can be taken into account in event of an elevated TOC value and in this instance the material can be classified as inert for the purpose of disposal.

#### Petroleum Hydrocarbons

Mineral Oil (C8-C40)

Reported results for mineral oil were above the laboratory MDL for all samples and ranged from 183mg/kg (TP2) to 7065mg/kg (TP4). Two samples, TP3 and TP4, exceeded the inert WAC (500mg/kg) with values of 571mg/kg and 7065mg/kg respectively.

#### **MTBE**

Concentrations of MTBE did not exceed the laboratory MDL of 5µg/kg.

#### BTEX

Benzene concentrations were below the relevant laboratory MDL ( $5\mu g/kg$ ) for all samples except TP3 ( $18\mu g/kg$ ). Reported results for toluene were above the laboratory MDL for all samples and ranged from  $7\mu g/kg$  (TP2) to  $66\mu g/kg$  (TP3). Concentrations of ethylbenzene were above the laboratory MDL for all samples and ranged from  $11\mu g/kg$  (TP4 and TP5) to  $107\mu g/kg$  (TP3). Concentrations of m/p xylene were above the relevant MDL for all samples and ranged from  $8\mu g/kg$  (TP4) to  $275\mu g/kg$  (TP3). Concentrations of o-xylene were above the MDL for all samples and ranged from  $13\mu g/kg$  (TP5) to  $95\mu g/kg$  (TP3). No BTEX parameters exceeded the relevant WAC.

#### Polycyclic Aromatic Hydrocarbons (PAHs)

Detectable concentrations of Total 6 PAHs<sup>1</sup> were reported ranging from 1.27mg/kg (TP5) to 9.72mg/kg (TP3). TP4 was diluted by a factor of ten and was below the laboratory MDL of 2.20mg/kg. Total 17 PAHs ranged from 2.52mg/k (TP5) to 20.27mg/kg (TP3). TP4 was diluted by a factor of ten and was below the laboratory MDL of 6.40mg/kg. WAC for PAHs has not been identified in the Council Directive which permits member states to identify their own PAH WAC. Typical WAC for PAHs is 100mg/kg for the Murphy Inert facility. None of the results exceeded this value.

#### Polychlorinated Biphenyls (PCBs)

Reported concentrations of individual and total PCBs were below the MDL for TP3 and TP4. The sample taken at TP2 had a value of 20µg/kg for PCB 28 while TP5 had a value of 9µg/kg for PCB 28 also. All other PCB congeners and total PCBs for both TP2 and TP5 were below their respective MDLs. No samples exceeded the WAC.

#### Soil Leachate (CEN 10:1 and NRA)

Soil leachate analysis was undertaken on samples using the CEN10:1 and NRA methods as requested in the tender. The CEN10:1 analysis has units in mg/kg while NRA has units of mg/l. CEN10:1 soil leachate analysis was undertaken on samples TP2 and TP4 while NRA soil leachate analysis was undertaken on TP3 and TP5.

#### Metals

#### Arsenic

Arsenic concentrations at TP2 and TP4 were below the MDL (0.025mg/kg) and did not exceed the WAC.

Arsenic concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.0025mg/l).

#### Barium

Barium concentrations at TP2 and TP4 were 1.00m/kg and 0.31mg/kg respectively and did not exceed the WAC.

Barium concentrations from the NRA leachate samples, TP3 and TP5, were 0.109mg/l and 0.63mg/l respectively.

#### Cadmium

Cadmium concentrations at TP2 and TP4 were below the MDL (0.005mg/kg) and did not exceed the WAC.

Cadmium concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.0005mg/l).

<sup>&</sup>lt;sup>1</sup> (benzo(k)fluoranthene, benzo(a)pyrene, benzo(b)fluoranthene, fluoranthene, indeno(1,2,3-cd)pyrene, and benzo(ghi)perylene)

#### Chromium

Chromium concentrations at TP2 and TP4 were below the MDL (0.015mg/kg) and did not exceed the WAC.

Chromium concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.0015mg/l).

#### Copper

Copper concentrations at TP2 and TP4 were below the MDL (0.07mg/kg) and did not exceed the WAC.

Copper concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.007mg/l).

#### Mercury

Mercury concentrations at TP2 and TP4 were both 0.0001mg/kg and did not exceed the WAC.

Mercury concentrations from the NRA leachate samples, TP3 and TP5, were 0.00005mg/l and 0.00081mg/l respectively.

#### Molybdenum

Molybdenum concentrations at TP2 and TP4 were 0.23mg/kg and 0.17mg/kg respectively and did not exceed the WAC.

Molybdenum concentrations from the NRA leachate samples, TP3 and TP5, were 0.01mg/kg and 0.013mg/kg respectively.

#### Lead

Lead concentration at TP2 was 0.05mg/kg and below the MDL (0.05mg/kg) at TP4. Neither sample exceeded the WAC.

Lead concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.005mg/l).

#### Nickel

Nickel concentration at TP2 was 0.17mg/kg and below the MDL (0.02mg/kg) at TP4. Neither sample exceeded the WAC.

Nickel concentrations from the NRA leachate samples, TP3 and TP5, were 0.002mg/l and 0.003mg/l respectively.

#### **Antimony**

Antimony concentrations at TP2 and TP4 were below the MDL (0.02mg/kg) and did not exceed the WAC.

Antimony concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.002mg/l).

#### Selenium

Selenium concentrations at TP2 and TP4 were below the MDL (0.03mg/kg) and did not exceed the WAC.

Selenium concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.003mg/l).

#### Zinc

Zinc concentration at TP2 was 0.11mg/kg and below the MDL (0.03mg/kg) at TP4. Neither sample exceeded the WAC.

Zinc concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.003mg/l).

#### Indicators and inorganics

Sulphate concentrations at TP2 and TP4 were 7409.1mg/kg and 560.7mg/kg. The sulphate concentration at TP2 exceeded the WAC for inert landfills of 1000mg/kg but did not exceed the WAC for non-hazardous landfills.

Sulphate concentrations from the NRA leachate samples, TP3 and TP5, were 139.12mg/l and 4.01mg/l respectively.

Chloride concentrations at TP2 and TP4 were 118mg/kg and 29mg/kg respectively and did not exceed the WAC.

Chloride concentrations from the NRA leachate samples, TP3 and TP5, were 2.5mg/l and 0.5mg/l respectively.

Fluoride concentrations at TP2 and TP4 were below the MDL (3mg/kg) and did not exceed the WAC.

Fluoride concentrations from the NRA leachate samples, TP3 and TP5, were below MDL (0.3mg/l) at TP3 and 0.5mg/l at TP5.

#### Dissolved Organic Carbon (DOC)

DOC concentrations at TP2 and TP4 were 190mg/kg and 170mg/kg respectively and did not exceed the WAC.

DOC concentrations from the NRA leachate samples, TP3 and TP5, were 15mg/l and 9mg/l respectively.

#### Total Dissolved Solids (TDS)

TDS concentrations at TP2 and TP4 were 10542mg/kg and 1820mg/kg. The TDS concentration at TP2 exceeded the WAC for inert landfills of 4000mg/kg but did not exceed the WAC for non-hazardous landfills.

TDS concentrations from the NRA leachate samples, TP3 and TP5, were 372mg/l and 130mg/l respectively.

#### Phenols

Phenol exceeded the WAC for inert landfills (1mg/kg) at both TP2 (37.1mg/kg) and TP4 (7.6mg/kg). However, the WAC for non-hazardous landfills was not exceeded in either sample.

Phenol concentrations from the NRA leachate samples, TP3 and TP5, were below the MDL (0.01mg/l).

#### 6.5.3 Groundwater Analytical Results

Groundwater results were assessed relative to available Irish guideline and legislative standards as follows:

- European Communities Environmental Objectives (Groundwater) Regulations, 2010. (SI No. 9 of 2010).
- In the absence of Environmental Objectives for certain parameters, the Environmental Protection Agency (EPA) interim groundwater guideline values (IGVs) (EPA, 2003) were used.

Groundwater analytical results together with the relevant assessment criteria are presented in Table No. 11.

#### **Indicators**

#### Field Indicators

Field measured parameters such as pH, EC, DO, temperature and ORP were measured onsite. EC values measured ranged from  $628\mu\text{S/cm}$  (MW4) to  $1,294\mu\text{S/cm}$  (MW5). The

sample collected from MW5 exceeded the guideline value of 800µg/l for the presence of saline or other intrusion stipulated in the groundwater regulations but all samples were below the guideline value of 1875 µg/l for human use. Temperature readings varied from 10.6°C (MW4) to 11.4°C (MW6) and were within the relevant guideline value of 25°C. pH values ranged from 6.30 pH units (MW5) to 11.43 pH units (MW6). MW5 was found to be below the EPA IGV guideline range of 6.5-9.5 pH units, while MW6 was above the guideline range.

There are no guideline values for DO or ORP. DO concentrations measured on site ranged from 33% (MW5) to 76.2% (MW4). ORP measured ranged from a negative ORP value of 270.1mV (MW6) to a positive ORP of 98.3mV (MW4). A negative ORP is indicative of reducing conditions while a positive ORP is indicative of oxidising conditions.

#### Indicators and inorganics

#### Sulphate

Sulphate was detected at concentrations ranging from 20.61mg/I (MW5) to 99.59mg/I (MW6) and did not exceed the relevant guideline values.

#### Chloride

Chloride concentrations ranged from 30mg/l (MW4) to 78.3mg/l (MW5). MW5 and MW6 (34.2mg/l) exceeded the EPA IGV groundwater objectives threshold value (30mg/l).

#### Fluoride

Fluoride concentrations at MW4, MW5 and MW6 were below the MDL (0.3mg/l) and did not exceed the relevant guideline values (1mg/l).

#### Ammoniacal Nitrogen

Ammoniacal nitrogen concentrations ranged from 0.15mg/l (MW4) to 9.66mg/l (MW5). MW5 and MW6 (6.62mg/l) exceeded the relevant groundwater quality objectives threshold value of 0.175mg/l.

#### Total Oxidised Nitrogen (TON)

TON was detected above the laboratory MDL (0.2mg/l) in one sample (MW5), with a concentration of 1.2mg/l. There are no threshold values for TON.

#### Molybdate Reactive Phosphorus (MRP)

MRP concentrations ranged from  $38\mu g/l$  (MW4) to  $111\mu g/l$  (MW6) and all three samples (MW4, MW5 and MW6) exceeded the relevant groundwater quality objectives threshold value of  $35\mu g/l$ .

#### Total Dissolved Solids (TDS)

TDS concentrations ranged from 386mg/l (MW6) to 928mg/l (MW5). All samples analysed were below the relevant EPA IGV guideline value (1000mg/l).

#### Total Alkalinity

Total alkalinity concentrations ranged from 124mg/l (MW6) to 404mg/l (MW5). There are no threshold values for total alkalinity.

#### Total Organic Carbon (TOC)

Concentrations of TOC ranged from 9mg/l (MW4) to 19mg/l (MW6). There are no threshold values for TOC.

#### Total Cyanide

Total cyanide was not detected above the laboratory MDL (0.01mg/l) for the samples analysed and did not exceed the relevant groundwater guidelines.

#### Microbiological parameters

Total coliforms ranged from below MDL at MW6 (1 most probably number (MPN)/100ml) to 43.5 MPN/100ml (MW4). MW4 and MW5 (28.5 MPN/100ml) exceeded the relevant EPA IGV guideline value (0 MPN/100ml).

Faecal coliforms ranged from below MDL at MW4 and MW6 (<1 colony forming units (cfu)/100ml) to 1 cfu/100ml (MW5). MW5 (1 cfu/100ml) exceeded the relevant EPA IGV quideline value (0 cfu/100ml).

#### Metals

#### Mercury

Reported concentrations of dissolved mercury were below the laboratory MDL (1µg/l). However, the laboratory MDL exceeds the relevant groundwater guideline (0.75µg/l).

#### Boron

Dissolved boron concentrations ranged from  $31\mu g/I$  (MW4) to  $545\mu g/I$  (MW5) and did not exceed the relevant guideline values.

#### Arsenic

Dissolved arsenic concentrations ranged from 2.6µg/l (MW4) to 10.3µg/l (MW5). MW5 exceeded the groundwater objectives threshold value of 7.5µg/l.

#### Zinc

Dissolved zinc concentrations ranged from below the laboratory MDL  $(3\mu g/I)$  at MW6 to  $49\mu g/I$  (MW5) and did not exceed the relevant guideline value.

#### Lead

Reported concentrations of dissolved lead ranged from 6µg/l (MW4 and MW6) to 10µg/l (MW5) but did not exceed the threshold value.

#### Nickel

Dissolved nickel concentrations ranged from 3µg/I (MW4) to 30µg/I (MW5) and exceeded the groundwater objectives threshold value of 15µg/I at MW5 and MW6 (23µg/I).

#### Copper

Reported concentrations of dissolved copper were below the laboratory MDL (7µg/l) and did not exceed the relevant threshold value.

#### Chromium

Total dissolved chromium concentrations in excess of the laboratory MDL (1.5 $\mu$ g/l) was detected at MW6 (2  $\mu$ g/l) and did not exceed the threshold value.

#### Cadmium

Reported concentrations of dissolved cadmium were below the laboratory MDL (0.5µg/l) for all samples and did not exceed the threshold value.

#### Manganese

Dissolved manganese concentrations ranged from below the laboratory MDL (2 $\mu$ g/l) at MW6 to 1644 $\mu$ g/l (MW5) and exceeded the relevant EPA IGV of 50 $\mu$ g/l at MW4 (464  $\mu$ g/l) and MW5.

#### Iron

Reported concentrations of total dissolved iron were below the laboratory MDL (20µg/l). However the laboratory MDL exceeds the relevant groundwater guideline (18.75µg/l).

#### Potassium

Dissolved potassium concentrations ranged from 2.7mg/l (MW4) to 26.4mg/l (MW6) and exceeded the relevant EPA IGV value of 5mg/l at MW6 and MW5 (15.9mg/l).

#### Sodium

Dissolved sodium concentrations ranged from 22.7mg/l (MW4) to 94.5mg/l (MW5) and did not exceed the relevant threshold value.

#### Calcium

Dissolved calcium concentrations ranged from 60.3mg/l (MW6) to 268.4mg/l (MW5). MW5 exceeded the relevant guideline value (200mg/l).

#### Magnesium

Dissolved magnesium concentrations ranged from below the laboratory MDL (0.1mg/l) at MW6 to 32mg/l (MW5) and did not exceed the relevant guideline value.

#### **sVOCs**

Reported concentrations of sVOCs were below the relevant laboratory MDLs for all parameters.

#### **VOCs**

Reported concentrations of VOCs were below the relevant laboratory MDLs for all parameters.

#### Polycyclic Aromatic Hydrocarbons (PAHs)

Concentrations of the seventeen PAH's analysed for MW4, MW5 and MW6 did not exceed their respective laboratory MDLs.

#### Phthalates

Concentrations of the six phthalates analysed for MW4, MW5 and MW6 did not exceed their respective laboratory MDLs.

#### **Pesticides**

Reported concentrations of atrazine and simazine were below the laboratory MDL (1 $\mu$ g/l for both parameters) for all samples. However, the laboratory MDL exceeded the relevant groundwater regulation value (0.075 $\mu$ g/l).

#### Organochlorine Pesticides

Concentrations of the organochlorine pesticides analysed for MW4, MW5 and MW6 did not exceed their respective laboratory MDLs.

#### Organophosphorus Pesticides

Concentrations of the organophosphorus pesticides analysed for MW4, MW5 and MW6 did not exceed their respective laboratory MDLs.

#### Acid Herbicides

Concentrations of all other pesticides analysed for MW4, MW5 and MW6 did not exceed their respective laboratory MDLs.

#### **sVOCs**

Reported concentrations of sVOCs were below the relevant laboratory MDLs and relevant guideline values for all parameters.

#### **VOCs**

Reported concentrations of VOCs were below the relevant laboratory MDLs and relevant guideline values for all parameters.

### 6.5.4 Leachate Analytical Results

Leachate results were assessed relative to available Irish guideline and legislative standards as follows as a conservative assessment in the event of the direct discharge to relevant bodies. Leachate results were also briefly reviewed in the context of the EPA Landfill Manual Design typical leachate composition values.

- European Communities Environmental Objectives (Groundwater) Regulations, 2010. (SI No. 9 of 2010).
- In the absence of Environmental Objectives for certain parameters, the Environmental Protection Agency (EPA) interim groundwater guideline values (IGVs) (EPA, 2003) were used.
- European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2012. (SI No. 327 of 2012).
- EPA (2000) Landfill Manuals: Landfill site design. Taken from Table 7.2: Summary of composition of methanogenic leachates sampled from large landfills with a relatively dry high waste input rate.

Only one leachate sample (BH2) was taken as no retrievable sample was possible from BH1 and BH3 as the two boreholes were dry at the time of sampling. Leachate results together with the relevant assessment criteria are presented in Table 12.

With regards to the EPA landfill site design values, the leachate values reported were within typical values observed.

## *Indicators*

# Field Indicators

Similar to the groundwater samples, field measured parameters such as pH, EC, DO, temperature and ORP were measured onsite. EC value measured at BH2 was  $2007\mu S/cm$  which exceeds the groundwater regulation value of  $1875 \mu S/cm$  for human use. Temperature reading at BH2 was  $11.1^{\circ}C$ . pH value at BH2 was 6.20 which was below the surface water regulations guideline range of 6-9.5 pH units. DO concentration measured at BH2 was 54.6%. The ORP reading ranged was a negative ORP of -45.3mV.

# Indicators and inorganics

Sulphate was detected at a concentration of 16.24mg/l at BH2 and did not exceed the relevant threshold value.

# Chloride

Chloride was detected at a concentration of 135.3mg/l at BH2 and did not exceed the relevant threshold value.

#### Fluoride

Reported concentration of fluoride was below the laboratory MDL for sample BH2 and did not exceed the relevant groundwater guideline value.

# Total Cyanide

Reported concentration of total cyanide was below the laboratory MDL for sample BH2 and did not exceed the relevant groundwater guideline value.

### Ammoniacal Nitrogen

Ammoniacal nitrogen concentration at BH2 was 45.4mg/l and exceeded both the groundwater and surface water regulation guideline values of 0.175mg/l and 0.065mg/l respectively.

# Total Oxidised Nitrogen (TON)

TON was below the laboratory MDL (0.2mg/l) at BH2. There are no threshold values for TON.

# Molybdate Reactive Phosphorus (MRP)

MRP concentration at BH2 was 161µg/l and exceeded both the groundwater regulation (35µg/l) and surface water regulation (35µg/l) guideline values.

# Biochemical Oxygen Demand (BOD)

BOD concentration at BH2 was 199mg/l and exceeded the relevant surface water guideline value (1.5mg/l).

# Chemical Oxygen Demand (COD)

COD concentration at BH2 was 328mg/l. There are no threshold values for COD.

# Metals

# Mercury

Reported concentration of dissolved mercury at BH2 was below the laboratory MDL ( $1\mu g/l$ ). However the laboratory MDL exceeds the relevant surface and groundwater guideline values of  $0.07\mu g/l$  and  $0.75\mu g/l$  respectively.

#### Boron

Dissolved boron concentration at BH2 was  $740\mu g/l$  and did not exceed the relevant groundwater guideline value (750  $\mu g/l$ )

#### Arsenic

Dissolved arsenic concentration at BH2 was 22.4µg/l which exceeded the relevant groundwater guideline value (7.5µg/l).

## Zinc

Dissolved zinc concentration at BH2 was 10µg/l which did not exceed the relevant groundwater guideline value (100µg/l).

#### Lead

Dissolved lead concentration at BH2 was 15µg/l and exceeded the EPA IGV guideline value of 10µg/l.

#### Nickel

Dissolved nickel concentration at BH2 was  $14\mu g/l$  and did not exceed the relevant groundwater guideline value ( $15\mu g/l$ ).

# Copper

Dissolved copper concentration at BH2 was below the laboratory MDL (7µg/l).

#### Chromium

Total dissolved chromium concentration at BH2 was 3.1µg/l and did not exceed the relevant guideline values.

# Cadmium

Dissolved cadmium was below the laboratory MDL (0.5µg/l) for BH2.

#### Manganese

Dissolved manganese concentration at BH2 was 3392µg/l and exceeded the EPA IGV guideline value of 50µg/l.

#### Iron

Total dissolved iron concentration at BH2 was 1392µg/l and exceeded the relevant groundwater guideline value of 18.75µg/l.

#### Potassium

Dissolved potassium concentration at BH2 was 54.2mg/l and exceeded the EPA IGV guideline value (5mg/l).

#### Sodium

Dissolved sodium concentration at BH2 was 279.9mg/l and exceeded the groundwater regulation guideline value (150mg/l).

#### Calcium

Dissolved calcium concentration at BH2 was 383.9mg/l and exceeded the EPA IGV guideline value (200mg/l).

# Magnesium

Dissolved magnesium concentration at BH2 was 59.8mg/l and exceeded the EPA IGV guideline value (50mg/l).

# Polycyclic Aromatic Hydrocarbons (PAHs)

Concentrations of the seventeen PAH's analysed for BH2 did not exceed their respective laboratory MDLs.

# Phthalates

Concentrations of the six phthalates analysed for BH2 did not exceed their respective laboratory MDLs.

# **Pesticides**

Reported concentrations of atrazine and simazine were below the laboratory MDL (1µg/l for both parameters) for BH2. However, the laboratory MDL exceeded the relevant groundwater regulation value (0.075µg/l), but did not exceed the surface water regulation value of 2µg/l (atrazine) and 4µg/l (simazine).

# Organochlorine Pesticides

Concentrations of the organochlorine pesticides analysed for BH2 did not exceed their respective laboratory MDLs.

#### Organophosphorus Pesticides

Concentrations of the organophosphorus pesticides analysed for BH2 did not exceed their respective laboratory MDLs.

# Acid Herbicides

Concentrations of all other pesticides analysed BH2 did not exceed their respective laboratory MDLs.

# sVOCs

Reported concentrations of sVOCs at BH2 were below the relevant laboratory MDLs for all parameters apart from 4-methylphenol (41µg/l) and phenol (24µg/l). Phenol exceeded the relevant groundwater regulation guideline value (0.5µg/l).

# **VOCs**

Reported concentrations of VOCs at BH2 were below the relevant laboratory MDLs for all parameters apart from benzene ( $5\mu g/l$ ), ethylbenzene ( $3\mu g/l$ ), p/m-xylene ( $7\mu g/l$ ), isopropylbenzene ( $3\mu g/l$ ) and 1,2,4-trimethylbenzene ( $26\mu g/l$ ). Benzene exceeded the relevant groundwater regulation guideline value ( $0.75\mu g/l$ ).

# 6.5.5 Surface Water Analytical Results

The surface water results were assessed relative to the Irish Surface Water Standards (SI No. 327 of 2012). Surface water analytical results together with relevant assessment criteria are presented in Table No. 13. A summary of the results is presented below.

#### Field indicators

Field measured parameters including pH, EC, DO, temperature and ORP were measured onsite for SW1 to SW6.

# рН

pH results ranged from 6.42 pH units in SW2 to 7.48 pH units in SW6. All samples were within the guideline range of 6.0-9.0 pH units.

#### EC

EC concentrations ranged from 245.2 $\mu$ S/cm (SW4) to 287.6 $\mu$ S/cm (SW5). There is no guideline value for EC.

# Temperature

Temperature readings varied from 3.5°C (SW3) to 3.7°C (SW4 and SW6). There is no guideline value for EC.

# DO

DO concentrations ranged from 95.8% in SW6 to 108.5% in SW4. All samples were within relevant standard range.

#### ORP

Measurements ranged from 48.9mV in SW6 to 175.1mV in SW2. There is no guideline value for ORP.

# Indicators and inorganics

Sulphate was detected at concentrations ranging from 13.14mg/l (SW6) to 17.34mg/l (SW2). There is no guideline value for sulphate.

Chloride concentrations ranged from 13.9mg/l (SW6) to 17.1mg/l (SW5). There is no guideline value for chloride.

Fluoride concentrations at SW5 and SW6 were below the MDL (0.3mg/l). There is no guideline value for fluoride.

Ammoniacal nitrogen concentrations ranged from 0.05mg/l (SW1, SW2 and SW6) to 0.09mg/l (SW5). SW5 exceeded the maximum allowable concentration value of 0.065mg/l.

Total oxidised nitrogen concentrations at SW5 and SW6 were 1.7mg/l and 1.6mg/l respectively. There is no guideline value for total oxidised nitrogen.

MRP concentrations at SW5 and SW6 were 69µg/l and 39µg/l respectively. Both samples exceeded the relevant surface water regulations 'good status' value of 35µg/l.

Total suspended solids concentrations were below the laboratory MDL (10µg/l) for SW5 and SW6. There is no guideline value for total suspended solids.

Total alkalinity concentrations at SW5 and SW6 were 220mg/l and 200mg/l respectively. There is no guideline value for total alkalinity.

Total cyanide was not detected above the laboratory MDL (0.01mg/l). There is no guideline value for total cyanide.

COD concentrations at SW5 and SW6 were below the MDL (7mg/l). There is no guideline value for COD.

BOD concentrations ranged from below MDL (<1mg/l) at SW1 to 2mg/l (SW5). SW5 exceeded the relevant guideline value (1.5mg/l).

# Petroleum Hydrocarbons

EPH (C8-C40)

EPH (C8-C40) was not detected above the laboratory MDL ( $10\mu g/l$ ). There is no guideline value for total cyanide.

# Metals

# Mercury

Concentrations of dissolved mercury were reported as being below the laboratory MDL ( $1\mu g/l$ ) for all samples. The MDL is greater than the surface water regulations max allowable concentration value of  $0.07\mu g/l$ .

#### Boron

Dissolved boron concentrations at SW5 and SW6 were  $16\mu g/l$  and  $<12\mu g/l$  (below MDL) respectively. There is no guideline value for dissolved boron.

#### Arsenic

Dissolved arsenic concentrations at SW5 and SW6 were 5.8µg/l and 4.2µg/l (below MDL) respectively. There is no guideline value for dissolved arsenic.

#### 7inc

Dissolved zinc concentrations were below the MDL (3µg/l) for SW5 and SW6. There is no guideline value for dissolved zinc.

#### Lead

Dissolved lead concentrations at SW5 and SW6 were 6µg/l and 7µg/l respectively. There is no guideline value for dissolved lead.

#### Nickel

Dissolved nickel concentrations were below the MDL (2µg/l) for SW5 and SW6. There is no guideline value for dissolved nickel.

# Copper

Dissolved copper concentrations were below the laboratory MDL (7µg/l) for SW5 and SW6. There is no guideline value for dissolved copper.

#### Chromium

Dissolved chromium concentrations at SW5 and SW6 were 8.4µg/l and 8.6µg/l respectively. The relevant surface water standard (32µg/l) was not exceeded.

# Cadmium

Dissolved cadmium concentrations were below the laboratory MDL (0.5µg/l) for SW5 and SW6. The relevant surface water standard (1.5µg/l) was not exceeded.

# Manganese

Dissolved manganese concentrations at SW5 and SW6 were  $3\mu g/l$  and  $4\mu g/l$  respectively. There is no guideline value for dissolved manganese.

#### Iron

Dissolved iron concentrations at SW5 and SW6 were 84µg/l and 53µg/l respectively. There is no guideline value for dissolved iron.

#### Potassium

Dissolved potassium concentrations ranged from 1.6mg/l (SW6) to 2.0mg/l (SW2 and SW5). There is no guideline value for dissolved potassium.

#### Sodium

Dissolved sodium concentrations ranged from 9.9mg/l (SW6) to 12.1mg/l (SW5). There is no guideline value for dissolved sodium.

#### Calcium

Dissolved calcium concentrations at SW5 and SW6 were 81.5mg/l and 70.2mg/l respectively. There is no guideline value for dissolved calcium.

# Magnesium

Dissolved magnesium concentrations at SW5 and SW6 were 6.8mg/l and 5.8mg/l respectively. There is no guideline value for dissolved magnesium.

# sVOCs

Reported concentrations of sVOCs were below the relevant laboratory MDLs for all parameters.

# **VOCs**

Reported concentrations of VOCs were below the relevant laboratory MDLs for all parameters.

# Petroleum Hydrocarbons

### **MTBE**

Concentrations of MTBE for SW5 and SW6 did not exceed the laboratory MDL of 1µg/kg.

# BTEX

Concentrations of BTEX for SW5 and SW6 did not exceed their respective laboratory MDL's.

# Polycyclic Aromatic Hydrocarbons (PAHs)

Concentrations of the seventeen PAH's analysed for SW5 and SW6 did not exceed their respective laboratory MDL's.

# Phthalates

Concentrations of the six phthalates analysed for SW5 and SW6 did not exceed their respective laboratory MDL's.

#### **Pesticides**

Reported concentrations of atrazine and simazine were below the laboratory MDL (1 $\mu$ g/l for both parameters) for all samples. The relevant surface water standard for atrazine (2 $\mu$ g/l) and simazine (4 $\mu$ g/l) were not exceeded.

# Organochlorine Pesticides

Concentrations of the organochlorine pesticides analysed for SW5 and SW6 did not exceed their respective laboratory MDL's.

# Organophosphorus Pesticides

Concentrations of the organophosphorus pesticides analysed for SW5 and SW6 did not exceed their respective laboratory MDL's.

### Acid Herbicides

Concentrations of all other pesticides analysed for SW5 and SW6 did not exceed their respective laboratory MDL's.

#### 6.6 Geotechnical Results

Two undisturbed samples (BH2 and BH3) were collected from the capping layer in December 2012 and sent to Causeway Geotechnical limited and Queens University Belfast for geotechnical (permeability) testing. Refer to Appendix K. Both samples are reported by the testing laboratory as black silty clay with gravel.

Soil permeability results of 7.70E<sup>-10</sup> m/s at BH2 and 2.70E<sup>-08</sup> m/s at BH3 are reported. These results indicate that the capping layer overlying the waste material is of low permeability, thus impeding rainfall infiltration into the waste material.

Samples from BH2 and BH3 were also tested for Particle Size Distribution (PSD) in accordance with BS 1377: 1990: Part 2: Clauses 9.2 & 9.5. Refer to Table 14.

**Table 14:** Geotechnical Results (PSD)

Sample	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobbles (%)	Boulders (%)
BH2	6	18	22	31	24	0
BH3	12	25	22	33	8	0

# **6.7 Landfill Gas Monitoring Results**

A gas monitoring survey was completed on two occasions (20/12/2012 and 16/05/2013) at the 3No. permanently installed gas monitoring wells (refer to Drawing No. 13).

Methane and carbon dioxide results (concentrations expressed as a percentage in volume (% v/v)) were assessed relative to the EPA 1997 threshold values outlined in the document 'Landfill Manuals – Landfill Operational Practices' (EPA, 1997) and the Department of the Environment exposure limits (1994). There are no threshold values or DOE exposure limits for hydrogen sulphide or carbon monoxide. Gas monitoring results together with the relevant assessment criteria are presented in Table 15.

#### BH1

Stable methane concentration ranged from 53.3% v/v to 58.1% v/v and exceeded the threshold value and exposure limit of 1.0% v/v and 0.5% v/v, respectively. Carbon dioxide concentration ranged from 27.2% v/v to 31.4% v/v and exceeded the threshold value of 1.5% v/v and 0.5% v/v respectively. Hydrogen sulphide was detected at a concentration of 2ppm on one occasion only. Carbon monoxide was detected at a concentration of 1ppm on one occasion only. The maximum flow observed was 0.2l/h.

### BH2

Stable methane concentration ranged from 11.2% v/v to 53.4% v/v and exceeded the threshold value and exposure limit of 1.0% v/v and 0.5% v/v, respectively. Carbon dioxide

concentration ranged from 6.8% v/v to 36.1% v/v and exceeded the threshold value of 1.5% v/v and 0.5% v/v respectively. Hydrogen sulphide was detected at a concentration of 0ppm on both occasions. Carbon monoxide was detected at a concentration of 2ppm on one occasion only. The maximum flow recorded was 0.3l/h.

# ВН3

Stable methane concentration ranged from 25.4% v/v to 30.1% v/v and exceeded the threshold value and exposure limit of 1.0% v/v and 0.5% v/v, respectively. Carbon dioxide concentration ranged from 16.0% v/v to 19.6% v/v and exceeded the threshold value of 1.5% v/v and 0.5% v/v respectively. Hydrogen sulphide and carbon monoxide were not detected at this location during either monitoring event. The maximum flow observed was 0.1l/h.

#### 7.0 TIER 2 RISK ASSESSMENT

#### 7.1 Landfill Material

Analytical results from the samples submitted indicated that the landfill material is generally composed of inert or non-hazardous material.

#### 7.2 Leachate

It has been established that leachate is present in the landfill given that it was encountered during the intrusive investigative works. Leachate results were compared against groundwater regulations (2010), EPA IGV's (2003) and surface water regulations (2012) for guidance purposes given the receptors identified. A number of parameters analysed exceeded the guideline values set out in the three guidance documents used. Dissolved oxygen and BOD exceeded the surface water regulations only. MRP as total phosphorus and ammoniacal nitrogen exceeded both the groundwater and surface water regulations. Electrical conductivity, dissolved arsenic, dissolved sodium, and total dissolved iron exceeded the groundwater regulations only. Dissolved calcium, dissolved lead, dissolved magnesium, dissolved manganese, dissolved potassium, benzene and phenol exceeded the EPA IGV's only.

In addition to the comparison with the different surface water and groundwater regulations, the leachate values were also put into context with a comparison with typical leachate values of a methanogenic landfill (EPA, 2000). In general the leachate values were lower than those of a methanogenic landfill and can be considered reasonably typical of leachate concentrations for a former landfill that had been closed in the last 30years.

#### 7.3 Groundwater and Surface Water

Analytical results indicate that groundwater and to a lesser extent surface water has been impacted by a number of contaminant sources including the former landfill and possibly other sources.

#### Waste Materials

The waste materials deposited at the former landfill are continuing to generate leachate as evident from the leachate results. Some of the elevated compounds identified in the leachate have also been identified in the surface water and groundwater, therefore it is reasonable to assume that the landfill is a contributory factor to the elevated concentrations of a number of parameters observed in the groundwater and surface water samples.

### Other sources

Other parameters, not typically associated with naturally occurring contaminants (with the exception of some metals), were also identified and include ammoniacal nitrogen, MRP, total and faecal coliforms, BOD, arsenic, calcium, nickel, manganese and potassium. This may or may not reflect an impact from the former landfill or potentially from other sources including:

- Upstream industrial facilities/agricultural sources in the case of the surface water samples.
- Upgradient industrial facilities in the case of the groundwater samples albeit the majority of parameters were higher in wells located downgradient of the landfill.

Typically elevated groundwater concentrations were detected in the downgradient wells. Of the downgradient samples, MW5 contained the highest concentrations. A large number of parameters were reported below the laboratory method detection limit including pesticides

PAHs, sVOCs, phthalates etc. However, a small number of parameters exceeded the appropriate regulatory levels including ammoniacal nitrogen which increased from 0.15mg/l upgradient to 9.66mg/l in MW5 downgradient. MW6 also located downgradient also contained elevated ammoniacal nitrogen concentrations of 6.62mg/l. The presence of ammoniacal nitrogen at downgradient locations provides strong evidence of the impact of the landfill on groundwater in the vicinity of the landfill. As a general rule dissolved phase metals displayed a similar trend with the highest concentrations observed in the downgradient wells. Faecal coliforms were detected in one monitoring well, MW5, at the laboratory MDL. All other samples were below the laboratory MDL. Albeit that elevated total coliforms were detected within the upgradient well, it is not considered that this reflects microbial contamination given that faecal coliforms were not detected in the same sample.

The River Liffey appears to be largely unaffected by any potential influences from the former landfill. The river water chemistry up and down stream of the site is very similar for the parameters analysed in both surface water samples (SW 2 and SW6). The only exceedance for the downstream River Liffey sample (SW6) is MRP (39µg/I) which marginally exceeds the surface water regulation guideline value of 35µg/I (refer Table 13).

However, the downstream water chemistry of the mill race appears to be influenced to a greater extent than that of the River Liffey as three exceedences occur; MRP, ammoniacal nitrogen and BOD. This is likely due to the greater dilution capacity of the River Liffey and the fact that the mill race is located in closer proximity to the landfill site.

#### 7.4 Gas

The gas monitoring wells (BH1 to BH3) installed onsite were fitted with landfill gas caps. The gas monitoring wells contained high levels of both stable methane (peak 58.1% v/v at BH1) and carbon dioxide (36.1% v/v at BH2) (Table 15). The methane and carbon dioxide gas levels recorded in the gas monitoring wells indicate that gas production is still occurring within the landfill. However, the flow rates at the three gas monitoring wells were low with a maximum of 0.3l/h. The low flow rates indicate that gas production onsite is past its peak.

# 7.5 Summary of Tier 1 Risk Assessment

# Soils/Waste

The majority of the soils/waste parameters complied with the inert WAC. All other parameters complied with the non-hazardous WAC.

# Leachate & Surface Water / Groundwater

Although clay was encountered beneath the landfill in all three boreholes installed within the waste body during the exploratory investigation, this material generally contained sand and gravel lenses suggesting that a complete confining layer is not present beneath the landfill. Given the available evidence of impacted groundwater and the limited presence of leachate within the landfill, it is clear that pathways exist between the landfill and the groundwater and ultimately a pathway for leachate to migrate to surface water via the groundwater pathway.

# Landfill Gas

Elevated concentrations of landfill gas have been identified onsite during the monitoring and assessment programme undertaken as part of this assessment.

**Table 16:** Tier 2 Summary

	Summary
Soils	As expected, waste complied with Inert/Non-hazardous limits.  Volume of landfill material – estimated in the region of 1,250,000m <sup>3</sup> .  Volume of capping material – estimated in the region of 300,000m <sup>3</sup> .

Leachate	Leachate identified and compared to typical composition. Generally concentrations observed were lower than typical concentrations or within the range.
Surface Water & Groundwater	Pathway exists between these water bodies and leachate generated by the former landfill via a groundwater pathway. Elevated concentrations of a number of parameters were observed in downgradient wells and downstream of the landfill in the Mill Race. The River Liffey did not appear to show an appreciable impact which is supported by desk-based information on the quality of water in the River Liffey which indicated that there is no appreciable impact from the landfill or any other sources further downstream in the River Liffey.
Gas	Elevated concentrations of landfill gas were observed within the landfill gas wells. Further detailed quantitative risk assessment is required to assess the risk of gas migrating to onsite and offsite properties.

# 7.6 Revised Site Prioritisation

The site prioritisation process was repeated following the Tier 2 exploratory investigation and assessment process. However, there was no change.

**Table 17:** Revised Site Prioritisation Summary

SPR	Linkages		Pathway via	SPR Value	Maximum Score	Normalised Score		
SPR1	Leachate ⇒Surfa Water	ce	Combined groundwater and surface water	120	300	40%		
SPR2	Leachate ⇒ SWD	TE	Combined groundwater and surface water	120	300	40%		
SPR3	Leachate   → Hum  Presence (private  well)		Groundwater Pathway	120	240	50%		
SPR4	Leachate   GWE	DTE	Groundwater Pathway	0	240	0%		
SPR5	Leachate   Aquit	er	Groundwater Pathway	120	400	30%		
SPR6	Leachate ⇒ Public Supply		Groundwater Pathway	0	560	0%		
SPR7	Leachate ⇒ Surface Water		Groundwater Pathway	120	240	50%		
SPR8	Leachate ⇒ Surface Water		Surface Water Pathway	0	60	0%		
SPR9	Leachate ⇒ SWD	TE	Surface Water Pathway	0	60	0%		
SPR10	Landfill Gas ⇒ Hu Presence – off-sit		Lateral and Vertical	150	150	100%		
SPR11	Landfill Gas ⇒ Hu Presence – onsite		Lateral and Vertical	250	250	100%		
OVERA	LL RISK SCORE				HIGH			
Risk Classification Range			Range of Risk Scores					
HIGH Risk (Class A) Score			Score greater than or equal to 70% for any individual SPR linkages					
MODERATE Risk (Class B)  Score between 40% and 70% for any individual SPR linkages						kages		
LOW Ris	sk (Class C)	Score less than 40% for any individual SPR linkages						

Sites with a score greater than or equal to 70% for any of the site specific SPR linkages are considered to represent potential high risk or high uncertainty sites. The risk classification assigned to the former Waterstown Landfill is High Risk - Class A and represents the intrinsic

risk that the former landfill poses to the environment. The linkages of greatest concern include the risk of landfill gas migrations to off-site and on-site receptors (SPR 10 and SPR11 respectively) with normalised scores of 100% (high risk). The linkages with a moderate risk (class B) are leachate migration via groundwater and combined groundwater and surface water to off-site surface water and groundwater receptors and offsite private well users. These linkages warrant further evaluation.

#### 8.0 CONCLUSIONS

Based on the results of this exploratory investigation undertaken by MOR in accordance with the EPA Code of Practice which included; the installation of 6No. trial pits, 6No. boreholes (of which 3No. were converted to groundwater wells and 3No. gas/leachate wells) and, laboratory analysis of 5No. soil, 3No. groundwater, 4No. surface water and 1No. leachate samples and the completion of 1No. gas monitoring event it is reasonable to conclude the following:

- The landfill was in operation from 1983 to 1987.
- The site was formerly a quarry that was filled with waste materials, followed by the progressive raising of site levels as landfilling continued on site.
- No gas or leachate collection systems have been installed at the site.
- A clay layer was encountered beneath the waste in all three boreholes installed within the waste body although it has been reported that waste materials were deposited directly onto the exposed bedrock..
- Given the location of the site in close proximity to a pNHA and within the Liffey Valley SAAO, the site is considered in a sensitive location.
- The type of waste found within the landfill is variable that includes both municipal and C&D wastes. There is a large area in the south central portion of the former landfill where it would appear that the majority of municipal wastes were deposited.
- The western and northern boundaries of the former landfill have been delineated; however it was not feasible within the scope of this exploratory investigation to confirm the southern and eastern boundaries of the former landfill although the adjacent roadway likely delineates the extent of the southern boundary.
- The site owned by SDCC covers an area of approximately 25ha; however the area of the former landfill that would fall under the scope of the Code of Practice and associated regulations would appear to be closer to 20ha in extent.
- It is estimated that in the region of 1,250,000m<sup>3</sup> of waste materials was accepted into the former landfill during its operational lifespan.
- Materials were imported to the site to form a capping layer. The depth of the capping layer would appear to vary across the site and it is estimated that in the region of 300,000m³ of capping material was imported onto the site.
- Clay materials were encountered at the base of all three boreholes installed within the former landfill and therefore the extent of any such confining materials would need to be confirmed.
- Soil sample results generally complied with either the Waste Acceptance Criteria for inert or non-hazardous landfill.
- Elevated landfill gas concentrations were detected at a number of locations at the site. The rate of gas generation at the former landfill is low.

- The groundwater quality downgradient of the site has been impacted by a number of elevated parameters including ammoniacal nitrogen. The presence of ammoniacal nitrogen at downgradient locations provides strong evidence that the former landfill is impacting on groundwater as the leachate within the landfill contains elevated concentrations of ammoniacal nitogen.
- The surface water monitoring results did not show any clear evidence that the water quality in the River Liffey has been significantly impacted by the former landfill as concentrations were broadly similar both upstream and downstream of the site.
- The surface water monitoring results of the Mill Race, located immediately adjacent to the site, and in particular ammoniacal nitrogen showed a potential impact of the landfill on the downgradient surface water chemistry.
- It is considered that the site is a high risk site due to the potential risks associated with landfill gas and the impacts of leachate apparent in the groundwater and nearby mill race.
- Additional investigative works would be warranted at the site in order to address the following key issues:
  - Fully delineate the extent of the former landfill.
  - Delineate the extent of capping materials and confining layers beneath the waste.
  - Establish the risk to offsite receptors from landfill gas generation at the site.
  - Establish the extent of groundwater impacts.
  - Establish the extent of surface water impacts.
  - Establish the extent of any remedial measures, if any, that would be warranted.

#### 9.0 RECOMMENDATIONS

Based on the exploratory site investigation completed and in order to ensure that the site is assessed in strict accordance with the relevant legislation, it is recommended that the following works should be undertaken as part of a detailed Tier 2 Site Investigation.

#### 1. Install 10No. additional Trial Pits

These trial pits should be installed with a tracked excavator. Details on the location and the rationale for installing these additional trial pits are presented in Table 18 below and illustrated on Drawing No. 16.

Table 18: Proposed Trial Pit locations

TP	Location	Rationale
TP7	Eastern site boundary	
TP8	Eastern site boundary	To delineate the extent of the landfill to the east.
TP9	Eastern site boundary	
TP10	Eastern site boundary	
TP11	Western site boundary	To further delineate the extent of the landfill to the west.
TP12	Central	
TP13	Central	To further characterise the thickness of the capping
TP14	Central	layer, composition of the shallow waste and further validate the geophysical survey.
TP15	Central	
TP16	Central	

This additional site investigation work should be supervised by an appropriately qualified and competent Environmental Consultant.

# 2. Install 9No. additional combined landfill gas/leachate monitoring wells

It is recommended that a shell and auger drill rig should be utilised to install 9No. permanent combined landfill gas/leachate monitoring wells at the locations outlined on Drawing No. 16. Details on the location and the rationale for installing these additional landfill gas and leachate monitoring wells are presented in Table 19 below.

Table 19: Proposed Combined Gas/Leachate Monitoring Well Locations

Well ID	Location	Rationale		
BH4	Southern site boundary – adjacent	To determine the potential for landfill gas to		
BH5	to offsite educational facility/ residential properties.	migrate offsite.		
BH6	Southern site boundary – adjacent to onsite receptors.	To determine the potential for landfill gas to migrate into onsite facilities.		
BH7				
ВН8	Southern site boundary – adjacent to offsite educational facility/	To determine the potential for landfill gas t migrate offsite.		
ВН9	residential properties.			

BH10 (PBH1)		
BH11	Central	To further characterise the landfill gas regime and leachate composition.
BH12		and loadinate demposition.

**Note:** PBH1 recommended in the geophysical survey (Appendix E)

Combined gas wells/leachate wells should be installed to the base of the fill material where conditions permit. The wells should be constructed with 50mm PVC casing and machine slotted screen and finished with heavy-duty, lockable, raised or flush box covers (depending on Client requirements). In accordance with best practice, the borehole annulus at all locations should be backfilled with washed pea gravel to approximately 1m above the screened interval followed by a bentonite seal and cement grout to surface. All landfill gas monitoring wells should be fitted with a rubber bung seal and gas valve.

This work should be supervised by an appropriately qualified and competent Environmental Consultant.

# 3. Install 7No. Additional Groundwater monitoring wells

It is proposed that an air rotary rig should be utilised to install 7No. groundwater monitoring wells at the locations outlined on Drawing No. 16. Details on the location and the rationale for installing these additional groundwater monitoring wells are presented in Table 20 below.

**Table 20: Proposed Groundwater Monitoring Well Locations** 

Well ID	Location	Rationale
MW7	Within the northern boundary of the landfill.	To characterise the groundwater quality at the downgradient boundary.
MW9 (PBH4)	Offsite – beyond the northern boundary	To characterise the groundwater quality beyond the downgradient boundary and further validate the conceptual model.  Recommended in the geophysical Report.
MW10 (PHB2)	Within the northern boundary of the landfill.	To characterise the groundwater quality at the downgradient boundary.  Recommended in the geophysical Report.
MW11	Within the eastern boundary of the landfill.	To characterise the groundwater quality at the eastern boundary – note groundwater flow is north-north east.
MW12	Offsite – beyond the eastern boundary.	To characterise the groundwater quality offsite at the eastern boundary.
MW13	Within the southern boundary	To confirm the upgradient groundwater quality.

**Note:** PBH2 and PBH4 were recommended in the geophysical survey (Appendix E). Please note that it is not proposed to install PBH3 as per the location identified in the geophysical report.

Groundwater wells should be drilled to gravels/bedrock depth depending on the conditions encountered in the field. The purpose of these wells would be to characterise the groundwater and determine the impact of leachate. The wells should be constructed with 50mm PVC casing and machine slotted screen and finished with heavy-duty, lockable, raised or flush box covers (depending on Client requirements). In accordance with best practice, the borehole annulus at all locations should be backfilled with washed pea gravel to approximately 1m above the screened interval followed by a bentonite seal and cement grout to surface. **Please note** particular care and mitigation measures will be required during drilling to ensure that a preferential pathway is not provided for any contamination to the underlying aquifer. Therefore, this work should be supervised by an appropriately qualified and competent Environmental Consultant.

# 4. Additional Landfill Gas Monitoring

It is proposed that 6No. landfill gas monitoring events should be completed over a 12 week period. This work should be undertaken by an appropriately qualified competent Environmental Consultant using a landfill gas meter, such as the GA2000, which is complete with flow measurement capabilities. Flow measurements should be collected from all of the permanent landfill gas monitoring wells installed onsite.

It is also proposed that an internal gas monitoring survey should be completed of the onsite structures to determine whether landfill gas is migrating to or building up in or in the case of the container beneath, the onsite buildings and presenting a risk to the onsite human health receptors. In that regard and in addition to the landfill gas meter, a flame ionisation detector (FID) should be utilised to complete this sensitive survey. The FID is a highly specialised piece of equipment that uses hydrogen to determine low concentrations of methane and is a requirement when completing internal gas surveys.

### 5. Additional Groundwater Monitoring

It is proposed that two rounds of groundwater monitoring should be completed of both the existing and newly proposed groundwater monitoring wells in order to accurately characterise the groundwater quality and the potential impact of any leachate being generated at the site.

# 6. Additional Surface Water Monitoring

It is proposed that two rounds of surface water monitoring should be completed of both the Mill Race and the River Liffey in order to accurately characterise the surface water quality and the potential impact of any leachate being generated at the site.

# 7. Hydrogeological Testing

As part of the detailed site investigation phase of works, it is proposed that level loggers should be installed over a one month period in 3No. groundwater monitoring wells and 3No. leachate wells (where feasible). In addition, the permeability of the made ground (waste material), the underlying gravels and limestone bedrock should be evaluated through in situ permeability testing (falling/rising head tests) and subsequent data analysis. This will enhance the understanding of current groundwater flow paths/migration pathways through the site, and potential risk to site receptors.

# 8. Appropriate Assessment

In order to provide the EPA with all relevant information required for a Certificate of Authorisation for Historic Landfills, a Stage I Screening for Appropriate Assessment (AA) should be undertaken by an appropriately qualified consultant in accordance with the European Commission Methodological Guidance on the provision of Article 6(3) and 6(4) of the 'Habitats' Directive 92/43/EEC (EC 2001) and the European Commission Guidance 'Managing Natura 2000 Sites'. In the event that it is determined following this screening exercise that an AA is required, then a Natura Impact Statement (NIS) should be prepared. This work should be carried out in tandem with the detailed site investigation in order to

ensure that a holistic approach would be undertaken, whereby all relevant monitoring is completed, that appropriate assessment and risk assessment parameters are addressed and to ensure that the remediation measures proposed address all risks identified.

# 9. Interpretation of Results and Reporting

Following the completion of the additional works, a review of the results together with the findings of the detailed site investigation and this exploratory site investigations should be undertaken to provide a scientific based understanding on the landfill gas regime at the site and the potential for onsite and offsite landfill gas migration and of the potential impact of leachate on the adjacent receptors. The findings of this additional work should be incorporated into an overall report that should be prepared to satisfy the requirements of the Code of Practice.

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Waterstown Landfill Palmerstown Co. Dublin

Table 8 Trial Pit and Borehole survey

Location ID	Easting	Northing	Ground Level Elevation (maOD)	TOCi Elevation (maOD)
BH1	708546.634	735526.274	33.86	33.7
BH2	708373.766	735584.797	32.85	32.73
ВН3	708257.889	735760.817	18.26	18.35
MW4	708419.184	735472.364	36.46	36.39
MW5	708637.062	735740.919	14.40	14.36
MW6	708484.679	735764.156	18.58	18.56
TP1	708599.759	735764.037	13.78	-
TP2	708587.108	735619.378	25.26	-
TP3	708605.205	735545.332	31.79	-
TP4	708390.182	735604.939	31.91	-
TP5	708388.525	735610.535	31.71	-
TP6	708353.522	735719.917	28.18	-

# Notes:

TOCi denotes Top of inner casing

Waterstown Landfill Palmerstown Co. Dublin

Table 9 Groundwater Level Results - Monthly event 1 (20/12/2012)

Monitoring Well I.D.	Strata opposite	TOCi Elevation	Monitoring Time (24 hr)	Depth to Water	Water Level	
	Screen	(maOD)	Units	mbTOC	mAOD	
BH1	MADEGROUND / LANDFILL	33.77	11:00	DRY	DRY	
BH2	MADEGROUND / LANDFILL	32.73	10:48	5.494	27.236	
ВН3	MADEGROUND / LANDFILL	18.35	10:33	6.657	11.693	
MW4	BEDROCK	36.39	11:51	8.860	27.530	
MW5	SAND/GRAVEL	14.36	11:23	2.695	11.665	
MW6	SAND/SILT	18.56	11:33	6.84	11.720	

# Notes:

TOCi denotes top of inner casing mbTOC denotes metres below top of casing. mAOD denotes metres above ordnance datum.

#### **Table 10 Soil Analytical Results**

Comple ID						TDO	TD2	TD4	TD5	
Sample ID			Waste A	cceptance Criteri I		TP2	TP3	TP4	TP5	
			Inert Waste	Non-Hazardous	<u>Hazardous</u>					
Sample Depth (mbgl)			Acceptance	Waste Acceptance	Waste Acceptance	2.9-3.0	1.15	1.45-1.55	1.2-1.3	
			Criteria	Criteria	Criteria					
				Citteria	<u>Orneria</u>					
Laboratory Report No.  Laboratory Sample No.						12/9568 13-15	12/9568 23-25	12/9568 29-31	12/9571 1-3	
Sample Date						04/12/2012	04/12/2012	04/12/2012	05/12/2012	
Parameters	Unit	LOD				04/12/2012	04/12/2012	04/12/2012	03/12/2012	
Total Organic Carbon #	%	<0.2	3	~	6	1.6	2.4	12.9**	2.4	
Mineral Oil (C8-C40)	mg/kg	<30	500	~	~	183	571	7065	331	
Petroleum Hydrocarbons										
MTBE #	ug/kg	<5	~	~	~	<5	<5	<5	<5	
Benzene #	ug/kg	<5	6000	~	~	<5	18	<5	<5	
Toluene #	ug/kg	<5	6000	~	~	7	66	9	11	
Ethylbenzene #	ug/kg	<5	6000	~	~	39	107	11	11	
m/p-Xylene#	ug/kg	<5	6000	~	~	135	275	8	22	
o-Xylene #	ug/kg	<5	6000	~	~	15	95	28	13	
Debesselie Assessica Hadranach and (DAHA) (M.C.)										
Polycyclic Aromatic Hydrocarbons (PAHs) (M-S)		<0.04				0.22	0.49	<0.40	0.08	
Naphthalene # Acenaphthylene	mg/kg	<0.04	~	~	~	0.23 <0.03	0.49	<0.40	<0.03	
Acenaphthylene #	mg/kg mg/kg	<0.05	~	~	~	0.23	0.17	<0.50	<0.05	
Fluorene #	mg/kg	<0.04	~	~	~	0.23	0.34	<0.40	0.08	
Phenanthrene #		<0.03	~	~	~	1.45	2.01	<0.30	0.30	
Anthracene #	mg/kg mg/kg	<0.03	~	~	~	0.23	0.61	<0.40	0.30	
Fluoranthene #		<0.03	~	~	~	1.14	3.32	<0.30	0.40	
Pyrene #	mg/kg mg/kg	<0.03	~	~	~	0.74	2.86	3.18	0.40	
Pyrene * Benzo(a)anthracene #		<0.03	~	~	~	0.74	1.68	<0.60	0.32	
Chrysene #	mg/kg mg/kg	<0.06	~	~	~	0.32	1.80	0.33	0.20	
Cnrysene Benzo(bk)fluoranthene #		<0.02	~	~	~	0.20	2.98	<0.70	0.22	
Benzo(a)pyrene #	mg/kg	<0.07	~	~	~	0.40	1.52	<0.70	0.39	
Indeno(123cd)pyrene #	mg/kg mg/kg	<0.04	~	~	~	0.25	0.96	<0.40	0.17	
Dibenzo(ah)anthracene #		<0.04	~	~	~	<0.04	0.96	<0.40	<0.04	
Dibenzo(ah)anthracene "  Benzo(ghi)perylene #	mg/kg	<0.04	~	~	~	<0.04 0.13	0.16	<0.40	<0.04 0.16	
Coronene	mg/kg mg/kg	<0.04	~	~	~	<0.04	0.94	<0.40	<0.04	
PAH 6 Total #	mg/kg	<0.22	~	~	~	2.04	9.72	<2.20	1.27	
PAH 17 Total	mg/kg	<0.64	100*	~	~	5.67	20.27	<6.40	2.52	
Benzo(b)fluoranthene	mg/kg	<0.05	~	~	~	0.29	2.15	<0.50	0.28	
Benzo(k)fluoranthene	mg/kg	<0.02	~	~	~	0.11	0.83	<0.20	0.11	
PAH Surrogate % Recovery	%	<0	~	~	~	100	104	91	98	
D 1 11 1 1 ( 18:1 1 1/20D )										
Polychlorinated Biphenyl (PCBs)		_				00	_	-		
PCB 28 #	ug/kg	<5	~	~	~	20	<5	<5	9	
PCB 52 #	ug/kg	<5	~	~	~	<5	<5	<5	<5	
PCB 101 #	ug/kg	<5	~	~	~	<5	<5	<5	<5	
PCB 118 #	ug/kg	<5	~	~	~	<5	<5	<5	<5	
PCB 138 #	ug/kg	<5	~	~	~	<5	<5	<5	<5	
PCB 153**	ug/kg	<5	~	~	~	<5	<5	<5	<5	
PCB 180 #	ug/kg	<5	~	~	~	<5	<5	<5	<5	
Total 7 PCBs*	ug/kg	<35	1000	~	~	<35	<35	<35	<35	
Leachate-NRA										
Dissolved Antimony	mg/l	<0.002	~	~	~	-	<0.002	-	<0.002	
Dissolved Arsenic	mg/l	<0.0025	~	~	~	-	<0.0025	-	<0.0025	
Dissolved Barium	mg/l	< 0.003	~	~	~	-	0.109	-	0.063	
Dissolved Cadmium	mg/l	<0.0005	~	~	~	-	<0.0005	-	<0.0005	
Dissolved Chromium	mg/l	<0.0015	~	~	~	-	<0.0015	-	<0.0015	
Dissolved Copper	mg/l	<0.007	~	~	~	-	<0.007	-	<0.007	
Dissolved Lead Dissolved Molybdenum	mg/l	<0.005 <0.002	~	~	~	-	<0.005 0.010	-	<0.005 0.013	
Dissolved Nickel	mg/l mg/l	<0.002	~	~	~	-	0.010	-	0.013	
Dissolved Selenium	mg/l	<0.002	~	~	~	-	<0.003	-	<0.003	
Dissolved Zinc	mg/l	<0.003	~	~	~	-	< 0.003	-	<0.003	
Mercury Dissolved by CVAF	mg/l	<0.00001	~	~	~	-	0.00005	-	0.00081	
Fluorido	//	0.0					0.0		25	
Fluoride Chloride	mg/l	<0.3 <0.3	~	~	~	-	<0.3 2.5	-	0.5 0.5	
Sulphate	mg/l mg/l	<0.3 <0.05	~	~ ~	~ ~	-	139.12	-	4.01	
	9/1	-0.00					.55.12			
Phenol	mg/l	<0.01	~	~	~	-	<0.01	-	<0.01	
Dissolved Organic Carbon	mg/l	<2	~	~	~	-	15	-	9	
Total Dissolved Solids	mg/l	<35	~	~	~	-	372	-	130	
Leachate CEN 10:1										
Dissolved Antimony	mg/kg	<0.02	0.06	0.7	5	<0.02	-	<0.02	-	
Dissolved Arsenic	mg/kg	<0.025	0.5	2	25	<0.025	-	<0.025		
Dissolved Barium	mg/kg	< 0.03	20	100	300	1.00	-	0.31	-	
Dissolved Cadmium	mg/kg	<0.005	0.04	1	5	<0.005	-	<0.005	-	
Dissolved Chromium	mg/kg	<0.015	0.5	10	70	<0.015	-	<0.015	-	
Dissolved Copper	mg/kg	<0.07	2	50	100	<0.07	-	<0.07	-	
Dissolved Lead Dissolved Molybdenum	mg/kg mg/kg	<0.05 <0.02	0.5 0.5	10 10	50 30	0.05 0.23	-	<0.05 0.17	-	
Dissolved Nickel	mg/kg	<0.02	0.5	10	40	0.23	-	<0.02		
Dissolved Selenium	mg/kg	<0.03	0.1	0.5	7	<0.03	-	<0.03	-	
Dissolved Zinc	mg/kg	< 0.03	4	50	200	0.11	-	<0.03	-	
Mercury Dissolved by CVAF	mg/kg	<0.0001	0.01	0.2	2	0.0001	-	0.0001	-	
Fluoride	mg/kg	<3	10	150	500	<3	-	<3	-	
Chloride Sulphate	mg/kg mg/kg	<3 <0.5	800 1,000	15,000 20,000	25,000 50,000	118 <b>7409.1</b>	-	29 560.7	-	
σιιριιαιο	ilig/kg	<υ.ט	1,000	20,000	30,000	1409.1	-	300.7	-	
Phenol Index	mg/kg	<0.5	1	~	~	37.1	-	7.6	-	
Dissolved Organic Carbon	mg/kg	<20	500	800	1,000	190	-	170	-	
Total Dissolved Solids	mg/kg	<350	4,000	60,000	100,000	10542	-	1820	-	
Notes:										
Notes:										

# Notes:

denotes parameter exceeds Inert Waste Acceptance Criteria. denotes parameter exceeds Non-Hazardous Waste Acceptance Criteria. Bold Italics Bold and Italics underlined denotes parameter exceeds Hazardous Waste Acceptance Criteria.

denotes method detection limit of laboratory.

denotes no WAC. denotes no parameter available

Council Decision of 19 December 2002 Establishing Criteria and Procedures for the Acceptance of Waste at Landfills Persuant to Article 16 of and Annex II to Directive 1999/31/EC Total PAH (sum of 17)

denotes sum of fluoranthene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-d,d)pyrene, naphthalene, acenaphthylene, and 1000mg/kg for hazardous landfill.

Table 11 Groundwater Analytical Results

Sample Identity Laboratory Report No.			Groundwate	. January	MW4 Jones 12/9860	MW5 Jones 12/9860	MW6 Jones 12/9855
Laboratory Sample No.			Groundwater Regulations 2010	EPA IGV's	13-18	7-12	1-6
Sample Date	l leda	LOD	(S.I. No. 9 of 2010)	LFAIGVS	13/12/2012	13/12/2012	13/12/2012
Parameters	Unit	LOD					
Field Measured Parameters	ml I conita			65.05	6.70	6.20	44.40
pH Electrical Conductivity	pH units µS/cm	•	800 / 1875	6.5-9.5	6.72 628	6.30 1294.0	11.43 771
Dissolved Oxygen	%	•	~	NAC	76.2	33.0	48.4
Dissolved Oxygen Temperature	ppm	+	~	NAC 25°C	8.45 10.6	3.63 10.80	5.46 11.4
Oxidation Reduction Potential	mV	•	~	25 C ~	98.3	8.20	-270.1
Colour	N/A	•	~	NAC	Clear	Cloudy	Slightly Cloudy
Odour Other observations	N/A N/A	•	~ ~	~ ~	None None	None None	None None
Metals (dissolved) Dissolved Arsenic	ua/l	<2.5	7.5	10	2.6	10.3	3.8
Dissolved Boron	ug/l ug/l	<12	7.5	1000	31	545	56
Dissolved Cadmium	ug/l	<0.5	3.75	5	<0.5	<0.5	<0.5
Dissolved Calcium	mg/l	<0.2	~	200	122.2	268.4	60.3
Total Dissolved Chromium Dissolved Copper	ug/l ug/l	<1.5 <7	37.5 1500	30 30	<1.5 <7	<1.5 <7	2.0 <7
Total Dissolved Iron	ug/l	<20	18.75	200	<20	<20	<20
Dissolved Lead	ug/l	<5	~	10	6	10	6
Dissolved Magnesium	mg/l	<0.1	~	50	18.0	32.0	<0.1
Dissolved Manganese	ug/l	<2	~	50	464	1644	<2
Dissolved Mercury	ug/l	<1	0.75	1	<1	<1	<1
Dissolved Nickel Dissolved Potassium	ug/l mg/l	<2 <0.1	15 ~	20 5	3 2.7	<b>30</b> 15.9	<b>23</b> 26.4
Dissolved Potassium Dissolved Sodium	mg/l	<0.1	150	150	22.7	94.5	61.1
Dissolved Coddini	ug/l	<3	~	100	15	49	<3
MRP as Total Phosphorus	ug/l	<5	35	30***	38	84	111
Volatile Organic Compounds (VOCs) MS							
Dichlorodifluoromethane	ug/l	<2	~	~	<2	<2	<2
Methyl Tertiary Butyl Ether	ug/l	<1	~	30	<1	<1	<1
Chloromethane	ug/l	<3	~	~	<3	<3	<3
Vinyl Chloride Bromomethane	ug/l ug/l	<2 <1	0.375	~ ~	<2 <1	<2 <1	<2 <1
Chloroethane	ug/l	<3	~	~	<3	<3	<3
Trichlorofluoromethane	ug/l	<3	~	~	<3	<3	<3
1,1-Dichloroethene	ug/l	<3	~	30**	<3	<3	<3
Dichloromethane	ug/l	<3	~	10	<3	<3	<3
trans-1-2-Dichloroethene	ug/l	<3	~	30**	<3	<3	<3
1,1-Dichloroethane cis-1-2-Dichloroethene	ug/l ug/l	<3 <3	~ ~	~ 30**	<3 <3	<3 <3	<3 <3
2,2-Dichloropropane	ug/l	<1	~	~	<1	<1	<1
Bromochloromethane	ug/l	<2	~	~	<2	<2	<2
Chloroform	ug/l	<2	75 <sup>Δ1</sup>	~	<2	<2	<2
1,1,1-Trichloroethane	ug/l	<2	~	500	<2	<2	<2
1,1-Dichloropropene Carbon tetrachloride	ug/l ug/l	<3 <2	~ ~	~	<3 <2	<3 <2	<3 <2
1,2-Dichloroethane	ug/l	<2	2.25	3	<2	<2	<2
Benzene	ug/l	<1	0.75	1	<1	<1	<1
Trichloroethene	ug/l	<3	7.5 <sup>Δ2</sup>	70	<3	<3	<3
1,2-Dichloropropane	ug/l	<2	~	~	<2	<2	<2
Dibromomethane	ug/l	<3	~	~	<3	<3	<3
Bromodichloromethane cis-1-3-Dichloropropene	ug/l ug/l	<2 <2	~ ~	~ ~	<2 <2	<2 <2	<2 <2
Toluene	ug/l	<2	~	10	<2	<2	<2
trans-1-3-Dichloropropene	ug/l	<2	~	~	<2	<2	<2
1,1,2-Trichloroethane	ug/l	<2	~ ^2	~	<2	<2	<2
Tetrachloroethene 1,3-Dichloropropane	ug/l ug/l	<3 <2	7.5 <sup>Δ2</sup>	40 ~	<3 <2	<3 <2	<3 <2
Dibromochloromethane	ug/l	<2	75 <sup>Δ1</sup>	~	<2	<2	<2
1,2-Dibromoethane	ug/l	<2	~	~	<2	<2	<2
Chlorobenzene	ug/l	<2	~	1	<2	<2	<2
1,1,1,2-Tetrachloroethane	ug/l	<2	~	~	<2	<2	<2
Ethylbenzene p/m-Xylene	ug/l ug/l	<2 <3	~ ~	10 10 <sup>Δ3</sup>	<2 <3	<2 <3	<2 <3
o-Xylene	ug/l	<2	~	10 <sup>Δ3</sup>	<2	<2	<2
Styrene	ug/l	<2	~	~	<2	<2	<2
Bromoform	ug/l	<2	75 <sup>Δ1</sup>	~	<2	<2	<2
Isopropylbenzene	ug/l	<3	~	~	<3	<3	<3
1,1,2,2-Tetrachloroethane Bromobenzene	ug/l ug/l	<4 <2	~ ~	~	<4 <2	<4 <2	<4 <2
1,2,3-Trichloropropane	ug/l	<3	~	~	<3	<3	<3
Propylbenzene	ug/l	<3	~	~	<3	<3	<3
2-Chlorotoluene	ug/l	<3	~	~	<3	<3	<3
1,3,5-Trimethylbenzene	ug/l	<3	~	~	<3	<3	<3
4-Chlorotoluene	ug/l	<3	~	~	<3 <3	<3 <3	<3
tert-Butylbenzene 1,2,4-Trimethylbenzene	ug/l ug/l	<3 <3	~ ~	~ ~	<3	<3 <3	<3 <3
sec-Butylbenzene	ug/l	<3	~	~	<3	<3	<3
4-Isopropyltoluene	ug/l	<3	~	~	<3	<3	<3
1,3-Dichlorobenzene	ug/l	<3	~	~	<3	<3	<3
1,4-Dichlorobenzene	ug/l	<3	~	~	<3	<3	<3
n-Butylbenzene	ug/l	<3	~	~	<3	<3	<3
1,2-Dichlorobenzene 1,2-Dibromo-3-chloropropane	ug/l	<3 <2	~ ~	10	<3 <2	<3 <2	<3 <2
1,2,4-Trichlorobenzene	ug/l ug/l	<3	~	0.4	<2 <3	<3	<3
Hexachlorobutadiene	ug/l	<3	~	0.1	<3	<3	<3
1,2,3-Trichlorobenzene	ug/l	<3	~	~	<3	<3	<3
Surrogate Recovery Toluene D8 Surrogate Recovery 4-Bromofluorobenzene	%	<0 <0	~	~ ~	102 115	105 116	82 91
			-				

Bold denotes value exceeds Groundwater regulations.

Italics denotes value exceeds IGV where no groundwater regulation is available.

\* denotes IGV relates to 'phenols'.

\*\*\* denotes IGV relates to 'dichloroethene'.

\*\*\* denotes orthophosphate

<sup>---</sup> denotes orthophosphate

Δ1 denotes quality standard relates Total Trihalomethanes. Total Trihalomethanes includes chloroform, dibromochloromethane and bromoform.

Δ2 denotes quality standard relates to the sum of Trichloroethene & Tetrachloroethene.

Δ3 denotes quality standard relates to Xylenes

NAC - No Abnormal Change

^ denotes alpha-endosulphan

+ denotes permethin

<sup>+</sup> denotes permethrin
# denotes non-specific individual pesticide value
++ Result outside calibration range, results should be considered as indicative only and are not accredited

Table 11 Groundwater Analytical Results

Sample Identity Laboratory Report No.		1	Groundwate	, www. ww	MW4 Jones 12/9860	MW5 Jones 12/9860	MW6 Jones 12/9855
Laboratory Sample No.			Groundwater	EDA 101/1-	13-18	7-12	1-6
Sample Date			Regulations 2010 (S.I. No. 9 of 2010)	EPA IGV's	13/12/2012	13/12/2012	13/12/2012
Parameters	Unit	LOD	( , , , , , , , , , , , , , , , , , , ,				
Semi-Volatile Organic Compounds (SVOCs)							
Phenois		10		000	4.0		40
2-Chlorophenol 2-Methylphenol	ug/l ug/l	<10 <10	~	200	<10 <10	<10 <10	<10 <10
2-Nitrophenol	ug/l	<10	~	~	<10	<10	<10
2,4-Dichlorophenol	ug/l	<10	~	~	<10	<10	<10
2,4-Dimethylphenol 2,4,5-Trichlorophenol	ug/l ug/l	<10 <10	~	~ ~	<10 <10	<10 <10	<10 <10
2,4,6-Trichlorophenol	ug/l	<10	~	200	<10	<10	<10
4-Chloro-3-methylphenol	ug/l	<10	~	~	<10	<10	<10
4-Methylphenol 4-Nitrophenol	ug/l ug/l	<10 <10	~	~	<10 <10	<10 <10	<10 <10
Pentachlorophenol	ug/l	<10	~	2	<10	<10	<10
Phenol	ug/l	<10	~	0.5*	<10	<10	<10
Polycyclic Aromatic Hydrocarbons (PAHs)							
2-Chloronaphthalene	ug/l	<10	~	~	<10	<10	<10
2-Methylnaphthalene Naphthalene	ug/l ug/l	<10 <10	~	1	<10 <10	<10 <10	<10 <10
Acenaphthylene	ug/l	<10	~	~	<10	<10	<10
Acenaphthene	ug/l	<10	~	~	<10	<10	<10
Fluorene Phenanthrene	ug/l ug/l	<10 <10	~	~	<10 <10	<10 <10	<10 <10
Anthracene	ug/l	<10	~	10000	<10	<10	<10
Fluoranthene	ug/l	<10	~	1	<10	<10	<10
Pyrene Benzo(a)anthracene	ug/l ug/l	<10 <10	~ ~	~	<10 <10	<10 <10	<10 <10
Chrysene	ug/l	<10	~	~	<10	<10	<10
Benzo(bk)fluoranthene	ug/l	<10	~	~	<10	<10	<10
Benzo(a)pyrene Indeno(123cd)pyrene	ug/l ug/l	<10 <10	0.0075	0.01	<10 <10	<10 <10	<10 <10
Dibenzo(ah)anthracene	ug/l	<10	~	~	<10	<10	<10
Benzo(ghi)perylene	ug/l	<10	~	0.05	<10	<10	<10
Other SVOCs							
1,2-Dichlorobenzene	ug/l	<10	~	10	<10	<10	<10
1,2,4-Trichlorobenzene 1,3-Dichlorobenzene	ug/l	<10	~	0.4	<10 <10	<10 <10	<10 <10
1,4-Dichlorobenzene	ug/l ug/l	<10 <10	~ ~	~	<10	<10 <10	<10 <10
2-Nitroaniline	ug/l	<10	~	~	<10	<10	<10
2,4-Dinitrotoluene 2,6-Dinitrotoluene	ug/l	<10 <10	~	~	<10 <10	<10 <10	<10
3-Nitroaniline	ug/l ug/l	<10	~	~	<10	<10	<10 <10
4-Bromophenylphenylether	ug/l	<10	~	~	<10	<10	<10
4-Chloroaniline 4-Chlorophenylphenylether	ug/l	<10 <10	~ ~	~	<10 <10	<10 <10	<10 <10
4-Nitroaniline	ug/l ug/l	<10	~	~	<10	<10	<10
Azobenzene	ug/l	<10	~	~	<10	<10	<10
Bis(2-chloroethoxy)methane Bis(2-chloroethyl)ether	ug/l ug/l	<10 <10	~	~	<10 <10	<10 <10	<10 <10
Carbazole	ug/l	<10	~	~	<10	<10	<10
Dibenzofuran	ug/l	<10	~	~	<10	<10	<10
Hexachlorobenzene Hexachlorobutadiene	ug/l ug/l	<10 <10	~	0.03	<10 <10	<10 <10	<10 <10
Hexachlorocyclopentadiene	ug/l	<10	~	~	<10	<10	<10
Hexachloroethane	ug/l	<10	~	~	<10	<10	<10
Isophorone N-nitrosodi-n-propylamine	ug/l ug/l	<10 <10	~	~ ~	<10 <10	<10 <10	<10 <10
Nitrobenzene	ug/l	<10	~	10	<10	<10	<10
Blat. La							
Phthalates Bis(2-ethylhexyl) phthalate	ug/l	<10	~	8	<10	<10	<10
Butylbenzyl phthalate	ug/l	<10	~	~	<10	<10	<10
Di-n-butyl phthalate	ug/l	<10	~	2	<10	<10	<10
Di-n-Octyl phthalate Diethyl phthalate	ug/l ug/l	<10 <10	~ ~	~	<10 <10	<10 <10	<10 <10
Dimethyl phthalate	ug/l	<10	~	~	<10	<10	<10
Pesticides MS							
Pesticides MS Organochlorine Pesticides							
Aldrin	ug/l	<0.01	~	0.01	<0.01	<0.01	<0.01
Alpha-BHC	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Beta-BHC Chlorothalonil	ug/l ug/l	<0.01 <0.01	~ ~	0.1 <sup>#</sup>	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01
cis-Chlordane	ug/l	<0.01	~	0.1	<0.01	<0.01	<0.01
Dieldrin	ug/l	<0.01	0.075	0.01	<0.01	<0.01	<0.01
Endosulphan I Endosulphan II	ug/l ug/l	<0.01 <0.01	~	0.001^ 0.001^	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01
Endosulphan sulphate	ug/l	<0.01	~	0.001^	<0.01	<0.01	<0.01
Endrin	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Gamma-BHC	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Heptachlor Heptachlor Epoxide	ug/l ug/l	<0.01 <0.01	~ ~	0.1 <sup>#</sup>	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01
Hexachlorobenzene	ug/l	<0.01	~	0.1	<0.01	<0.01	<0.01
Isodrin	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
o,p'-DDE	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
p,p'-DDT p,p'-Methoxychlor	ug/l ug/l	<0.01 <0.01	~	0.1 <sup>#</sup>	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01
p,p'-TDE	ug/l	<0.01	~	0.1	<0.01	<0.01	<0.01
p,p'-DDE	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
o,p'-DDT	ug/l	<0.01	0.075	0.1#	<0.01	<0.01	<0.01
p,p'-Methoxychlor p,p'-TDE	ug/l	<0.01 <0.01	~	0.1 <sup>#</sup>	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01
p,p-TDE Pendimethalin	ug/l ug/l	<0.01 <0.01	~ ~	0.1" 0.1 <sup>#</sup>	<0.01	<0.01	<0.01 <0.01
Permethrin I	ug/l	<0.01	~	20+	<0.01	<0.01	<0.01
Permethrin II	ug/l	<0.01	~	20+	<0.01	<0.01	<0.01
Quintozene Tecnazene	ug/l ug/l	<0.01 <0.01	~ ~	0.1 <sup>#</sup>	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01
Telodrin	ug/l	<0.01	~	0.1	<0.01	<0.01	<0.01
			~	0.1	<0.01	<0.01	<0.01
trans-Chlordane	ug/l	<0.01	~				
rrans-Chlordane Triadimefon	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
							1

Notes:

Bold denotes value exceeds Groundwater regulations.

Italics denotes value exceeds IGV where no groundwater regulation is available.

\* denotes IGV relates to 'phenols'.

\*\*\* denotes IGV relates to 'dichloroethene'.

\*\*\*\* denotes orthophosphate
Δ1 denotes quality standard relates Total Trihalomethanes. Total Trihalomethanes includes chloroform, dibromochloromethane and bromoform.
Δ2 denotes quality standard relates to the sum of Trichloroethene & Tetrachloroethene.
Δ3 denotes quality standard relates to Xylenes
NAC - No Abnormal Change
^ denotes alpha-endosulphan
+ denotes permethrin
# denotes non-specific individual pesticide value
++ Result outside calibration range, results should be considered as indicative only and are not accredited

Table 11 Groundwater Analytical Results

Sample Identity			Groundwate	r Standards	MW4	MW5	MW6
Laboratory Report No.					Jones 12/9860	Jones 12/9860	Jones 12/9855
Laboratory Sample No.			Groundwater	EDA 101//-	13-18	7-12	1-6
Sample Date			Regulations 2010 (S.I. No. 9 of 2010)	EPA IGV's	13/12/2012	13/12/2012	13/12/2012
Parameters	Unit	LOD	(3.1. NO. 9 01 2010)				
Organophosphorus Pesticides							
Azinphos ethyl	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Azinphos methyl	ug/l	<0.01	~	0.1#	<0.01	<0.01	< 0.01
Carbophenothion	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Chlorfenvinphos	ug/l	<0.01	~	5	<0.01	<0.01	<0.01
Chlorpyrifos	ug/l	<0.01	~	90	<0.01	<0.01	<0.01
Chlorpyrifos-methyl	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Diazinon	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Dichlorvos	ug/l	<0.01	~	0.001	<0.01	<0.01	<0.01
Dimethoate	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Ethion	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Ethyl Parathion (Parathion)	ug/l	<0.01	~	0.1	<0.01	<0.01	<0.01
Etrimphos	ug/l	<0.01	~	0.1	<0.01	<0.01	<0.01
Fenitrothion		<0.01	~	0.1	<0.01	<0.01	<0.01
	ug/l						
Fenthion Molethian	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Malathion	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Methyl Parathion	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Mevinphos	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Phosalone	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Pirimiphos Methyl	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Propetamphos	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Triazophos	ug/l	<0.01	~	0.1#	<0.01	<0.01	<0.01
Benazolin	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
Bentazone	ug/l	<0.1	0.075	0.1#	<0.1	<0.1	<0.1
Bromoxynil	ug/l	<0.1	~	5	<0.1	<0.1	<0.1
Clopyralid	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
4- CPA	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
2,4 – D	ug/l	<0.1	0.075	0.1#	<0.1	<0.1	<0.1
2,4 -DB	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
Dicamba	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
Dichloroprop	ug/l	<0.1	~	100	<0.1	<0.1	<0.1
Diclofop	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
Fenoprop	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
Flamprop	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
Flamprop – isopropyl	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
loxynil	ug/l	<0.1	~	0.1	<0.1	<0.1	<0.1
MCPA	ug/l	<0.1	0.075	0.1	<0.1	<0.1	<0.1
MCPB	ug/l	<0.1	~	0.1	<0.1	<0.1	<0.1
Mecoprop	ug/l	<0.1	0.075	10	<0.1	<0.1	<0.1
Picloram	ug/l	<0.1	0.073	0.1#	<0.1	<0.1	<0.1
Pentachlorophenol	•	<0.1	~		<0.1	<0.1	<0.1
	ug/l			0.1#			
2,4,5 – T	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
2,3,6 – TBA	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
Triclopyr	ug/l	<0.1	~	0.1#	<0.1	<0.1	<0.1
Atrazine	ue/I	.4	0.075	A	.4	.4	.4
	ug/l	<1	0.075	1	<1	<1	<1
Simazine	ug/l	<1	0.075	1	<1	<1	<1
Fluoride	mg/l	<0.3	~	1	<0.3	<0.3	<0.3
Sulphate		<0.05	187.5	~	94.69	20.61	99.59
	mg/l						
Chloride	mg/l	<0.3	187.5	30	30.0	78.3	34.2
Total Oxidised Nitrogen as N	mg/l	<0.2	~	~	<0.2	1.2	<0.2
Total Cyanide	mg/l	<0.01	0.0375	0.01	<0.01	<0.01	<0.01
Ammoniacal Nitrogen as N	mg/l	<0.03	0.175	0.15 (NH3)	0.15	9.66**	6.62
Total Alkalinity as CaCO3	mg/l	<1	~	NAC	188	404	124
Total Organic Carbon	mg/l	<2	~	NAC	9	14	19
Total Dissolved Solids	mg/l	<35	~	1000	488	928	386
Faecal coliforms	cfu/100ml	<1	~	0	<1	1	<1
Coliforms	MPN/100ml	<1	~	0	43.5	28.5	<1
						1	

Notes:
Bold denotes value exceeds Groundwater regulations.
Italics denotes value exceeds IGV where no groundwater regulation is available.

\* denotes IGV relates to 'phenols'.

\*\* denotes IGV relates to 'dichloroethene'.

\*\* denotes orthophosphate

A1 denotes quality standard relates Total Trihalomethanes. Total Trihalomethanes.

a denotes orniopnosphate

Ad denotes quality standard relates Total Trihalomethanes. Total Trihalomethanes includes chloroform, dibromochloromethane and bromoform.

Δ2 denotes quality standard relates to the sum of Trichloroethene.

A3 denotes quality standard relates to Xylenes

NAC - No Abnormal Change

A denotes alpha-endosulphan

+ denotes alpha-endosulphan

+ denotes permethrin

# denotes non-specific individual pesticide value

++ Result outside calibration range, results should be considered as indicative only and are not accredited

Table 12 Leachate Analytical Results

Sample Identity			Groundwate	r Standards	Surface Water Standards	Compari	son Study	BH2
Laboratory Report No.			Groundwater	Standards	Surrace water Standards	-	-	Jones 12/9860
Laboratory Sample No.			Groundwater Regulations	EPA IGV's	Surfacewater Regulations		andfill Manuals: ite Design <sup>1</sup>	1-6
Sample Date Parameters	Unit	LOD	2010 (S.I. No. 9 of 2010)	LIMIOVS	2012 (S.I. No. 327 of 2012)	Minimum	Maximum	13/12/2012
	Onit	LOD				William	Waxiiiuiii	
Field Measured Parameters	pH units	•	~	6.5-9.5	6.0-9.0	6.80	8.20	6.20
Electrical Conductivity	μS/cm	<b>*</b>	800 # / 1875	~	~	5990	19300	2007
Dissolved Oxygen	%	•	~	NAC	80-120	~	~	<u>54.6</u>
Dissolved Oxygen Temperature	ppm	•	~ ~	NAC 25°C	~	~	~	5.45 11.1
Oxidation Reduction Potential	mV	•	~	~	~	~	~	-45.3
Colour	N/A	•	~	NAC	~	~	~	Dark Grey
Odour Other observations	N/A N/A	•	~	~ ~	~	~ ~	~	acidic None
outer about another	1477	•						110110
Metals (dissolved)				40			405	
Dissolved Arsenic Dissolved Boron	ug/l ug/l	<2.5 <12	7.5 750	10 1000	~	<1 ~	485 ~	<b>22.4</b> 740
Dissolved Cadmium	ug/l	<0.5	3.75	5	0.45°	10	80	<0.5
Dissolved Calcium	mg/l	<0.2	~	200	~	23	501	383.9
Total Dissolved Chromium	ug/l	<1.5	37.5	30	32	<30	560	3.1
Dissolved Copper	ug/l	<7 <20	1500 18.75	30 200	~	<20 1600	620 160000	<7 1392
Total Dissolved Iron Dissolved Lead	ug/l ug/l	<5	16.75	10	~	<40	1900	1592
Dissolved Magnesium	mg/l	<0.1	~	50	~	40	1580	59.8
Dissolved Manganese	ug/l	<2	~	50	~	40	3590	3392
Dissolved Mercury	ug/l	<1	0.75	1	0.07	<0.1	0.8	<1
Dissolved Nickel	ug/l	<2	15	20	~	<30	600	14
Dissolved Potassium Dissolved Sodium	mg/l	<0.1 <0.1	~ 150	5 150	~ ~	100 474	1580 3650	54.2 <b>279.9</b>
Dissolved Sodium Dissolved Zinc	mg/l ug/l	<0.1	150	100	~	30	6700	10
MRP as Total Phosphorus	ug/l	<5	35	30***	35	~	~	<u>161</u>
Veletile Organic Comp to (VOC.) F22								
Volatile Organic Compounds (VOCs) MS Dichlorodifluoromethane	ug/l	<2	~	~	~	~	~	<2
Methyl Tertiary Butyl Ether	ug/l	<1	~	30	~	~	~	<1
Chloromethane	ug/l	<3	~	~	~	~	~	<3
Vinyl Chloride	ug/l	<2	0.375	~	~	~	~	<2
Bromomethane Chloroethane	ug/l ug/l	<1 <3	~ ~	~	~ ~	~	~	<1 <3
Trichlorofluoromethane	ug/l	<3	~	~	~	~	~	<3
1,1-Dichloroethene	ug/l	<3	~	30**	~	~	~	<3
Dichloromethane	ug/l	<3	~	10	~	~	~	<3
trans-1-2-Dichloroethene	ug/l	<3	~	30**	~	~	~	<3
1,1-Dichloroethane cis-1-2-Dichloroethene	ug/l ug/l	<3 <3	~ ~	30**	~	~	~	<3 <3
2,2-Dichloropropane	ug/l	<1	~	~	~	~	~	<1
Bromochloromethane	ug/l	<2	~	~	~	~	~	<2
Chloroform	ug/l	<2	75 <sup>∆1</sup>	~	~	~	~	<2
1,1,1-Trichloroethane	ug/l	<2	~	500	~	~	~	<2
1,1-Dichloropropene  Carbon tetrachloride	ug/l ug/l	<3 <2	~	~ ~	~	~	~	<3 <2
1,2-Dichloroethane	ug/l	<2	2.25	3	~	~	~	<2
Benzene	ug/l	<1	0.75	1	50	~	~	5
Trichloroethene	ug/l	<3	7.5 <sup>Δ2</sup>	70	~	~	~	<3
1,2-Dichloropropane	ug/l	<2	~	~	~	~	~	<2
Dibromomethane Bromodichloromethane	ug/l ug/l	<3 <2	~	~ ~	~	~	~	<3 <2
cis-1-3-Dichloropropene	ug/l	<2	~	~	~	~	~	<2
Toluene	ug/l	<2	~	10	~	~	~	<2
trans-1-3-Dichloropropene	ug/l	<2	~	~	~	~	~	<2
1,1,2-Trichloroethane Tetrachloroethene	ug/l ug/l	<2 <3	~ 7.5 <sup>Δ2</sup>	~ 40	~	~	~	<2 <3
1,3-Dichloropropane	ug/l	<2	7.5 ~	~	~	~	~	<2
Dibromochloromethane	ug/l	<2	75 <sup>Δ1</sup>	~	~	~	~	<2
1,2-Dibromoethane	ug/l	<2	~	~	~	~	~	<2
Chlorobenzene	ug/l	<2	~	1	~	~	~	<2
1,1,1,2-Tetrachloroethane Ethylbenzene	ug/l ug/l	<2 <2	~	10	~	~	~	<2 3
p/m-Xylene	ug/l	<3	~	10 <sup>Δ3</sup>	~	~	~	7
o-Xylene	ug/l	<2	~	10 <sup>Δ3</sup>	~	~	~	<2
Styrene	ug/l	<2	~	~	~	~	~	<2
Bromoform	ug/l	<2	75 <sup>∆1</sup>	~	~	~	~	<2 3
Isopropylbenzene 1,1,2,2-Tetrachloroethane	ug/l ug/l	<3 <4	~ ~	~	~	~	~	3 <4
Bromobenzene	ug/l	<2	~	~	~	~	~	<2
1,2,3-Trichloropropane	ug/l	<3	~	~	~	~	~	<3
Propylbenzene	ug/l	<3	~	~	~	~	~	<3
2-Chlorotoluene 1,3,5-Trimethylbenzene	ug/l ug/l	<3 <3	~	~	~	~	~	<3 <3
4-Chlorotoluene	ug/l	<3	~ ~	~	~	~	~	<3
tert-Butylbenzene	ug/l	<3	~	~	~	~	~	<3
1,2,4-Trimethylbenzene	ug/l	<3	~	~	~	~	~	26
sec-Butylbenzene	ug/l	<3	~	~	~	~	~	<3
4-Isopropyltoluene	ug/l	<3	~	~	~	~	~	<3 <3
1,3-Dichlorobenzene 1,4-Dichlorobenzene	ug/l ug/l	<3 <3	~ ~	~	~ ~	~	~	<3 <3
n-Butylbenzene	ug/l	<3	~	~	~	~	~	<3
1,2-Dichlorobenzene	ug/l	<3	~	10	~	~	~	<3
	ug/l	<2	~	~	~	~	~	<2
1,2-Dibromo-3-chloropropane		<3	~	0.4	~	~	~	<3
1,2,4-Trichlorobenzene	ug/l ug/l		~	0.1	~	~	~	<3
1,2,4-Trichlorobenzene Hexachlorobutadiene 1,2,3-Trichlorobenzene	ug/l ug/l ug/l	<3 <3	~ ~	0.1	~ ~	~	~ ~	<3 <3
1,2,4-Trichlorobenzene Hexachlorobutadiene	ug/l	<3					<del></del>	

- Italics denotes value exceeds IGV where no groundwater regulation is available.

  Underlined denotes value exceeds Surface Water EQS (MAC inland surface waters)

  1: Landfill Manuals: Landfill site design. EPA, (2000). Taken from Table 7.2: Summary of composition of methanogenic leachates sampled from large landfills with a relatively dry high waste input rate.
- \* denotes IGV relates to 'phenols'.
- \*\* denotes IGV relates to 'dichloroethene'.
  \*\*\* denotes orthophosphate
- Δ1 denotes quality standard relates Total Trihalomethanes. Total Trihalomethanes includes chloroform, dibromochloromethane and bromoform. Δ2 denotes quality standard relates to the sum of Trichloroethene & Tetrachloroethene.
  Δ3 denotes quality standard relates to Xylenes
  NAC No Abnormal Change

- ^ denotes alpha-endosulphan
- + denotes permethrin
- # denotes non-specific individual pesticide value
- ++ Result outside calibration range, results should be considered as indicative only and are not accredited 
  of denotes most conserative value due to unknown CaCO3 concentation

Table 12 Leachate Analytical Results

Sample Identity	Groundwater	r Standards	Surface Water Standards	Compari	BH2			
Laboratory Report No.						· ·	andfill Manuals:	Jones 12/9860
Laboratory Sample No. Sample Date			Groundwater Regulations 2010 (S.I. No. 9 of 2010)	EPA IGV's	Surfacewater Regulations 2012 (S.I. No. 327 of 2012)		ite Design <sup>1</sup>	1-6 13/12/2012
Parameters	Unit	LOD	2010 (6.1. No. 3 01 2010)		2012 (0.1. NO. 327 01 2012)	Minimum	Maximum	13/12/2012
Semi-Volatile Organic Compounds (SVOCs) Phenols								
-Chlorophenol	ug/l	<10	~	200	~	~	~	<10
-Methylphenol -Nitrophenol	ug/l ug/l	<10 <10	~	~	~ ~	~	~	<10 <10
,4-Dichlorophenol	ug/l	<10	~	~	~	~	~	<10
2,4-Dimethylphenol	ug/l	<10	~	~	~	~	~	<10 <10
2,4,5-Trichlorophenol 2,4,6-Trichlorophenol	ug/l ug/l	<10 <10	~ ~	200	~ ~	~	~	<10 <10
-Chloro-3-methylphenol	ug/l	<10	~	~	~	~	~	<10
I-Methylphenol I-Nitrophenol	ug/l ug/l	<10 <10	~	~	~ ~	~	~	41 <10
Pentachlorophenol	ug/l	<10	~	2	1	~	~	<10
Phenol	ug/l	<10	~	0.5*	46	~	~	24
olycyclic Aromatic Hydrocarbons (PAHs)						~	~	
-Chloronaphthalene -Methylnaphthalene	ug/l ug/l	<10 <10	~	~	~	~ ~	~	<10 <10
laphthalene	ug/l	<10	~	1	~	~	~	<10
cenaphthylene cenaphthene	ug/l ug/l	<10 <10	~	~	~	~ ~	~	<10 <10
luorene	ug/l	<10	~	~	~	~	~	<10
henanthrene nthracene	ug/l ug/l	<10 <10	~ ~	10000	0.4	~	~	<10 <10
luoranthene	ug/l	<10	~	1	1	~	~	<10
yrene enzo(a)anthracene	ug/l ug/l	<10 <10	~	~	~	~	~	<10 <10
hrysene	ug/l	<10	~	~	~	~	~	<10
denzo(bk)fluoranthene	ug/l	<10 <10	~ 0.0075	~ 0.01	0.1	~	~	<10 <10
enzo(a)pyrene ndeno(123cd)pyrene	ug/l ug/l	<10 <10	0.0075	0.01	0.1	~	~	<10 <10
bibenzo(ah)anthracene	ug/l	<10	~	~	~	~	~	<10
enzo(ghi)perylene	ug/l	<10	~	0.05	~	~	~	<10
other SVOCs	"			10		~	~	
,2-Dichlorobenzene ,2,4-Trichlorobenzene	ug/l ug/l	<10 <10	~ ~	10 	~ ~	~ ~	~	<10 <10
,3-Dichlorobenzene	ug/l	<10	~	~	~	~	~	<10
,4-Dichlorobenzene -Nitroaniline	ug/l ug/l	<10 <10	~	~	~	~ ~	~	<10 <10
,4-Dinitrotoluene	ug/l	<10	~	~	~	~	~	<10
,6-Dinitrotoluene -Nitroaniline	ug/l ug/l	<10 <10	~	~	~ ~	~	~	<10 <10
-Nitroanime -Bromophenylphenylether	ug/l	<10	~	~	~	~	~	<10
-Chloroaniline	ug/l	<10	~	~	~	~	~	<10
-Chlorophenylphenylether -Nitroaniline	ug/l ug/l	<10 <10	~ ~	~	~ ~	~	~	<10 <10
zobenzene	ug/l	<10	~	~	~	~	~	<10
is(2-chloroethoxy)methane iis(2-chloroethyl)ether	ug/l ug/l	<10 <10	~ ~	~	~	~	~	<10 <10
Carbazole	ug/l	<10	~	~	~	~	~	<10
bibenzofuran lexachlorobenzene	ug/l ug/l	<10 <10	~ ~	0.03	0.05	~ ~	~	<10 <10
lexachlorobutadiene	ug/l	<10	~	0.1	0.6	~	~	<10
lexachlorocyclopentadiene lexachloroethane	ug/l ug/l	<10 <10	~ ~	~ ~	~ ~	~	~	<10 <10
sophorone	ug/l	<10	~	~	~	~	~	<10
I-nitrosodi-n-propylamine litrobenzene	ug/l ug/l	<10 <10	~	 10	~	~	~	<10 <10
intoperizerie	ug/i	<10	~	10	~	~	~	
Phthalates		-10		0		~	~	-10
uis(2-ethylhexyl) phthalate utylbenzyl phthalate	ug/l ug/l	<10 <10	~ ~	<u>8</u> ~	~	~	~	<10 <10
i-n-butyl phthalate	ug/l	<10	~	2	~	~	~	<10
bi-n-Octyl phthalate Diethyl phthalate	ug/l ug/l	<10 <10	~ ~	~	~	~ ~	~	<10 <10
imethyl phthalate	ug/l	<10	~	~	~	~	~	<10
Pesticides MS						~	~	
Organochlorine Pesticides						~	~	
ldrin Ipha-BHC	ug/l ug/l	<0.01 <0.01	~	0.01 0.1 <sup>#</sup>	~	~	~	<0.01 <0.01
eta-BHC	ug/l	<0.01	~	0.1″ 0.1 <sup>#</sup>	~	~ ~	~	<0.01
hlorothalonil	ug/l	<0.01	~	0.1#	~	~	~	<0.01
s-Chlordane ieldrin	ug/l ug/l	<0.01 <0.01	0.075	0.1 <sup>#</sup> 0.01	~ ~	~ ~	~	<0.01 <0.01
ndosulphan I	ug/l	<0.01	0.075	0.001^	0.01^	~	~	<0.01
ndosulphan II ndosulphan sulphate	ug/l	<0.01 <0.01	~ ~	0.001^	0.01^ 0.01^	2 2	~ ~	<0.01 <0.01
ndosulphan sulphate ndrin	ug/l ug/l	<0.01	~	0.001^ 0.1 <sup>#</sup>	0.01^	~ ~	~	<0.01 <0.01
amma-BHC	ug/l	<0.01	~	0.1#	~	~	~	<0.01
eptachlor eptachlor Epoxide	ug/l ug/l	<0.01 <0.01	~	0.1 <sup>#</sup>	~	~	~	<0.01 <0.01
exachlorobenzene	ug/l	<0.01	~	0.1″ 0.1 <sup>#</sup>	0.05	~ ~	~	<0.01
odrin	ug/l	<0.01	~	0.1#	~	~	~	<0.01
p'-DDE p'-DDT	ug/l ug/l	<0.01 <0.01	~	0.1 <sup>#</sup>	~ ~	~	~	<0.01 <0.01
p'-DD1 p'-Methoxychlor	ug/l	<0.01	~	0.1″ 0.1 <sup>#</sup>	~ ~	~ ~	~	<0.01
p'-TDE	ug/l	<0.01	~	0.1#	~	~	~	<0.01
p'-DDE p'-DDT	ug/l ug/l	<0.01 <0.01	0.075	0.1 <sup>#</sup>	~	~	~	<0.01 <0.01
p'-Methoxychlor	ug/l	<0.01	0.075	0.1 <sup>#</sup>	~ ~	~	~	<0.01
,p'-TDE	ug/l	<0.01	~	0.1#	~	~	~	<0.01
endimethalin ermethrin I	ug/l ug/l	<0.01 <0.01	~	0.1 <sup>#</sup> 20+	~ ~	~	~	<0.01 <0.01
ermethrin I ermethrin II	ug/l	<0.01	~ ~	20+	~	~	~	<0.01
uintozene	ug/l	<0.01	~	0.1#	~	~	~	<0.01
ecnazene elodrin	ug/l ug/l	<0.01 <0.01	~	0.1 <sup>#</sup>	~	~ ~	~	<0.01 <0.01
		<0.01	~	0.1	~	~	~	<0.01
ans-Chlordane	ug/l		~					
	ug/l ug/l ug/l	<0.01 <0.01 <0.01	~ ~	0.1 <sup>#</sup> 0.1 <sup>#</sup>	~	~	~	<0.01 <0.01

**Bold** denotes value exceeds Groundwater regulations.

Italics denotes value exceeds IGV where no groundwater regulation is available.

Underlined denotes value exceeds Surface Water EQS (MAC inland surface waters)

1: Landfill Manuals: Landfill site design. EPA, (2000). Taken from Table 7.2: Summary of composition of methanogenic leachates sampled from large landfills with a relatively dry high waste input rate.

\* denotes IGV relates to 'phenols'.

\*\* denotes IGV relates to 'dichloroethene'.

<sup>\*\*\*</sup> denotes orthophosphate

 $<sup>\</sup>Delta 1$  denotes quality standard relates Total Trihalomethanes. Total Trihalomethanes includes chloroform, dibromochloromethane and bromoform .  $\Delta 2$  denotes quality standard relates to the sum of Trichloroethene & Tetrachloroethene.

Δ3 denotes quality standard relates to Xylenes NAC - No Abnormal Change

<sup>^</sup> denotes alpha-endosulphan + denotes permethrin

<sup>#</sup> denotes non-specific individual pesticide value
++ Result outside calibration range, results should be considered as indicative only and are not accredited
of denotes most conserative value due to unknown CaCO3 concentation

**Table 12 Leachate Analytical Results** 

Sample Identity			Groundwater	Standards	Surface Water Standards	Compari	son Study	BH2
Laboratory Report No. Laboratory Sample No.			Groundwater Regulations	EPA IGV's	Surfacewater Regulations		andfill Manuals: ite Design <sup>1</sup>	Jones 12/9860 1-6
Sample Date			2010 (S.I. No. 9 of 2010)	LFA IGVS	2012 (S.I. No. 327 of 2012)	Landilli S	ite Design	13/12/2012
arameters	Unit	LOD				Minimum	Maximum	
rganophosphorus Pesticides								
zinphos ethyl	ug/l	<0.01	~	0.1#	~	~	~	<0.01
zinphos methyl	ug/l	<0.01	~	0.1#	~	~	~	<0.01
arbophenothion	ug/l	<0.01	~	0.1#	~	~	~	<0.01
hlorfenvinphos	ug/l	<0.01	~	5	0.3	~	~	<0.01
hlorpyrifos	ug/l	<0.01	~	90	0.1	~	~	<0.01
hlorpyrifos-methyl	ug/l	<0.01	~	0.1#	~	~	~	<0.01
iazinon	ug/l	<0.01	~	0.1*	0.02	~	~	<0.01
ichlorvos	ug/l	<0.01	~	0.001	~	~	~	<0.01
imethoate	ug/l	<0.01	~	0.1*	4	~	~	<0.01
thion	ug/l	<0.01	~	0.1	~	~	~	<0.01
			~					<0.01
thyl Parathion (Parathion)	ug/l	<0.01		0.1#	~	~	~	
trimphos	ug/l	<0.01	~	0.1#	~	~	~	<0.01
enitrothion	ug/l	<0.01	~	0.1#	~	~	~	<0.01
enthion	ug/l	<0.01	~	0.1#	~	~	~	<0.01
lalathion	ug/l	<0.01	~	0.1#	~	~	~	<0.01
lethyl Parathion	ug/l	<0.01	~	0.1#	~	~	~	<0.01
levinphos	ug/l	<0.01	~	0.1#	~	~	~	<0.01
hosalone	ug/l	<0.01	~	0.1#	~	~	~	<0.01
irimiphos Methyl	ug/l	<0.01	~	0.1#	~	~	~	<0.01
ropetamphos	ug/l	<0.01	~	0.1#	~	~	~	<0.01
riazophos	ug/l	<0.01	~	0.1#	~	~	~	<0.01
nazopnos		10.00		0.1		~	~	10101
enazolin	ug/l	<0.1	~	0.1#	~	~	~	<0.1
	ug/l	<0.1	0.075	0.1*	~	~	~	<0.1
entazone romoxynil	ug/l	<0.1	0.075	5	~	~	~	<0.1
·		<0.1	~		~		t	<0.1
lopyralid	ug/l			0.1#		~	~	
- CPA	ug/l	<0.1	~	0.1#	~	~	~	<0.1
,4 – D	ug/l	<0.1	0.075	0.1#	~	~	~	<0.1
.4 –DB	ug/l	<0.1	~	0.1#	~	~	~	<0.1
icamba	ug/l	<0.1	~	0.1#	~	~	~	<0.1
ichloroprop	ug/l	<0.1	~	100	~	~	~	<0.1
iclofop	ug/l	<0.1	~	0.1#	~	~	~	<0.1
enoprop	ug/l	<0.1	~	0.1#	~	~	~	<0.1
lamprop	ug/l	<0.1	~	0.1#	~	~	~	<0.1
lamprop – isopropyl	ug/l	<0.1	~	0.1#	~	~	~	<0.1
oxynil	ug/l	<0.1	~	0.1#	~	~	~	<0.1
ICPA	ug/l	<0.1	0.075	0.1#	~	~	~	<0.1
ICPB	ug/l	<0.1	~	0.1*	~	~	~	<0.1
lecoprop	ug/l	<0.1	0.075	10	~	~	~	<0.1
icloram	ug/l	<0.1	~	0.1*	~	~	~	<0.1
entachlorophenol	ug/l	<0.1	~	0.1	~	~	~	<0.1
	ug/l	<0.1	~		~	~	~	<0.1
4,5 – T		<0.1		0.1#				<0.1
3,6 – TBA	ug/l		~	0.1#	~	~	~	
riclopyr	ug/l	<0.1	~	0.1#	~	~	~	<0.1
Ana-in-			0.675			~	~	
trazine	ug/l	<1	0.075	1 1	2	~	~	<1
imazine	ug/l	<1	0.075	1	4	~	~	<1
uorido	m~/l	-0.3		4		~	~	-0.9
uoride	mg/l	<0.3	~ 407.5	1	~	~ -E	~	<0.3
ulphate	mg/l	<0.05	187.5	~	~	<5	322	16.24
hloride	mg/l	<0.3	187.5	30	~	570	4710	135.3
otal Oxidised Nitrogen as N	mg/l	<0.2	~	~	~	~	~	<0.2
otal Cyanide	mg/l	<0.01	0.0375	0.01	~	~	~	<0.01
mmoniacal Nitrogen as N	mg/l	<0.03	0.175	0.15 (NH3)	0.065	283	2040	<u>45.46<sup>++</sup></u>
OD (Settled)	mg/l	<7	~	~	~	622	8000	328
OD	mg/l	<1	~	~	1.5	110	1900	<u>199</u>

Notes:

Bold denotes value exceeds Groundwater regulations.

Italics denotes value exceeds IGV where no groundwater regulation is available.

Underlined denotes value exceeds Surface Water EQS (MAC inland surface waters)

1: Landfill Manuals: Landfill site design. EPA, (2000). Taken from Table 7.2: Summary of composition of methanogenic leachates sampled from large landfills with a relatively dry high waste input rate.

- \* denotes IGV relates to 'phenois'.

  \*\* denotes IGV relates to 'dichloroethene'.
- \*\*\* denotes orthophosphate
- $\Delta 1$  denotes quality standard relates Total Trihalomethanes. Total Trihalomethanes includes chloroform, dibromochloromethane and bromoform.
- Δ2 denotes quality standard relates to the sum of Trichloroethene & Tetrachloroethene.
  Δ3 denotes quality standard relates to Xylenes
  NAC No Abnormal Change
- ^ denotes alpha-endosulphan
- + denotes permethrin
- # denotes non-specific individual pesticide value
- ++ Result outside calibration range, results should be considered as indicative only and are not accredited
- ° denotes most conserative value due to unknown CaCO3 concentation

Table 13 Surface water Analytical Results

Sample Identity			Surface Water	SW1	SW2	SW3	SW4	SW5	SW6
Laboratory Report No.			Standards	Jones 12/9793	Jones 12/9793	Jones 12/9793	Jones 12/9793	Jones 12/9793	Jones 12/9793
Laboratory Sample No.			Surfacewater Regulations 2012	1-8	9-16	40/40/0040	40/40/0040	33-40	41-48 12/12/2012
Sample Date Sample Location			(S.I. No. 327 of 2012)	12/12/2012 Mill Race	12/12/2012 River Liffey	12/12/2012 Mill Race	12/12/2012 River Liffey	12/12/2012 Mill Race	River Liffey
Parameters	Unit	LOD	2012)						
Field Measured Parameters									
pH Electrical Conductivity	pH units μS/cm	•	6.0-9.0	6.86 269.9	6.42 253.9	7.38 261.6	7.21 245.2	7.44 287.6	7.48 248.5
Dissolved Oxygen	%	•	80-120	98.3	102.7	106.8	108.5	97	95.8
Dissolved Oxygen Temperature	ppm	• •	~	13.03 3.6	13.57 3.6	14.17 3.5	14.31 3.7	12.84 3.6	12.74 3.7
Oxidation Reduction Potential	mV	•	~	102.50	175.1	73.8	78.7	79.6	48.9
Colour Odour	N/A N/A	•	~	Brown None	Brown None	Brown None	Brown None	Brown None	Brown None
Other observations	N/A	•	~	None	None	None	None	None	None
Metals (dissolved)									
Dissolved Arsenic	ug/l	<2.5	~	-	-	-		5.8	4.2
Dissolved Boron Dissolved Cadmium	ug/l ug/l	<12 <0.5	- 1.5°	-		-		16 <0.5	<12 <0.5
Dissolved Calcium	mg/l	<0.2	~	-	-	-	-	81.5	70.2
Total Dissolved Chromium	ug/l	<1.5	32	-	-	•	•	8.4	8.6
Dissolved Copper Total Dissolved Iron	ug/l ug/l	<7 <20	~ ~	-		-		<7 84	<7 53
Dissolved Lead	ug/l	<5	~		-			7	6
Dissolved Magnesium	mg/l	<0.1	~	-	-			6.8	5.8
Dissolved Manganese Dissolved Mercury	ug/l ug/l	<2 <1	0.07	-		-		3 <1	4 <1
Dissolved Mickel	ug/l	<2	~	-	-			<2	<2
Dissolved Potassium	mg/l	<0.1	~	1.8	2.0	-	-	2.0	1.6
Dissolved Sodium Dissolved Zinc	mg/l ug/l	<0.1 <3	~	11.6	11.1	-	-	12.1 <3	9.9
MRP as Total Phosphorus	ug/l	<5 <5	35	-	-	-		<u>69</u>	3 <u>9</u>
Methyl Tertiary Butyl Ether #	ug/l	<1	~	-				<1	<1
Benzene #	ug/l	<1	10	-	-		-	<1	<1
Toluene#	ug/l	<2	~	-	-	-	-	<2	<2
Ethylbenzene # p/m-Xylene #	ug/l ug/l	<2 <3	~				•	<2 <3	<2 <3
o-Xylene #	ug/l	<2	~	-	-	-	-	<2	<2
Surrogate Recovery Toluene D8 Surrogate Recovery 4-Bromofluorobenzene	%	<0 <0	~	-				103 118	103 114
,	70	ζ0	~	-	-			110	114
Volatile Organic Compounds (VOCs) MS Dichlorodifluoromethane	ug/l	<2	~					<2	<2
Methyl Tertiary Butyl Ether	ug/l	<1	~	-	-	•	•	<1	<1
Chloromethane	ug/l	<3	~	-	-			<3	<3
Vinyl Chloride Bromomethane	ug/l ug/l	<2 <1	~		-		•	<2 <1	<2 <1
Chloroethane	ug/l	<3	~	-	-			<3	<3
Trichlorofluoromethane 1,1-Dichloroethene	ug/l ug/l	<3 <3	~					<3 <3	<3 <3
Dichloromethane	ug/l	<3	~	-	-	-	-	<3	<3
trans-1-2-Dichloroethene	ug/l	<3	~	-	-			<3	<3
1,1-Dichloroethane cis-1-2-Dichloroethene	ug/l ug/l	<3 <3	~	-				<3 <3	<3 <3
2,2-Dichloropropane	ug/l	<1	~		-			<1	<1
Bromochloromethane Chloroform	ug/l	<2	~	-	-	-	-	<2	<2 <2
1,1,1-Trichloroethane	ug/l ug/l	<2 <2	~	-		-	-	<2 <2	<2
1,1-Dichloropropene	ug/l	<3	~	-	-			<3	<3
Carbon tetrachloride 1,2-Dichloroethane	ug/l	<2 <2	~ ~	-	-	-		<2 <2	<2 <2
Benzene	ug/l ug/l	<1	50					<1	<1
Trichloroethene	ug/l	<3	~	-	-			<3	<3
1,2-Dichloropropane Dibromomethane	ug/l ug/l	<2 <3	~	-		-		<2 <3	<2 <3
Bromodichloromethane	ug/l	<2	~	-	-	-		<2	<2
cis-1-3-Dichloropropene	ug/l	<2	~	-	-	-	-	<2	<2
Toluene trans-1-3-Dichloropropene	ug/l ug/l	<2 <2	~ ~	-	-	-	-	<2 <2	<2 <2
1,1,2-Trichloroethane	ug/l	<2	~	-	-	-	-	<2	<2
Tetrachloroethene 1,3-Dichloropropane	ug/l	<3 <2	~	-	-			<3 <2	<3 <2
Dibromochloromethane	ug/l ug/l	<2	~	-	-	-	-	<2	<2 <2
1,2-Dibromoethane	ug/l	<2	~	-	-	-	-	<2	<2
Chlorobenzene 1,1,1,2-Tetrachloroethane	ug/l ug/l	<2 <2	~	-	-	-	-	<2 <2	<2 <2
Ethylbenzene	ug/l	<2	~	-	-		-	<2	<2
p/m-Xylene	ug/l	<3	~	-	-	-	-	<3	<3
o-Xylene Styrene	ug/l ug/l	<2 <2	~	-	-	-	-	<2 <2	<2 <2
Bromoform	ug/l	<2	~		-	-	-	<2	<2
Isopropylbenzene 1,1,2,2-Tetrachloroethane	ug/l	<3 <4	~	-	-	-	-	<3 <4	<3 <4
1,1,2,2-1 etrachioroethane Bromobenzene	ug/l ug/l	<4 <2	~	-	-	-	-	<4 <2	<4 <2
1,2,3-Trichloropropane	ug/l	<3	~	-	-	-	-	<3	<3
Propylbenzene 2-Chlorotoluene	ug/l ug/l	<3 <3	~	-	-	-	-	<3 <3	<3 <3
1,3,5-Trimethylbenzene	ug/l	<3	~	-	-		-	<3	<3 <3
4-Chlorotoluene	ug/l	<3	~	-	-	-	-	<3	<3
tert-Butylbenzene 1,2,4-Trimethylbenzene	ug/l ug/l	<3 <3	~	-	-	-	-	<3 <3	<3 <3
sec-Butylbenzene	ug/l	<3 <3	~	-	-	-	-	<3	<3
4-Isopropyltoluene	ug/l	<3	~	-	-	-	-	<3	<3
1,3-Dichlorobenzene 1,4-Dichlorobenzene	ug/l ug/l	<3 <3	~ ~	-	-	-	-	<3 <3	<3 <3
n-Butylbenzene	ug/l ug/l	<3 <3	~	-	-	-	-	<3 <3	<3 <3
1,2-Dichlorobenzene	ug/l	<3	~	-	-	-	-	<3	<3
1,2-Dibromo-3-chloropropane 1,2,4-Trichlorobenzene	ug/l ug/l	<2 <3	~ ~	-	-	-	-	<2 <3	<2 <3
Hexachlorobutadiene	ug/l	<3	~	-	-	-	•	<3	<3
1,2,3-Trichlorobenzene Surrogate Recovery Toluene D8	ug/l %	<3 <0	~ ~	-	-	-	-	<3 103	<3 103
Surrogate Recovery 4-Bromofluorobenzene	%	<0	~	-	-	-	-	118	114

Notes:

Underlined denotes value exceeds Surface Water EQS (MAC inland surface waters)

^ denotes alpha-endosulphan

° denotes value corresponde to samples where average CaCO3 exceeds 200mg/l

Table 13 Surface water Analytical Results

Sample Identity		<u>L</u>	Surface Water Standards	SW1	SW2	SW3	SW4	SW5	SW6
Laboratory Report No.			Surfacewater	Jones 12/9793	Jones 12/9793	Jones 12/9793	Jones 12/9793	Jones 12/9793	Jones 12/9793
Laboratory Sample No. Sample Date			Regulations 2012	1-8 12/12/2012	9-16 12/12/2012	- 12/12/2012	12/12/2012	33-40 12/12/2012	41-48 12/12/2012
Sample Location			(S.I. No. 327 of 2012)	Mill Race	River Liffey	Mill Race	River Liffey	Mill Race	River Liffey
Parameters	Unit	LOD	=						
Semi-Volatile Organic Compounds (SVOCs) Phenols									
2-Chlorophenol	ug/l	<10	~	-	-	-	-	<10	<10
2-Methylphenol 2-Nitrophenol	ug/l ug/l	<10 <10	~		-	-	-	<10 <10	<10 <10
2,4-Dichlorophenol	ug/l	<10	~	-	-	-		<10	<10
2,4-Dimethylphenol 2,4,5-Trichlorophenol	ug/l ug/l	<10 <10	~			-	-	<10 <10	<10 <10
2,4,6-Trichlorophenol	ug/l	<10	~	-	-	-	-	<10	<10
4-Chloro-3-methylphenol 4-Methylphenol	ug/l ug/l	<10 <10	~	-	-			<10 <10	<10 <10
4-Nitrophenol	ug/l	<10	~	-	-	-	-	<10	<10
Pentachlorophenol	ug/l	<10	1	-	-	-		<10	<10
Phenol	ug/l	<10	46		-	•	•	<10	<10
Polycyclic Aromatic Hydrocarbons (PAHs)								4.0	40
2-Chloronaphthalene 2-Methylnaphthalene	ug/l ug/l	<10 <10	~		-			<10 <10	<10 <10
Naphthalene	ug/l	<10	~	-	-	-	-	<10	<10
Acenaphthylene Acenaphthene	ug/l ug/l	<10 <10	~					<10 <10	<10 <10
Fluorene	ug/l	<10	~	-	-	-	-	<10	<10
Phenanthrene	ug/l	<10	~	-	-	-		<10	<10
Anthracene Fluoranthene	ug/l ug/l	<10 <10	0.4	-	-			<10 <10	<10 <10
Pyrene	ug/l	<10	~	-	-	-		<10	<10
Benzo(a)anthracene Chrysene	ug/l ug/l	<10 <10	~		-			<10 <10	<10 <10
Benzo(bk)fluoranthene	ug/l	<10	~		-			<10	<10
Benzo(a)pyrene	ug/l	<10	0.1		-			<10	<10
Indeno(123cd)pyrene Dibenzo(ah)anthracene	ug/l ug/l	<10 <10	~		-	-	-	<10 <10	<10 <10
Benzo(ghi)perylene	ug/l	<10	~	-	-	-	-	<10	<10
Other SVOCs									
1,2-Dichlorobenzene	ug/l	<10	~	-	-	-	-	<10	<10
1,2,4-Trichlorobenzene	ug/l	<10	~	-	-	-		<10	<10
1,3-Dichlorobenzene	ug/l ug/l	<10 <10	~	-	-	-	-	<10 <10	<10 <10
2-Nitroaniline	ug/l	<10	~	-	-	-	-	<10	<10
2,4-Dinitrotoluene	ug/l	<10	~	-	-	-	-	<10	<10
2,6-Dinitrotoluene 3-Nitroaniline	ug/l ug/l	<10 <10	~					<10 <10	<10 <10
4-Bromophenylphenylether	ug/l	<10	~	-	-	-	-	<10	<10
4-Chloroaniline 4-Chlorophenylphenylether	ug/l ug/l	<10 <10	~	-	-	-	-	<10 <10	<10 <10
4-Nitroaniline	ug/l	<10	~	-	-	-	-	<10	<10
Azobenzene	ug/l	<10	~	-	-	-	-	<10	<10
Bis(2-chloroethoxy)methane Bis(2-chloroethyl)ether	ug/l ug/l	<10 <10	~					<10 <10	<10 <10
Carbazole	ug/l	<10	~	-	-	-	-	<10	<10
Dibenzofuran	ug/l	<10 <10	0.05					<10 <10	<10
Hexachlorobenzene Hexachlorobutadiene	ug/l ug/l	<10	0.6	-	-	-	-	<10	<10 <10
Hexachlorocyclopentadiene	ug/l	<10	~	-	-	-	-	<10	<10
Hexachloroethane Isophorone	ug/l ug/l	<10 <10	~	-	-	-	-	<10 <10	<10 <10
N-nitrosodi-n-propylamine	ug/l	<10	~	-	-	-	-	<10	<10
Nitrobenzene	ug/l	<10	~	-	-	-	-	<10	<10
Phthalates									
Bis(2-ethylhexyl) phthalate	ug/l	<10	~	-	-	-		<10	<10
Butylbenzyl phthalate Di-n-butyl phthalate	ug/l ug/l	<10 <10	~		-	-	-	<10 <10	<10 <10
Di-n-Octyl phthalate	ug/l	<10	~	-	-	-	-	<10	<10
Diethyl phthalate	ug/l	<10	~	-	-	-	-	<10	<10
Dimethyl phthalate	ug/l	<10	~		-	•	•	<10	<10
Pesticides MS									
Organochlorine Pesticides Aldrin	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Alpha-BHC	ug/l	<0.01	~	-	-	-		<0.01	<0.01
Beta-BHC Chlorothalonil	ug/l ug/l	<0.01 <0.01	~	-	-	-	-	<0.01 <0.01	<0.01 <0.01
cis-Chlordane	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Dieldrin	ug/l	<0.01	~	-	-			<0.01	<0.01
Endosulphan I Endosulphan II	ug/l ug/l	<0.01 <0.01	0.01^ 0.01^	-	-	-	-	<0.01 <0.01	<0.01 <0.01
Endosulphan sulphate	ug/l	<0.01	0.01^	-	-	-	-	<0.01	<0.01
Endrin Gamma-BHC	ug/l	<0.01 <0.01	~	-			-	<0.01 <0.01	<0.01 <0.01
Heptachlor	ug/l ug/l	<0.01	~	-	-			<0.01	<0.01
Heptachlor Epoxide	ug/l	<0.01	~	-	-	-		<0.01	<0.01
Hexachlorobenzene Isodrin	ug/l ug/l	<0.01 <0.01	0.05	-	-	-	-	<0.01 <0.01	<0.01 <0.01
o,p'-DDE	ug/l	<0.01	~	-	-	-	•	<0.01	<0.01
o,p'-DDT o,p'-Methoxychlor	ug/l ug/l	<0.01 <0.01	~	-	-			<0.01 <0.01	<0.01 <0.01
p,p'-TDE	ug/l ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
p,p'-DDE	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
p,p'-DDT p,p'-Methoxychlor	ug/l ug/l	<0.01 <0.01	~	-	-	-	-	<0.01 <0.01	<0.01 <0.01
p,p'-TDE	ug/l	<0.01	~	-	-	•	•	<0.01	<0.01
Pendimethalin	ug/l	<0.01	~	-	-	•	•	<0.01	<0.01
Permethrin I Permethrin II	ug/l ug/l	<0.01 <0.01	~	-	-	-	-	<0.01 <0.01	<0.01 <0.01
Quintozene	ug/l	<0.01	~	-	-	-	•	<0.01	<0.01
T	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Tecnazene Telodrin	ua/l	-0 O1		_	_		_	~n n1	
Telodrin trans-Chlordane	ug/l ug/l	<0.01 <0.01	~ ~	-	-	-	-	<0.01 <0.01	<0.01 <0.01
Telodrin									

Notes:
Underlined denotes value exceeds Surface Water EQS (MAC inland surface waters)
^ denotes alpha-endosulphan
° denotes value corresponde to samples where average CaCO3 exceeds 200mg/l

# Waterstown Landfill Palmerstown Co. Dublin

Table 13 Surface water Analytical Results

Sample Identity			Surface Water Standards	SW1	SW2	SW3	SW4	SW5	SW6
Laboratory Report No.				Jones 12/9793	Jones 12/9793				
Laboratory Sample No.			<u>Surfacewater</u>	1-8	9-16		-	33-40	41-48
Sample Date			Regulations 2012	12/12/2012	12/12/2012	12/12/2012	12/12/2012	12/12/2012	12/12/2012
Sample Location			(S.I. No. 327 of 2012)	Mill Race	River Liffey	Mill Race	River Liffey	Mill Race	River Liffey
Parameters	Unit	LOD	2012)						
Organophosphorus Pesticides									
Azinphos ethyl	ug/l	<0.01	~	-		-	-	<0.01	<0.01
Azinphos methyl	ug/l	<0.01	~	-			-	<0.01	<0.01
Carbophenothion	ug/l	<0.01	~	-			-	<0.01	<0.01
Chlorfenvinphos	ug/l	<0.01	0.3	-	-	-	-	<0.01	<0.01
Chlorpyrifos	ug/l	<0.01	0.1	-		-	-	<0.01	<0.01
Chlorpyrifos-methyl	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Diazinon	ug/l	<0.01	0.02	-	-	-	-	<0.01	<0.01
Dichlorvos Dimethoate	ug/l	<0.01 <0.01	~	-	-	-	-	<0.01 <0.01	<0.01 <0.01
Ethion	ug/l ug/l	<0.01	4 ~	-	-		-	<0.01	<0.01
Ethyl Parathion (Parathion)	ug/l	<0.01	~	-	-			<0.01	<0.01
Etrimphos	ug/l	<0.01	~				-	<0.01	<0.01
Fenitrothion	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Fenthion	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Malathion	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Methyl Parathion	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Mevinphos	ug/l	<0.01	~	-			-	<0.01	<0.01
Phosalone	ug/l	<0.01	~	-		-	-	<0.01	<0.01
Pirimiphos Methyl	ug/l	<0.01	~	-			-	<0.01	< 0.01
Propetamphos	ug/l	<0.01	~	-			-	<0.01	<0.01
Triazophos	ug/l	<0.01	~	-	-	-	-	<0.01	<0.01
Benazolin	ug/l	<0.1	~	-	-	-	-	<0.1	<0.1
Bentazone	ug/l	<0.1	~	-	-	-	-	<0.1	<0.1
Bromoxynil	ug/l	<0.1	~	-	-	-	-	<0.1	<0.1
Clopyralid	ug/l	<0.1	~		-		-	<0.1	<0.1
4- CPA	ug/l	<0.1	~	-	-	-	-	<0.1	<0.1
2,4 – D 2,4 –DB	ug/l	<0.1 <0.1	~	-	-	-	-	<0.1 <0.1	<0.1 <0.1
Dicamba	ug/l ug/l	<0.1	~	-	-		-	<0.1	<0.1
Dichloroprop	ug/l	<0.1	~	-	-	-		<0.1	<0.1
Diclofop	ug/l	<0.1	~	-	-		-	<0.1	<0.1
Fenoprop	ug/l	<0.1	~	-	-		-	<0.1	<0.1
Flamprop	ug/l	<0.1	~				-	<0.1	<0.1
Flamprop – isopropyl	ug/l	<0.1	~	-			-	<0.1	<0.1
loxynil	ug/l	<0.1	~				-	<0.1	<0.1
MCPA	ug/l	<0.1	~	-	-	-	-	<0.1	<0.1
MCPB	ug/l	<0.1	~	-			-	<0.1	<0.1
Mecoprop	ug/l	<0.1	~	-			-	<0.1	<0.1
Picloram	ug/l	<0.1	~	-			-	<0.1	<0.1
Pentachlorophenol	ug/l	<0.1	~	-			-	<0.1	<0.1
2,4,5 – T	ug/l	<0.1	~	-			-	<0.1	<0.1
2,3,6 – TBA	ug/l	<0.1	~	-	-	-	-	<0.1	<0.1
Triclopyr	ug/l	<0.1	~	-			-	<0.1	<0.1
									<u> </u>
Atrazine	ug/l	<1	2	-	-	-	-	<1	<1
Simazine	ug/l	<1	4	-	-	-	-	<1	<1
Eluarida	ne II	-0.0						-0.0	-0.0
Fluoride	mg/l	<0.3	~	16.70	- 47.24			<0.3	<0.3
Sulphate	mg/l	<0.05	~	16.70	17.34	-	-	15.78	13.14
Chloride	mg/l	<0.3	~	16.5	16.6	-	-	17.1	13.9
Total Oxidised Nitrogen as N	mg/l	<0.2	~	-			-	1.7	1.6
Total Cyanide	mg/l	<0.01	~	-	-	-	-	<0.01	<0.01
		<b>.</b>							<u> </u>
EPH (C8-C40)	ug/l	<10	~	-	-	-	-	<10	<10
Ammoniacal Nitrogen as N	mg/l	<0.03	0.065	0.05	0.05	-	-	0.09	0.05
Total Alkalinity as CaCO3	mg/l	<1	~	-		•	-	220	200
COD (Settled)	mg/l	<7	~	-	-	-	-	<7	<7
Total Susspended Solids	mg/l	<10	~	-	-	-	-	<10	<10
	i	Ī	1				i l		1
BOD	mg/l	<1	1.5	<1	1	-		2	1

Notes:
Underlined denotes value exceeds Surface Water EQS (MAC inland surface waters)
^ denotes alpha-endosulphan
° denotes value corresponde to samples where average CaCO3 exceeds 200mg/l

**Table 14 Geotechnical Results** 

Sample ID		BH2	BH3
Sample Depth (mbgl)		0.2	0.2
Laboratory Report No.		NA	NA
Laboratory Sample No.		NA	NA
Sample Date		31/12/2012	31/12/2012
Parameters	Unit		
Sample Height	mm	100	100
Sample Diameter	mm	105	105
Sample Volume	cm <sup>3</sup>	865	865
Initial Wet Mass	g	1915	1623
Final Wet Mass	g	1920	1650
Dry Mass	g	1680	1329
Bulk Density	mg/m <sup>3</sup>	2213	1875
Dry Density	mg/m <sup>3</sup>	1941	1536
Initial Water Content	%	14	22.1
Final Water Content	%	14.3	24.2
Seturation Stars			
Saturation Stage Initial B Value		<0.8	<0.8
Back Pore Water Pressure During Saturation	kPa	450	450
Cell Pressure	kPa	420	420
Final B Value			
Duration	- h	0.95 72	0.95 72
Duration	11	12	12
Consolidation Stage			
Cell pressure	kPa	500	500
Back Pore Water Pressure	kPa	450	450
Duration of Consolidation	h	48	48
Permeability Stage			
Temperature	C°	20	20
Cell Pressure	kPa	500	500
Pore Water Pressure (Top)	kPa	450	450
Pore Water Pressure (Bottom)	kPa	470	470
Average Effective Stress	kPa	40	40
Head Difference	kPa	20	20
Head Loss	kPa	2	2
Net Head difference	m	1.83	1.83
Sample Height	m	0.1	0.1
Hydraulic Gradient	i	18.35	18.35
Flow Rate	cm <sup>3</sup> /min	0.0068	0.24
Area of the Sample	cm <sup>2</sup>	80.4	80.4
Permeability	m/s	7.70E-10	2.70E-08
· omeanity	111/0	7.752 10	2.702 00

# Waterstown Landfill Palmerstown

Co. Dublin

Table 15: Gas Monitoring Results

Monitoring Well I.D.	Monitoring Event Date	Monitoring Time (24 hr)	Stable Methane (CH <sub>4</sub> )	Peak Methane (CH <sub>4</sub> )	LEL	Carbon Dioxide (CO <sub>2</sub> )	Oxygen (O <sub>2</sub> )	Balance	Hydrogen Sulphide (H₂S)	Carbon Monoxide (CO)	Flow Measurement	Atmospheric Pressure	Relative Pressure	TOCi Elevation (maOD)	Depth to Water	Water Level
		Units	%	%	%	%	%	%	ppm	ppm	l/h	mb	mb		mbTOC	mAOD
BH1	20/12/2012	11:00	58.1	58.2	>>>	31.4	0	10.5	2	1	0.2	996	0	33.77	DRY	DRY
DITI	16/05/2013	15:10	53.3	53.3	>>>	27.2	0	19.5	0	0	-0.1	995	0.17	33.77	7.290	26.480
BH2	20/12/2012	11:31	53.4	53.5	>>>	36.1	0	10.5	0	2	0.3	996	0.3	32.73	5.494	27.236
DHZ	16/05/2013	15:45	11.2	11.5	>>>	6.8	14.5	67.4	0	0	0	995	0.3	32.73	8.970	23.760
ВНЗ	20/12/2012	10:33	30.1	30.1	>>>	19.6	0	50.3	0	0	0.1	998	0	18.35	6.657	11.693
ьпэ	16/05/2013	14:45	25.3	25.4	>>>	16.0	16.0	57.2	0	0	-0.1	995	0.05	10.33	4.790	13.560
EPA 1997 Thresh	nolds <sup>1</sup>		1.0	1.0	~	1.5	~	~	~	~	~	~	~			
DOE Exposure Li	mits <sup>2</sup>		1.0	1.0	~	0.5	~	~	~	~	~	~	~			

#### Notes:

LEL denotes Lower Explosive Limit (expressed as percentage of 5% v/v methane). >>> denotes exceeds the LEL.

~ denotes no threshold available.

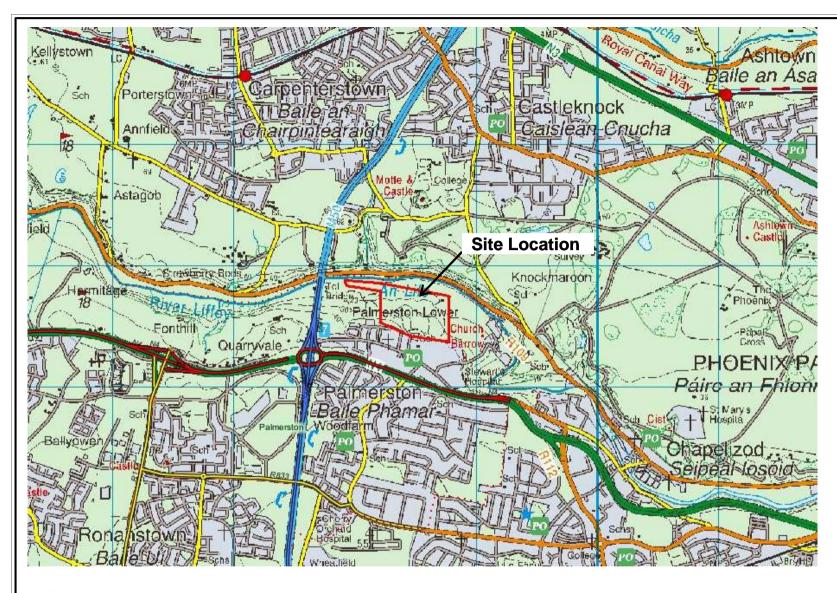
mbTOC denotes metres below top of casing.
mAOD denotes metres above ordnance datum.

**Bold** denotes level exceeds EPA threshold.

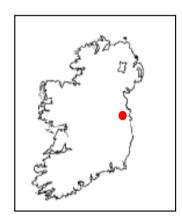
Italics denotes level exceeds DOE exposure limit.

1: Environmental Protection Agency (EPA) 1997: Landfill Manuals - Landfill operational Practices. EPA, Ireland.
2: Department of the Environment (1994): Protection of New Buildings and Occupants from Landfill Gas. DOE, Ireland

TOCi denotes top of inner casing







Approximate Site Boundary



2B Richview Office Park, Clonskeagh, DUBLIN 14.

Tel: +353 1 260 2655 Fax: +353 1 260 2660 Email: enviro@morce.ie

As shown May '13

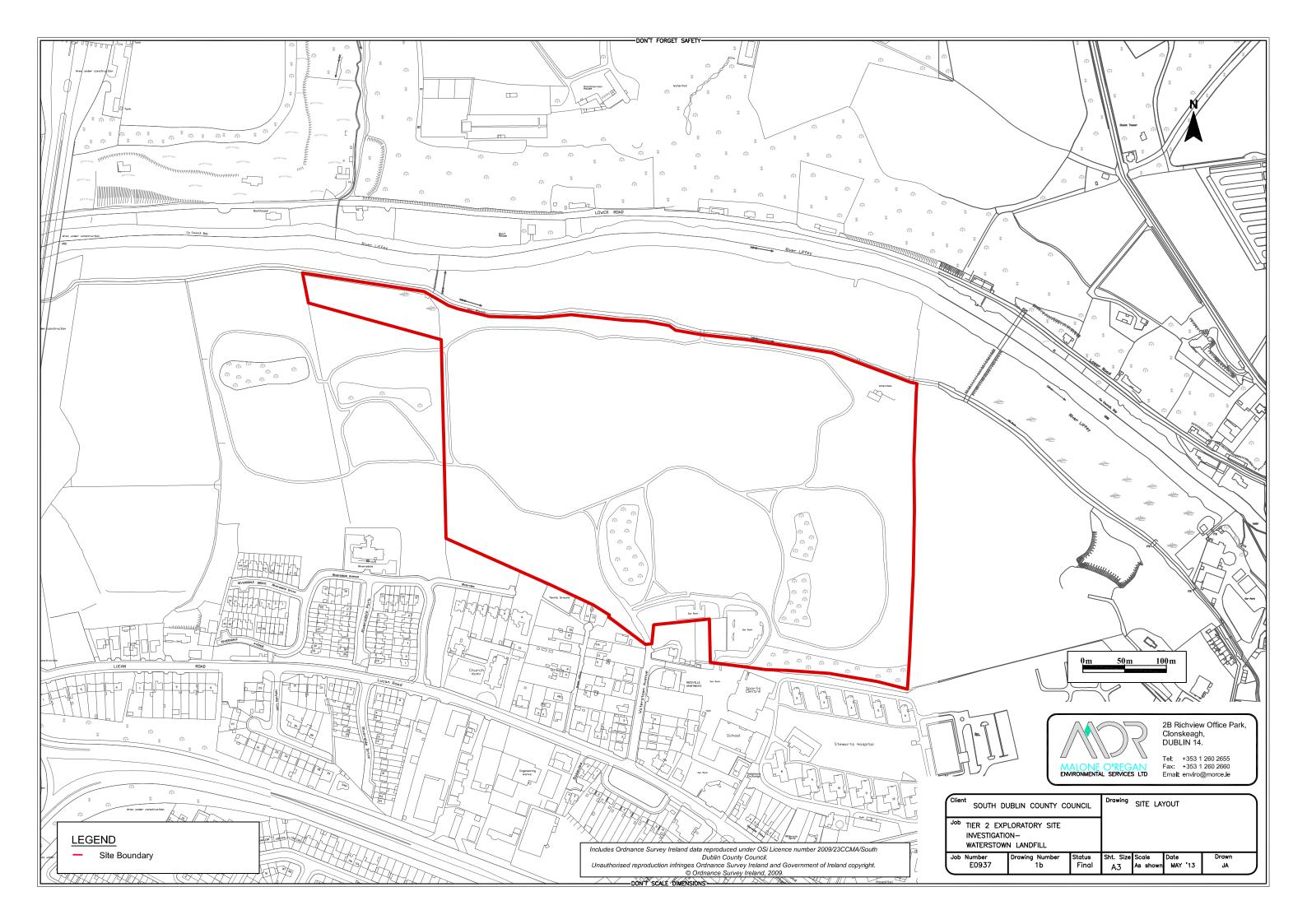
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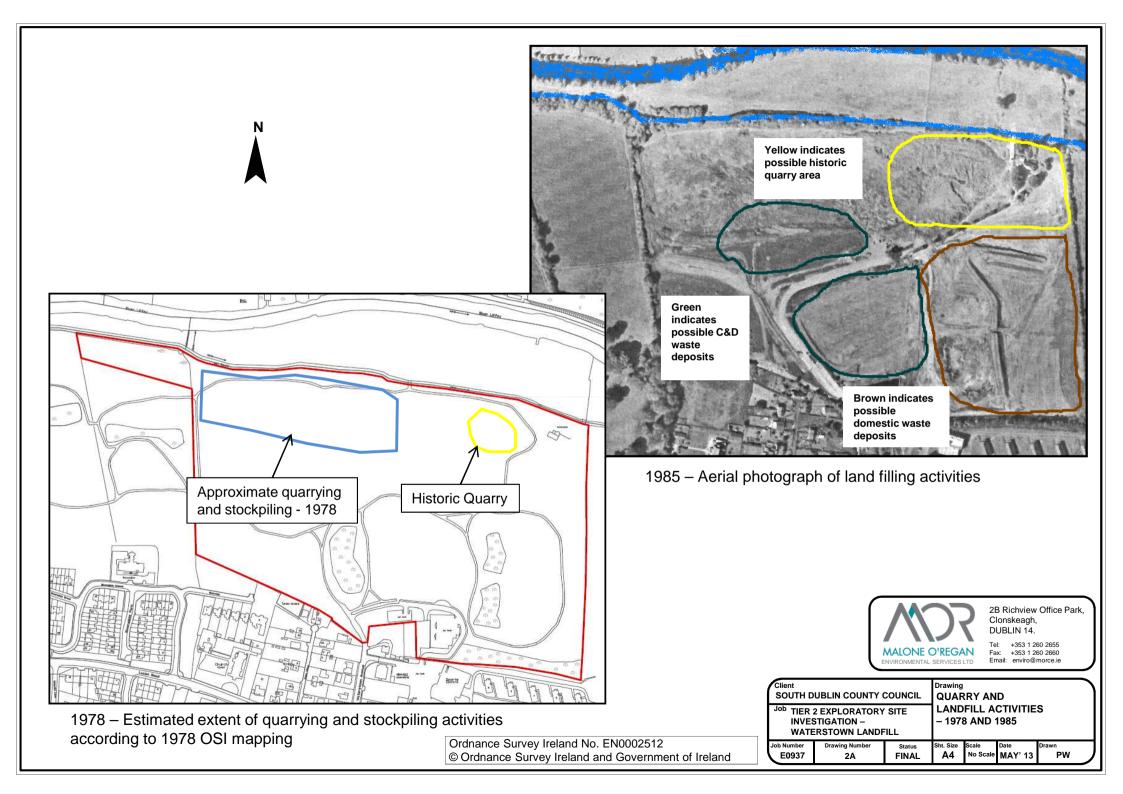
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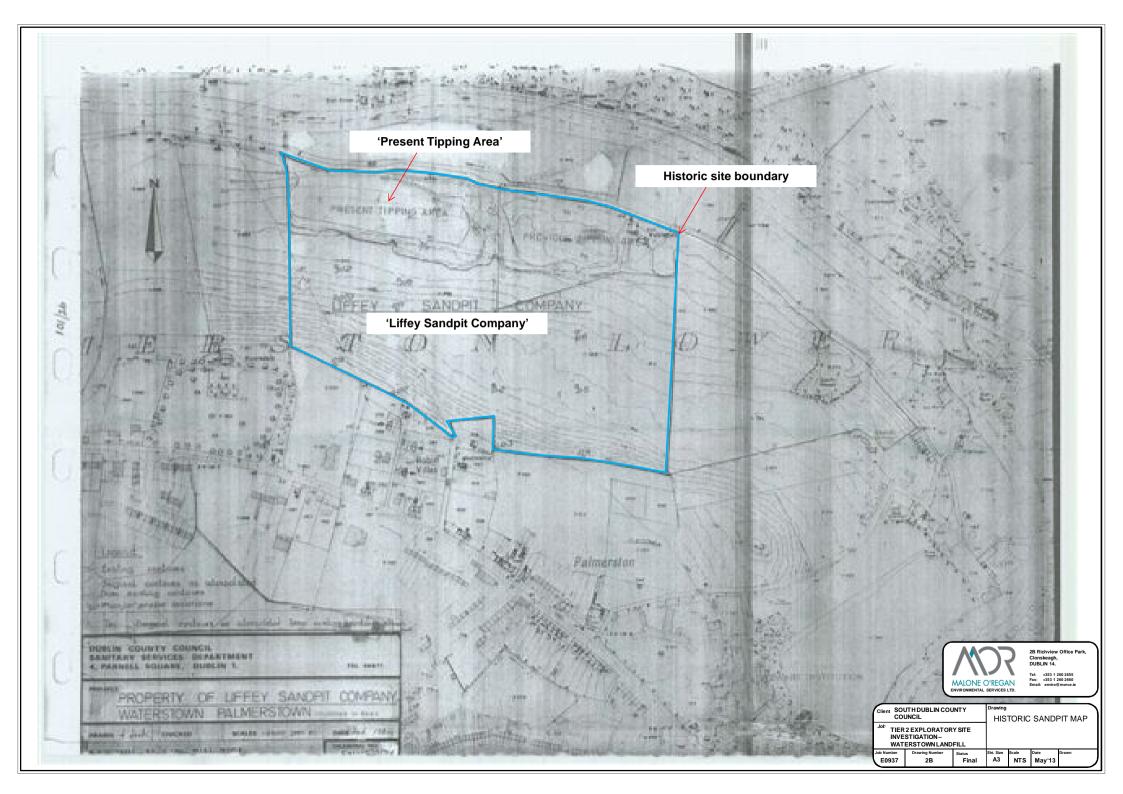
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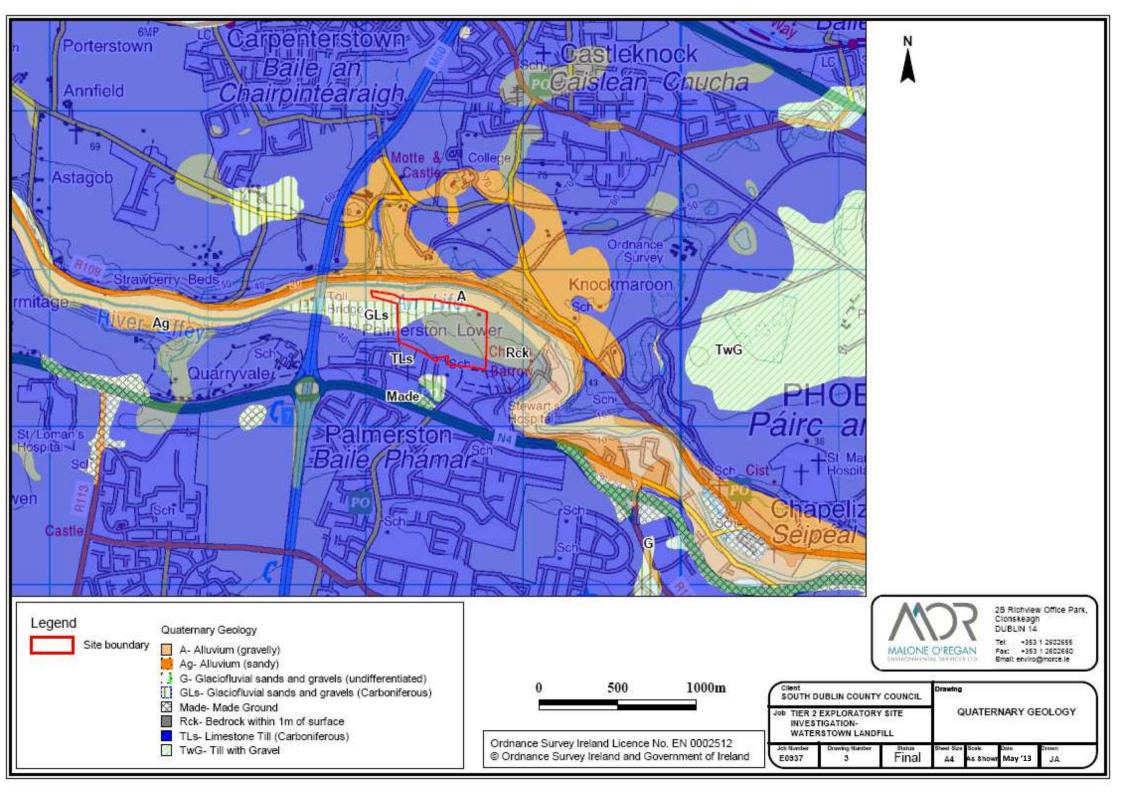
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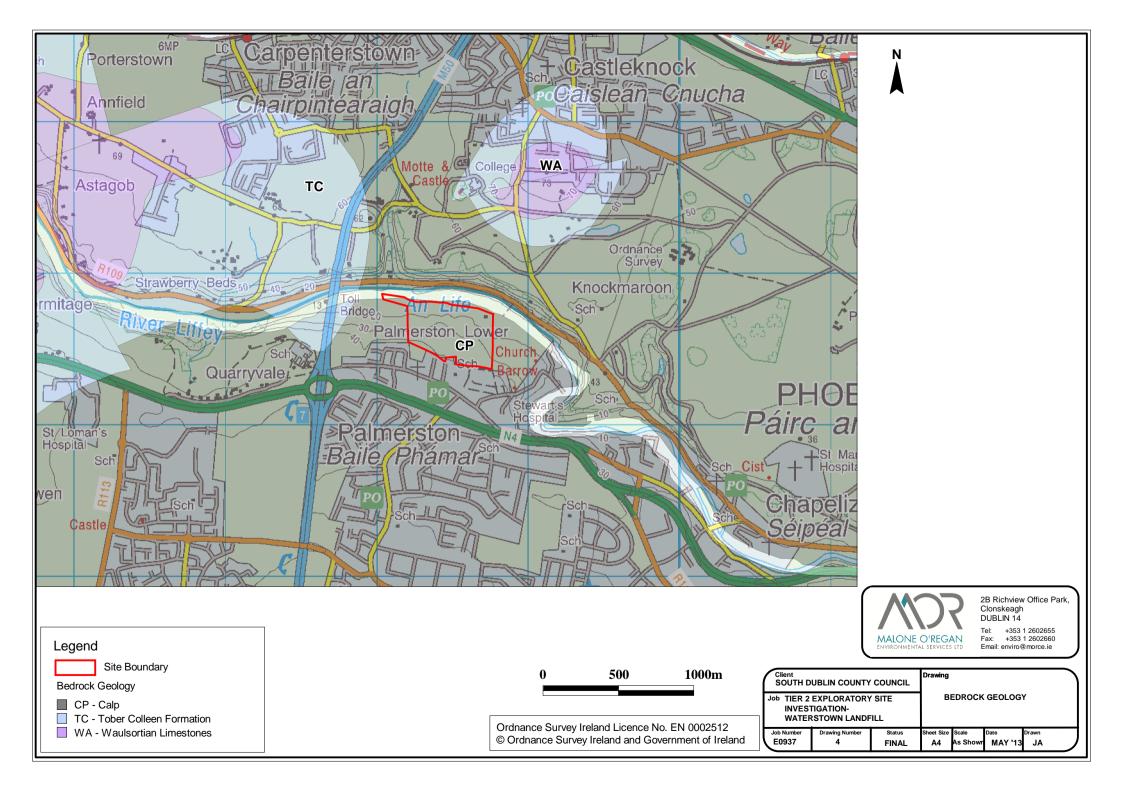
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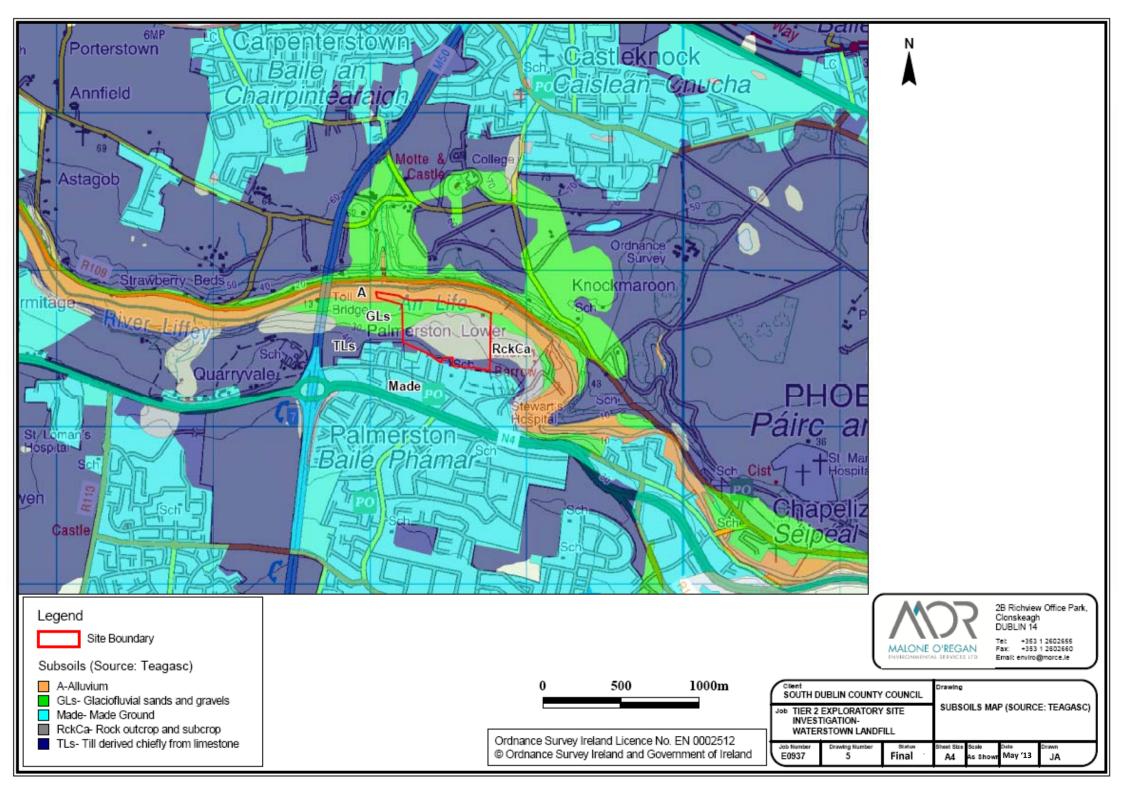


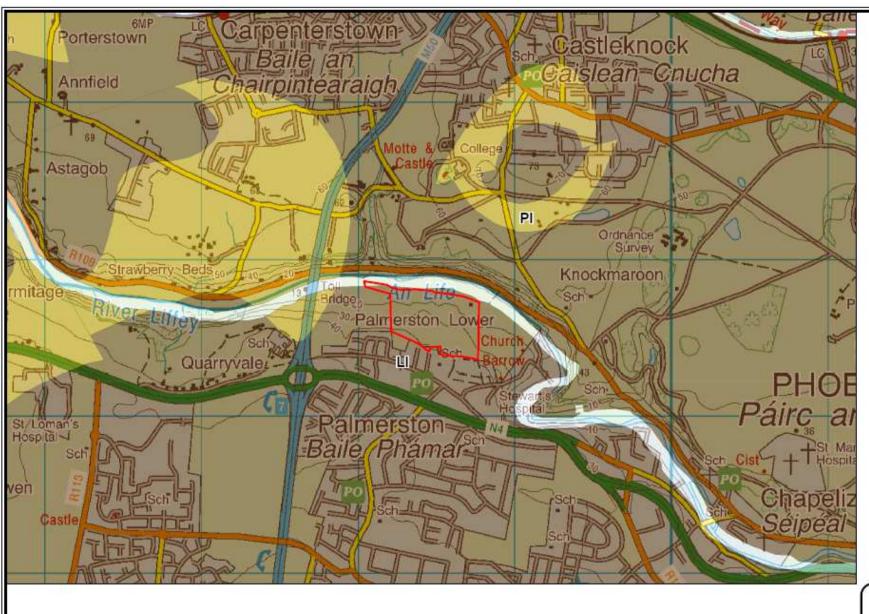












2B Richview Office Park, Clonskeagh DUBLIN 14

+353 1 2602655 +353 1 2602660

Email: enviro@morce.ie

## Legend

Site Boundary

Bedrock Aquifer

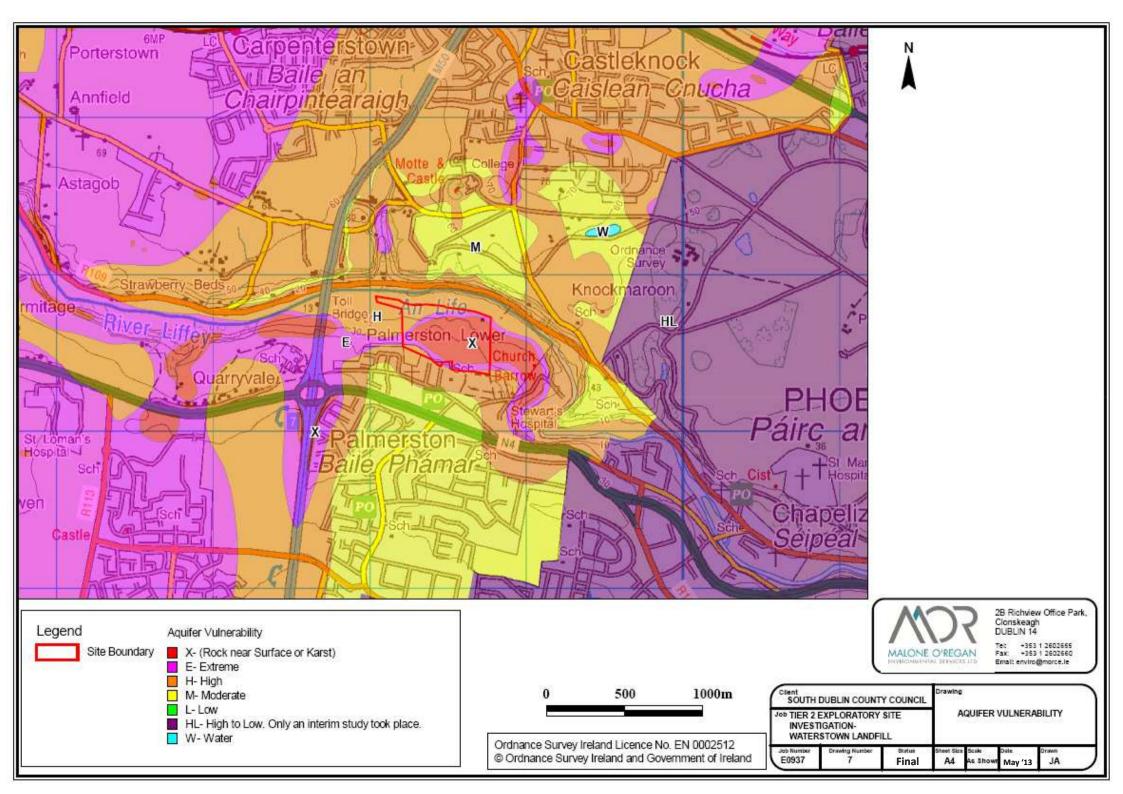
LI- Locally Important Aquifer. Bedrock Moderately Productive Only in Local Zones

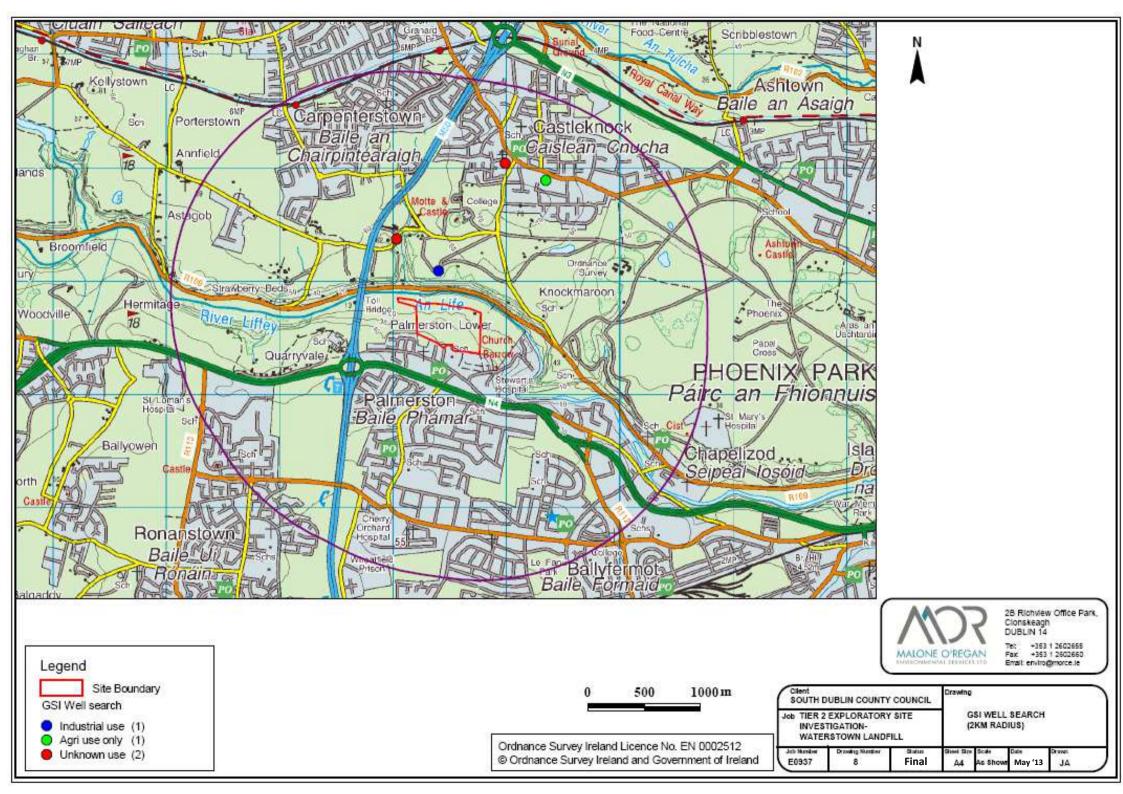
PI- Poor Aquifer. Bedrock, Bedrock Generally Unproductive except for Local Zones

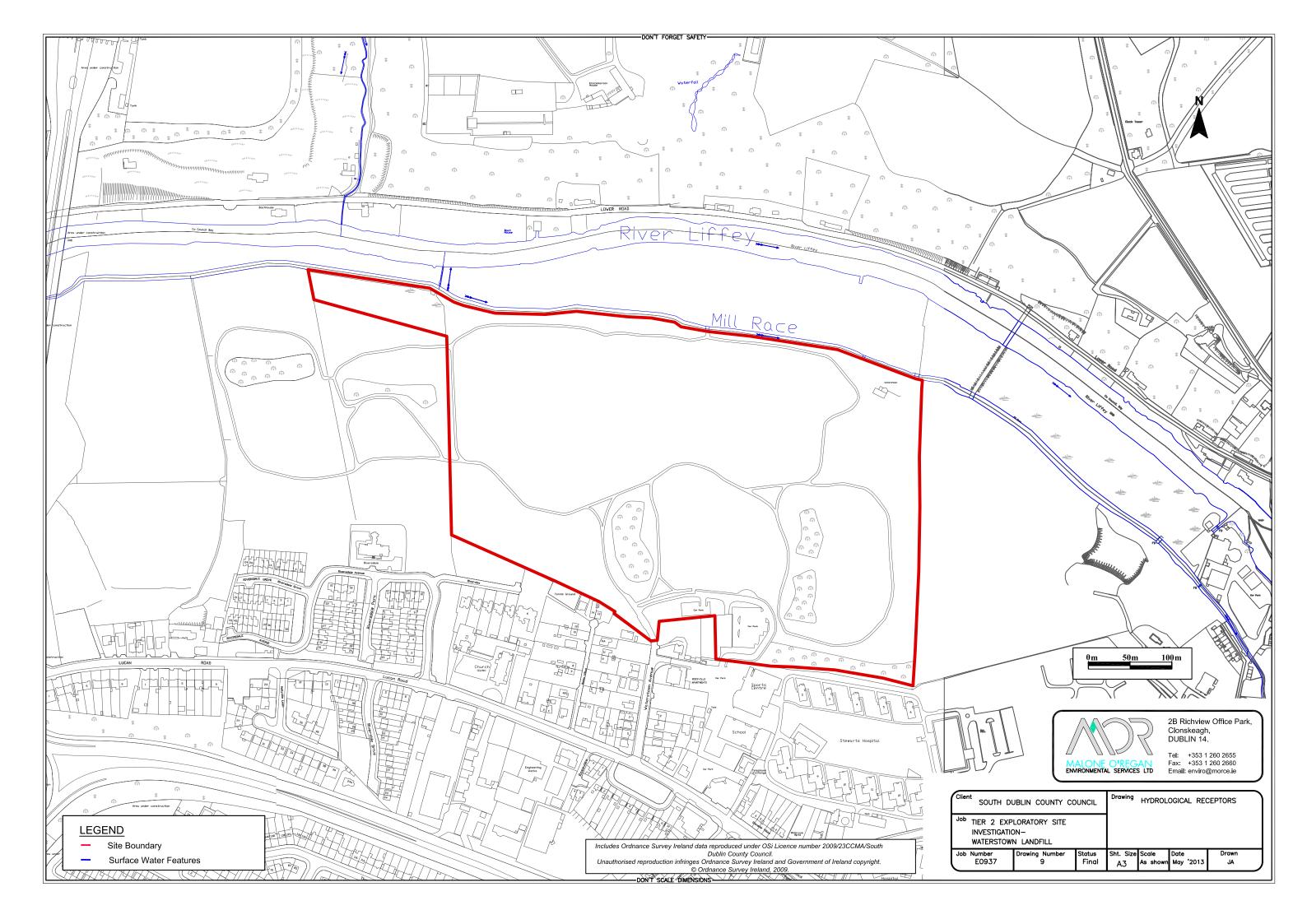
500 1000m

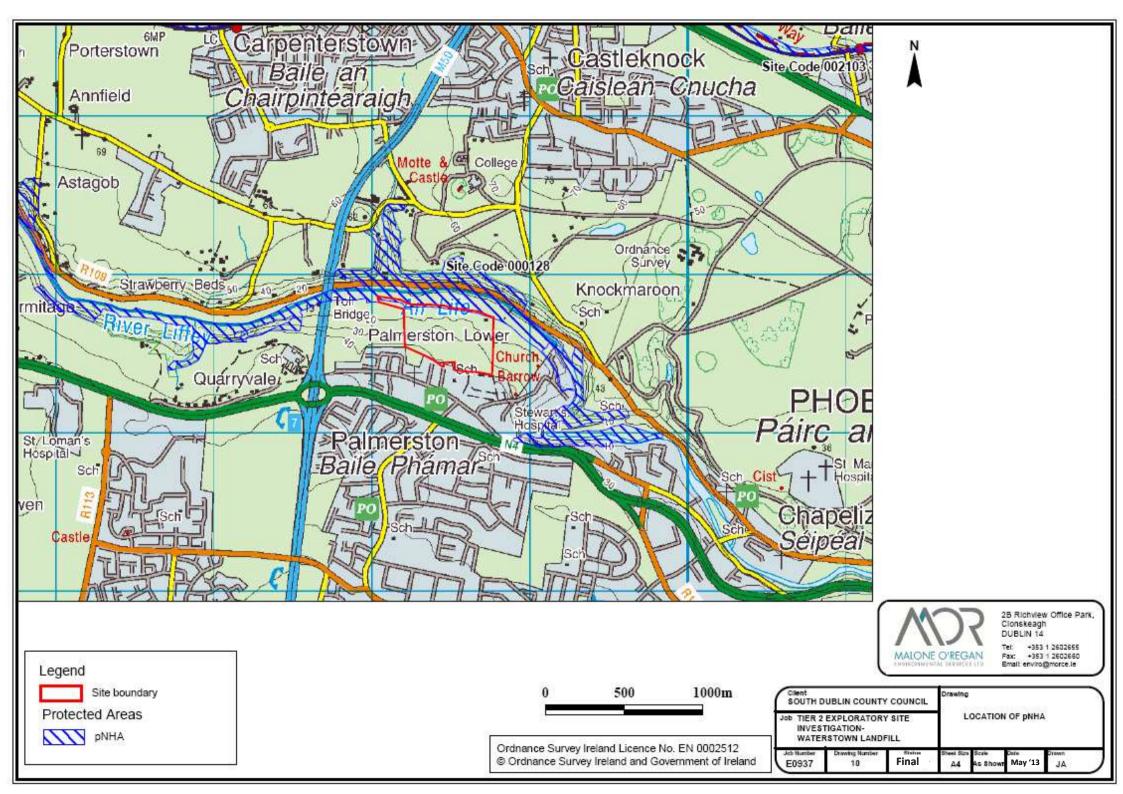
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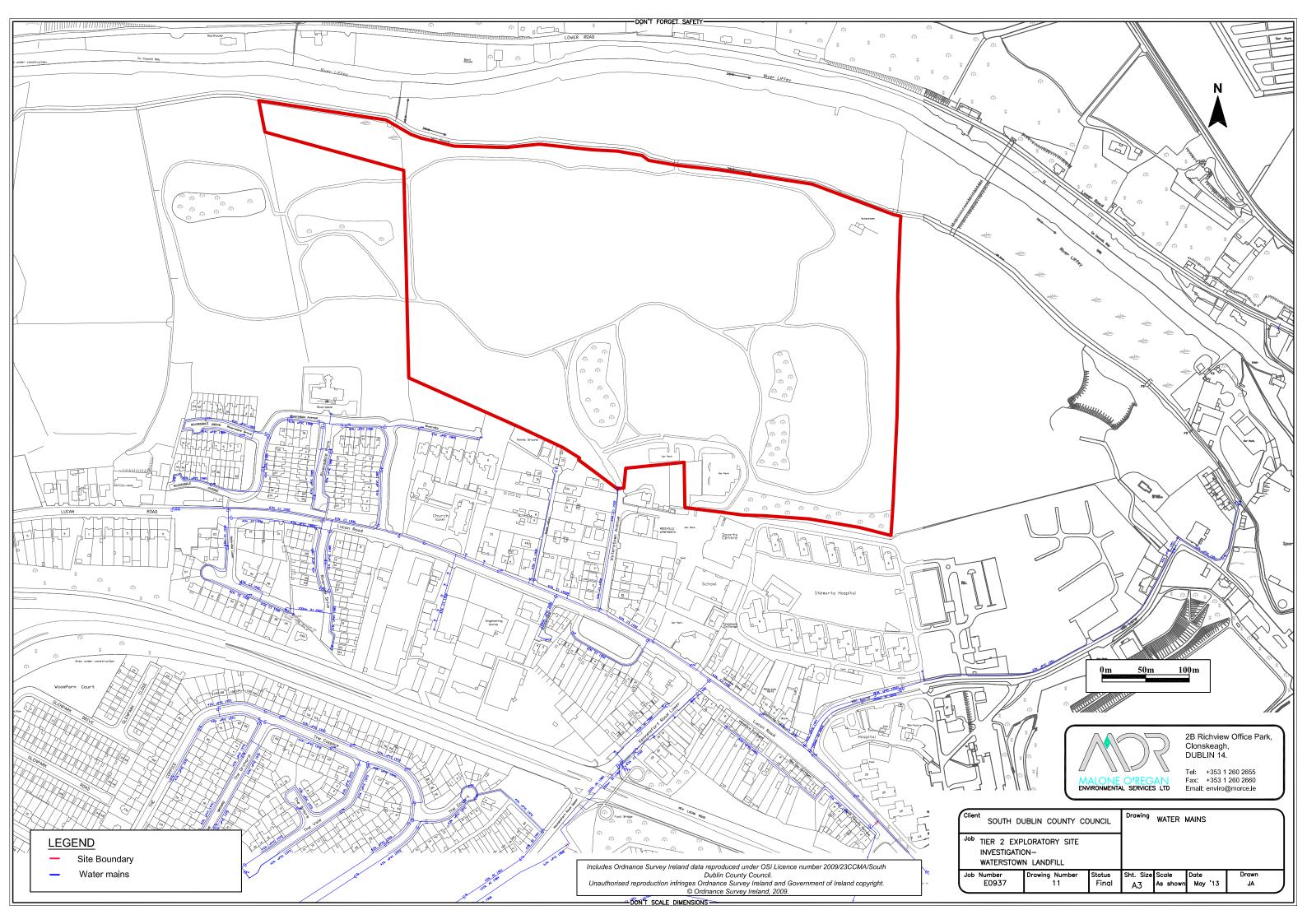
Clent SOUTH DUBLIN COUNTY COUNCIL			Drawing AQUIFER CLASSIFICATION					
Job TIER 2 INVES WATER								
Job Number E0937	Drawing Number 6	Final	Sheet Stre A4	Scale As Shown	May '13	JA	_	

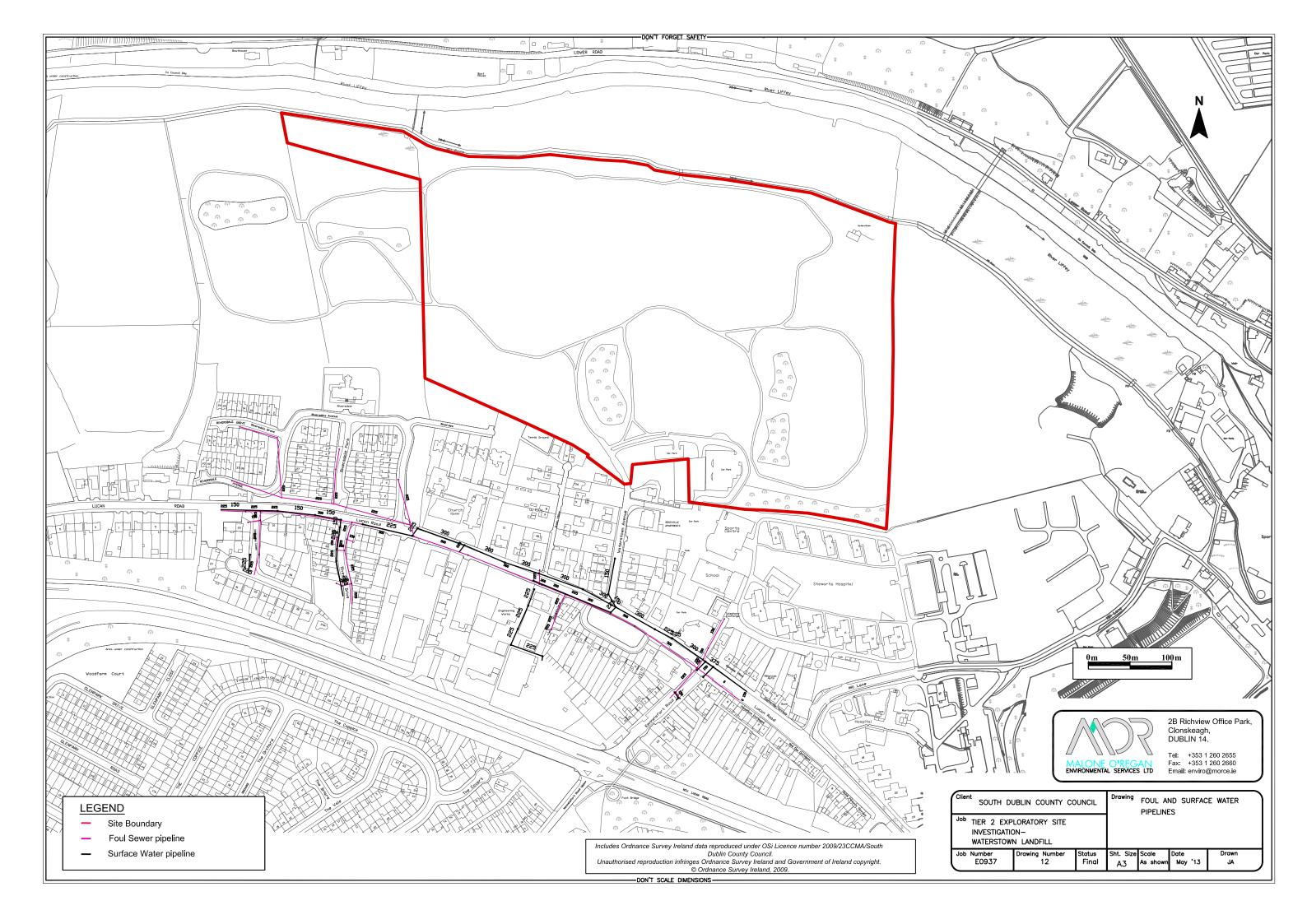


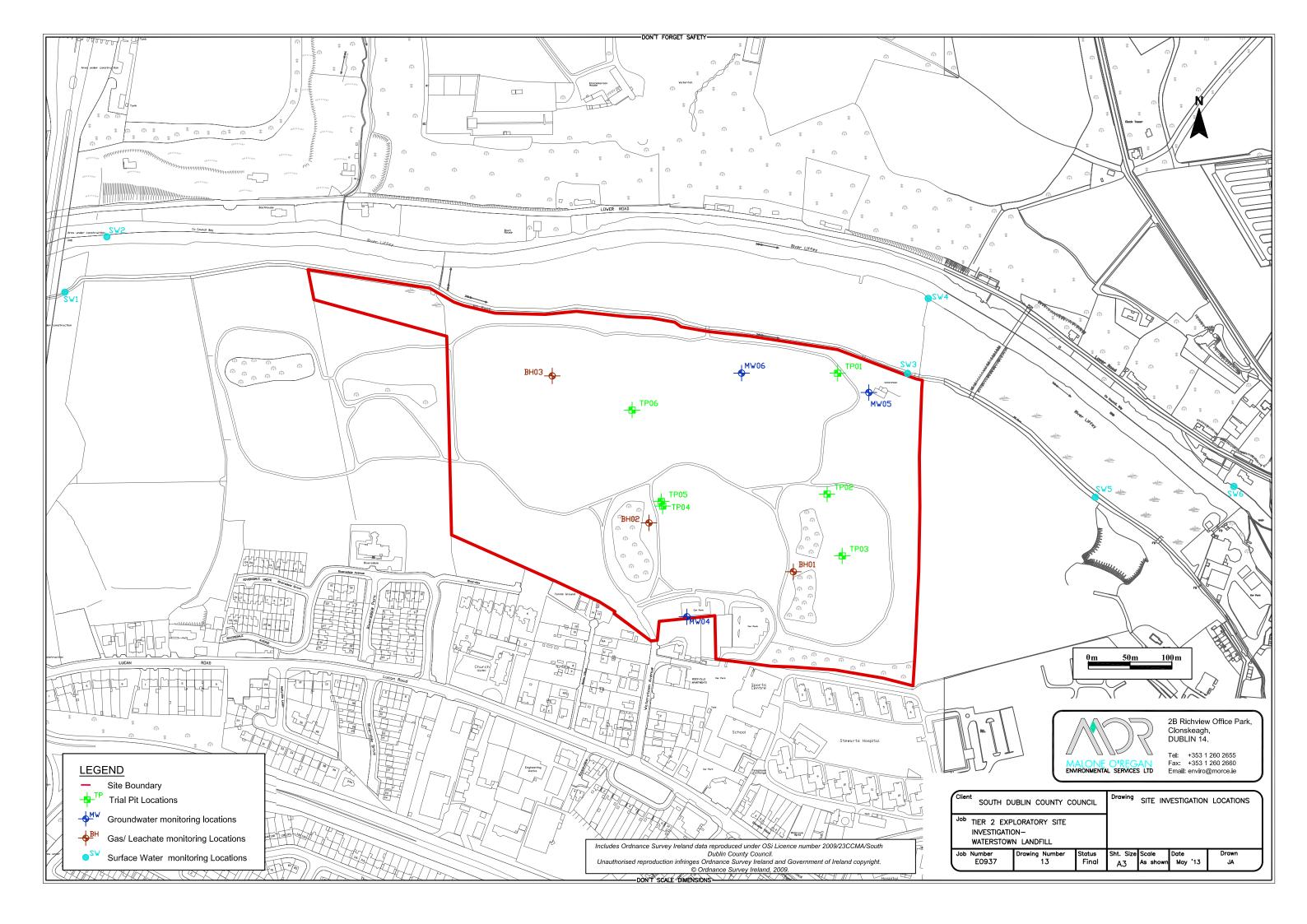




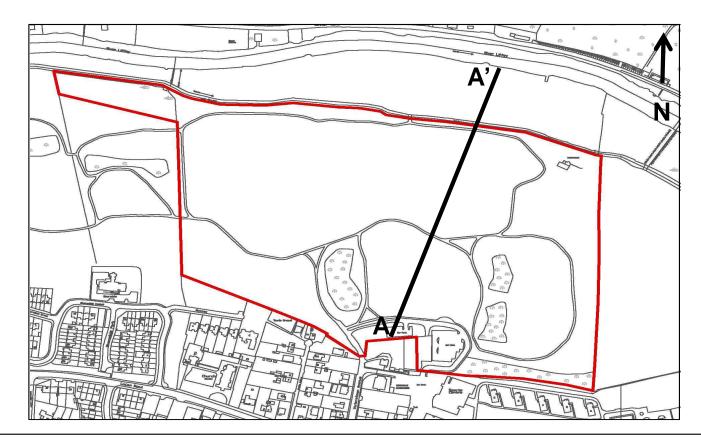








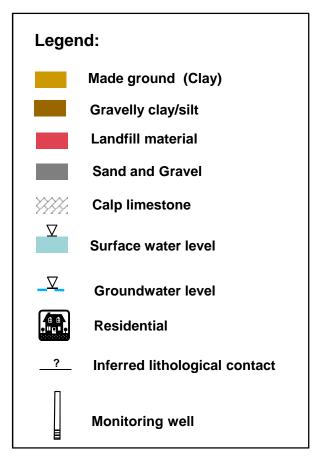
## Section A-A' A A' MIII Raco River Liffey



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Note: This is a schematic and indicative drawing.





Clonskeagh,
DUBLIN 14.

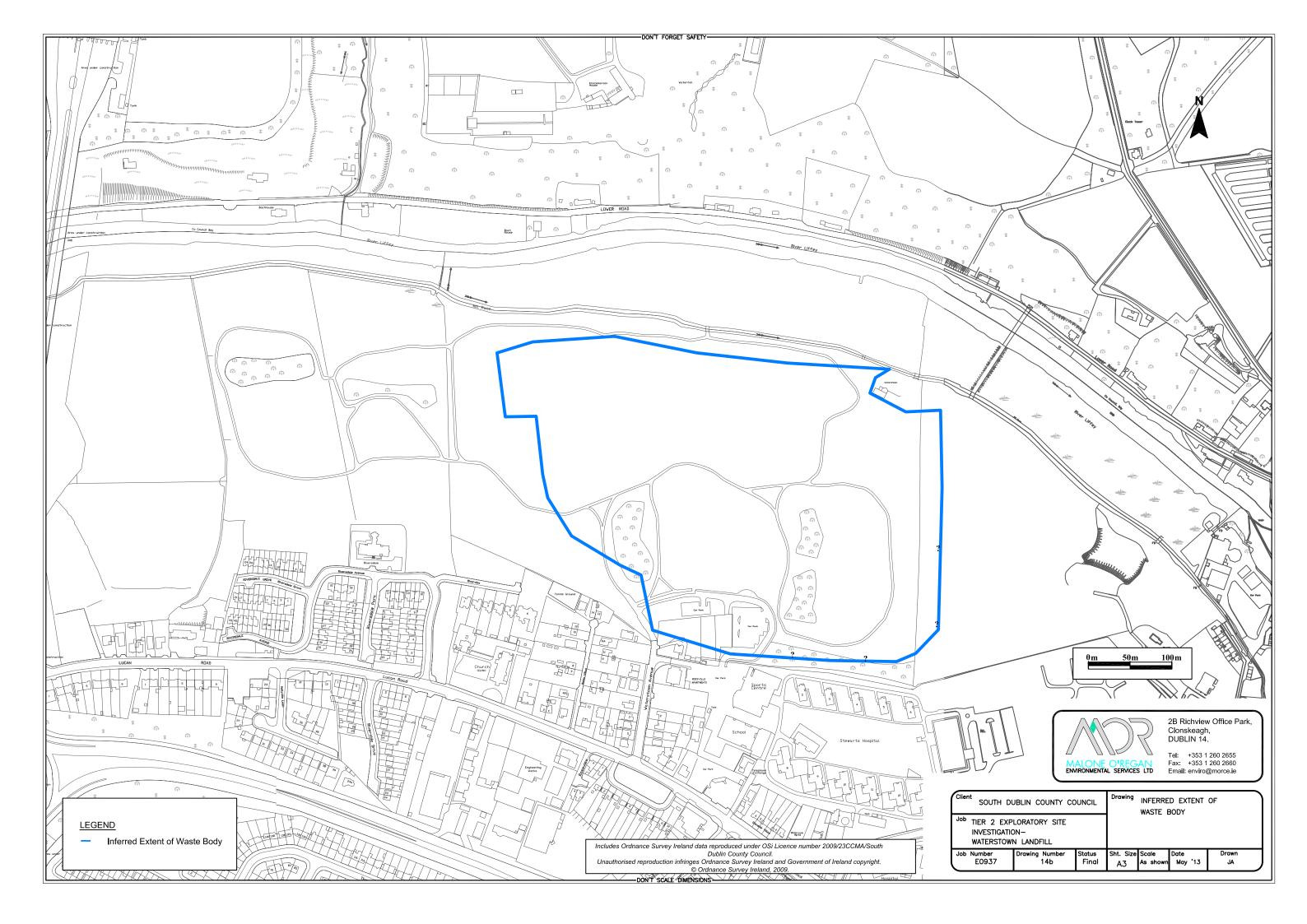
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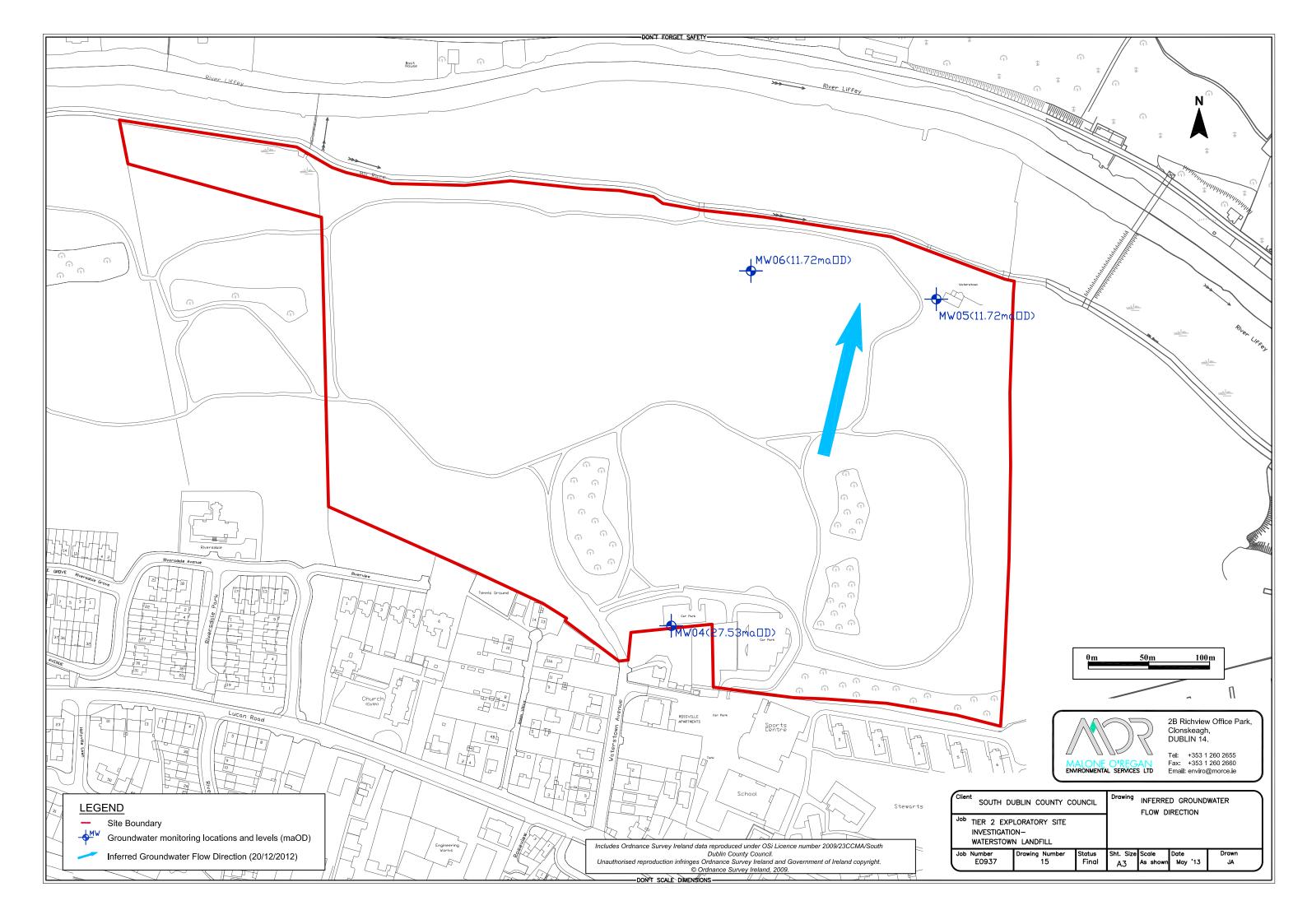
Client SOUTH DUBLIN COUNTY
COUNCIL

Job
TIER 2 EXPLORATORY SITE
INVESTIGATION WATERSTOWN LANDFILL

Job Number
LOSS SECTION OF THE SITE

A3 NTS May '13





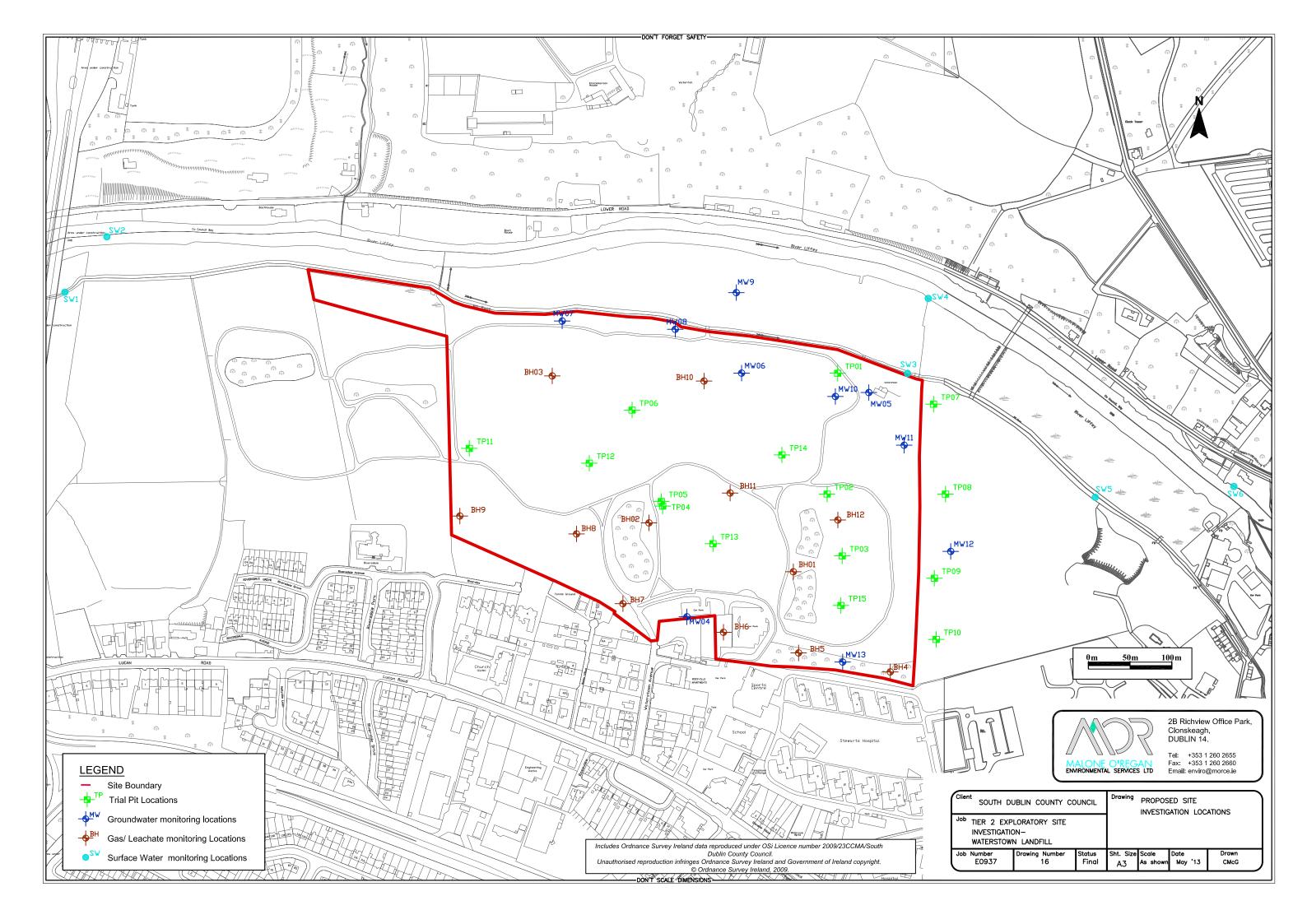




Plate 1: TP1 spoil



Plate 2: TP1



Plate 3: TP2 spoil



Plate 4: TP2



Plate 5: TP3 spoil



Plate 6: TP3



Plate 7: TP4 spoil



Plate 8: TP5 and newspaper from trial pit



Plate 9: TP5



Plate 10: TP6 spoil



**Plate 11:** TP6



Plate 12: Historic gas vent



Plate 13: View to west of site.



**Plate 14:** View to north east of site showing dense areas of weeds, shrubs and bushes.



**Plate 15:** View to south-south-west of site showing Riversdale house.



**Plate 16:** View to north east of site taken near Waterstown avenue park entrance.



**Plate 17:** View from car park to north west of site showing M50 flyover in distance.



**Plate 18:** View to north of site showing exercise equipment in foreground.



**Plate 19:** View of car park showing SDCC facility beyond cars.

## SITE SYNOPSIS

SITE NAME: LIFFEY VALLEY

**SITE CODE: 000128** 

The Liffey Valley site is situated along the River Liffey between Leixlip Bridge on the Kildare-Dublin border and downstream of the weir at Glenaulin, Palmerstown, Co. Dublin. The river meanders through low hills for much of its course through the site and forms the focus for the site itself. The Mill Race between Palmerstown and the weir at the Wren's Nest Public House is also included in the site.

The river is a Salmon river and there are a series of weirs along the river between Palmerstown and Leixlip. The water level in the Mill Race has dropped and the channel has been filled with vegetation in a number of areas as a result.

The main terrestrial habitat included within the site is mixed deciduous woodland on fertile, limey alluvium and boulder clay, in which Beech (*Fagus sylvatica*) is dominant in some areas. Elsewhere Ash (*Fraxinus excelsior*) and willow species (*Salix* spp.) are common and there are also some stands of larch (*Larix* spp.) and Scots Pine (*Pinus sylvestris*). Toothwort (*Lathraea squamaria*) has been recorded on a number of tree species.

The ground flora commonly includes Ivy (*Hedera helix*), Primrose (*Primula vulgaris*), voilet species (*Viola* spp.), Lords-and-ladies (*Arum maculatum*) and Hart'stongue (*Phyllitis scolopendrium*). These woodlands occur on both sides of the river and normally consist of old estate woodlands.

A wet marsh occurs on the strip of land between the Mill Race and the river east of the metal bridge and west of the paint factory. This marsh is fed by seepage from the Mill Race and plant species such as Bulrush (*Typha latifolia*), Marsh-marigold (*Caltha palustris*) and sweet-grass (*Glyceria* spp.) occur here. This strip of land also contains rough grassland which is not regularly grazed. Much of the river bank and the banks of the Mill Race are fringed with willow (*Salix* spp.) and Alder (*Alnus glutinosa*).

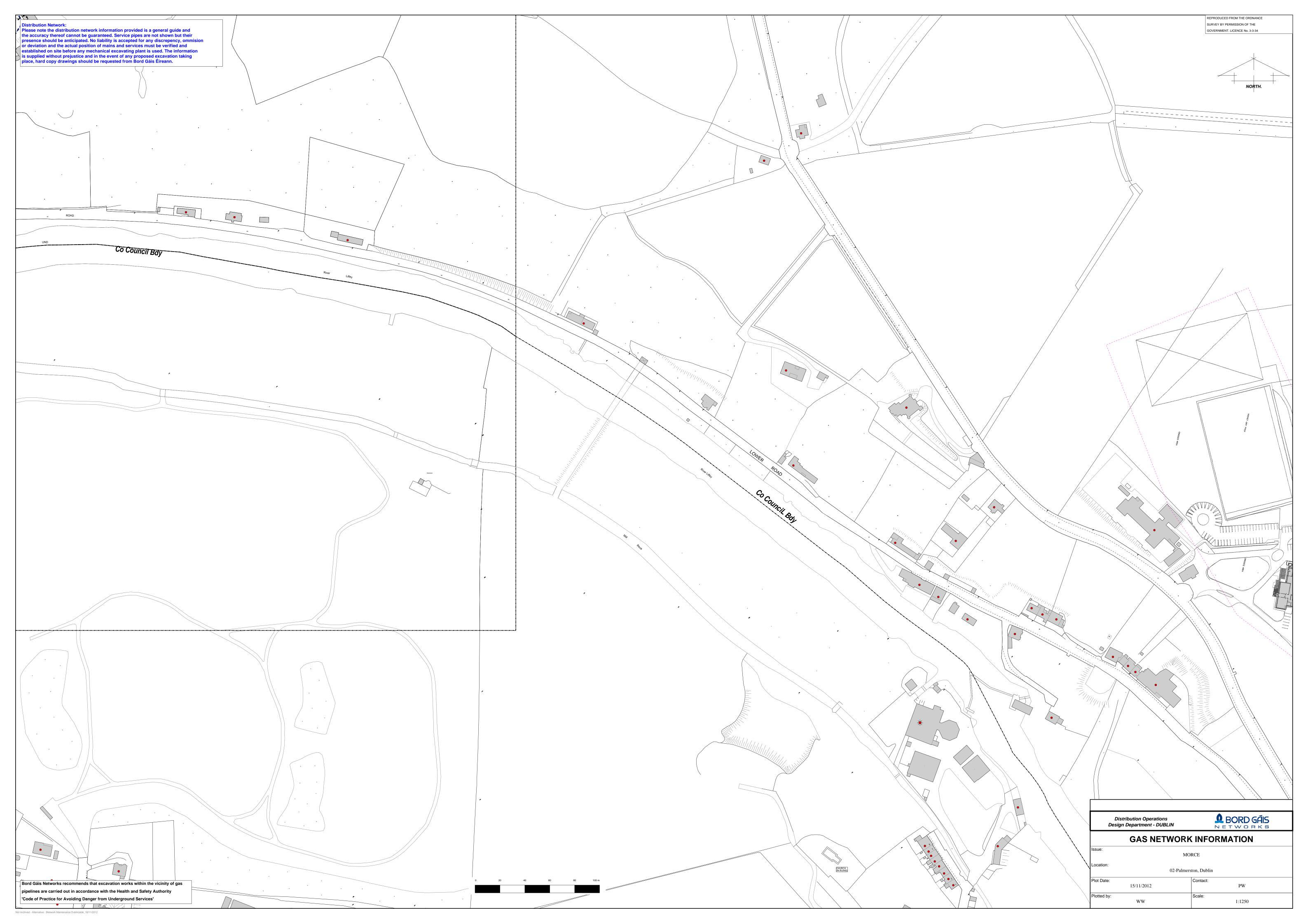
The threatened Green Figwort (*Scrophularia umbrosa*), a species listed in the Irish Red Data Book, is recorded from a number of stations along the river within the site. This stretch of the river Liffey has the greatest number of recently recorded populations of this species in Ireland. The rare and legally protected Hairy St. John'swort (*Hypericum hirsutum*) (Flora Protection Order 1987) has been recorded from the woodlands in this site. This species has only been recorded in Kildare and Dublin, at sites on the river Liffey, since 1970. The threatened Yellow Archangel (*Lamiastrum galeobdolon*), listed in the Irish Red Data Book, is also recorded from these woodlands.

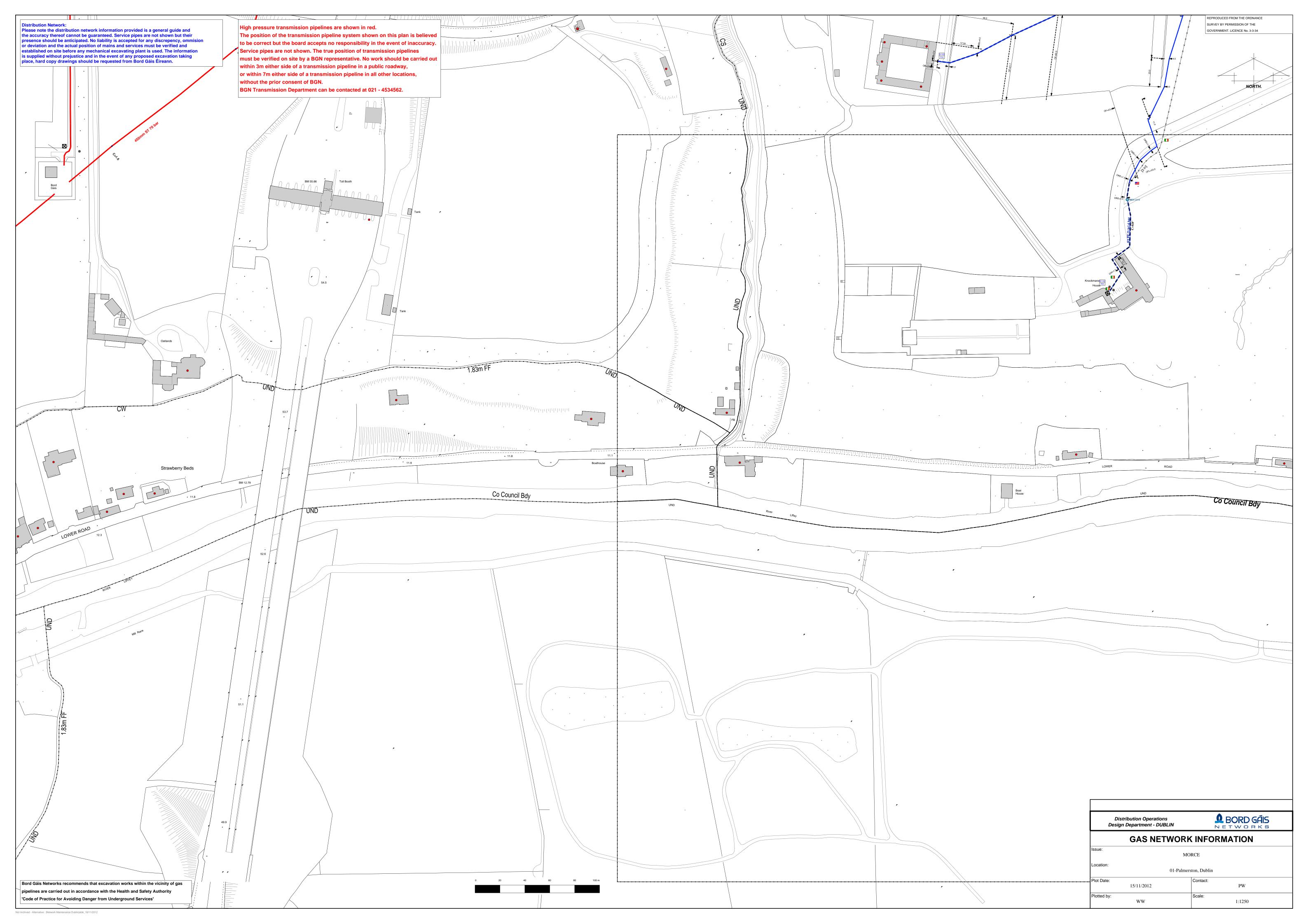
The section of river within the site is used by canoeists. The West Link Bridge spans the valley west of Palmerstown. Recent management of woodlands at Brooklawn and

Quarryvale has cleared a lot of Cherry Laurel (*Prunus laurocerasus*) and undergrowth. Some mature Beech have been removed from this area.

This site is part of the Liffey Valley Special Amenity Areas Order 1990. The site is important because of the diversity of the habitats within the site, ranging from aquatic to terrestrial. A number of rare and threatened plant species have been recorded from the site.







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COLOUR	CODF:					
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BLACK - 38KV & HIGHER VOLTAGE OVERHEAD LINES GREEN - MV (10KV/20KV) OVERHEAD LINES

BLUE - LV (400V/230V) OVERHEAD LINES

CYAN - 38KV & HIGHER VOLTAGE UNDERGROUND CABLE ROUTES

RED - MV/LV (10KV/20KV & 400V/230V) UNDERGROUND CABLE ROUTES

T | T | E : 2012/11/



# 1/15-005

DATE: 15-NOV-2012 SCALE: 1:1250

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This map indicates the approximate location of ESE lines in the general area of the proposed works. ESE house services, factory/shop services, public lighting assumed. Additional more detailed information is average representative – see attached list for contact details prior consultation with ESB Networks.

Before any mechanical excavation is undertaken, the (a) Up-to-date map records; (b) Cable locator equipm "HSA Code of Practice for Avoiding Danger from ESB takes no responsibility and shall bear no liabil



5-NOV-2012 1:1250

mission: Licence No. EN 0023709 ey Ireland Government of Ireland

#### WARNING

This map indicates the approximate location of ESB Networks Transmission (400kV, 220kV, 110kV, 38kV) and Distribution (20kV, 10kV, 230V/400V) underground cables and overhead lines in the general area of the proposed works. ESB Networks takes no responsibility for the accuracy or completeness of this map. Low voltage (230V/400V) service cables (e.g. house services, factory/shop services, public lighting lamp services, etc) are not included but their presence should be anticipated. The depths of underground cables must never be assumed. Additional more detailed information is available for high voltage Transmission underground cables (38kV, 110kV, 220kV, 400kV) from the local ESB Networks transmission representative – see attached list for contact details or call 1850 372 757. No work should be carried out in the vicinity of 38kV or higher voltage underground cables without prior consultation with ESB Networks.

Before any mechanical excavation is undertaken, the actual location of all underground electricity cables must be established and verified on site using:

(a) Up-to-date map records; (b) Cable locator equipment operated in both power and radio modes; (c) Careful hand digging of trial holes using 'Safe Digging Practice'. Refer also to "HSA Code of Practice for Avoiding Danger from Underground Services".

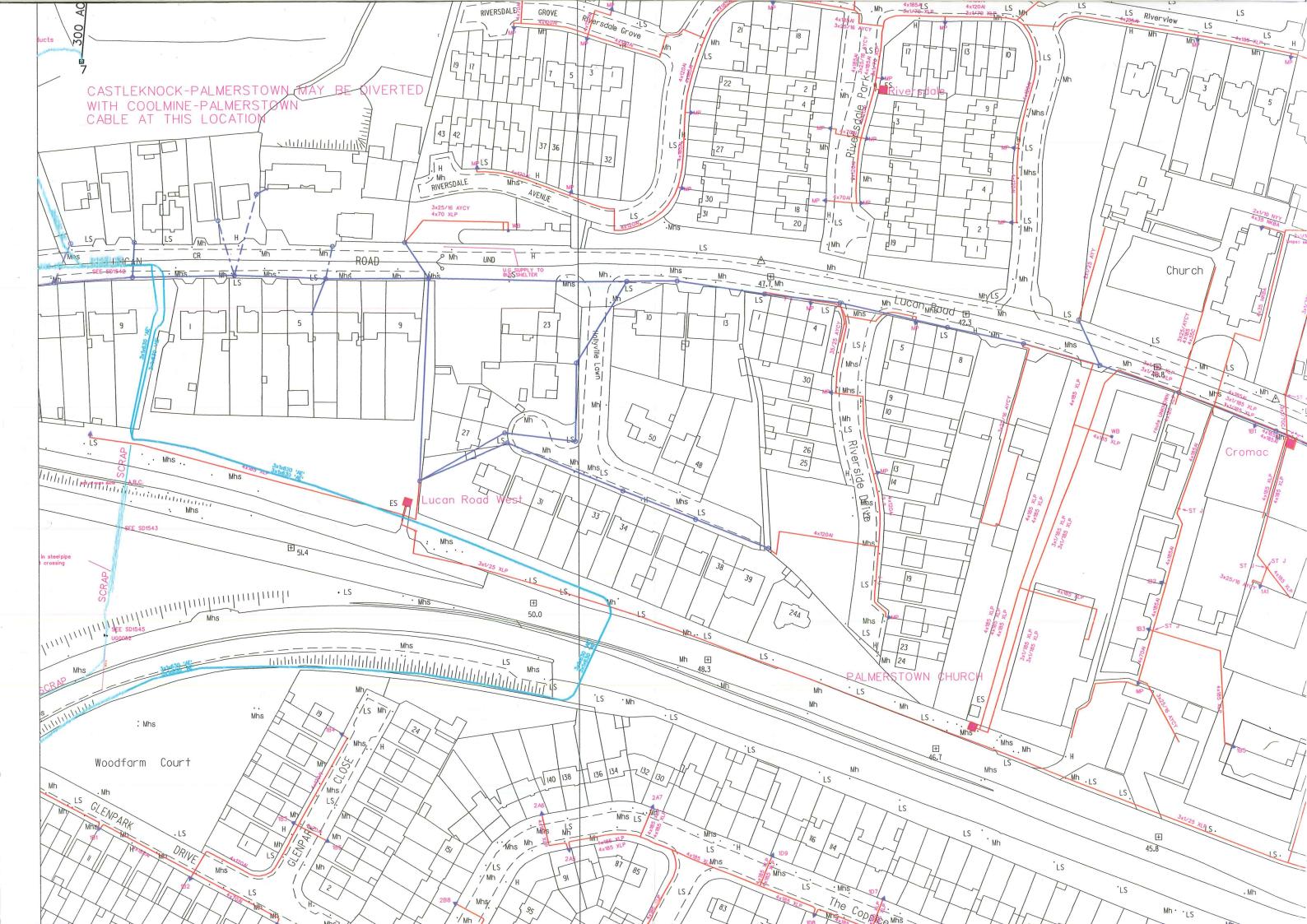
ESB takes no responsibility and shall bear no liability in relation to any damage, injury/death or loss of supply as a result of damage or interference with its networks.

















### Candidate Historic Landfill site( High Risk Category) for Pilot Project Presented on behalf of Dublin City Council, Dun Laoghaire- Rathdown County Council, Fingal County Council and South Dublin County Council For Dublin Region

Document Title	Waterstown Map Ref 240		,Palmerstown
	Report of Methodolog		Assessment
	Conceptual Screening a		
Version	3	Date	04-10-2011
Prepared By	Waste Mana Services, So Council	•	vironmental County
Status	Issue No:		

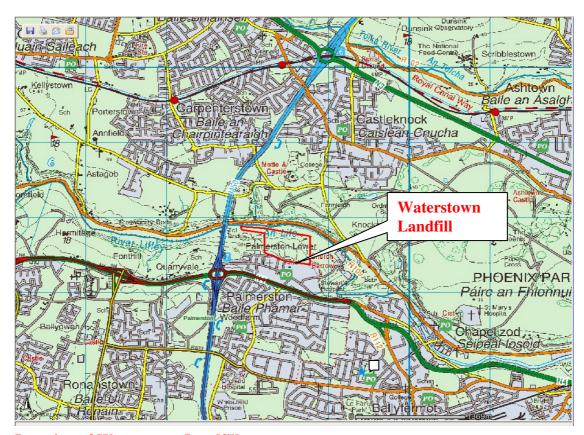
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4	Soils and Subsoil	7
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	References	24

## 1 Introduction:

Waterstown Landfill is located 10 km, Southwest of Dublin City Centre in Palmerstown. The Geographic Information System (GIS) Coordinates of this site are E308,500 ,N 235,567. The site occupies a total area of 25 Ha and was operated by South Dublin County Council from 1983 -1987. It was used as a disposal facility for municipal waste as well as solid inert waste from commercial/industrial sources.

The site was originally a gravel pit quarry. This site is located within 100m of River Liffey. The Mill Race stream flows within 50 m at the edge of this site in Southerly direction. The site is in a sensitive ecological zone. According to South Dublin County Council Development Plan 2004-2010, a special Amenity Area Order for Liffey valley between Lucan Bridge and Palmerstown was confirmed by the Minister for Environment in March 1990. Waterstown Landfill is located between Lucan Bridge and Palmerstown. Hence this landfill can be considered as part of the Special Amenity Area Order.



**Location of Waterstown Landfill** 

#### 2 Site Walkover Survey

The site walkover inspection was carried out on 9<sup>th</sup> April 2009 as shown in appendix 1. Over the past 30 years, the site has been developed into a public Park. During the last 12 months, South Dublin County Council has been developing a car park and work on the car park is still ongoing.

The site is accessible through Waterstown Avenue and is approximately 150 m from Stewart Hospital School and within 50m of some residential houses. There is a gate at the entrance. Residential houses border the site. During the walkover, some residents

around Mill Lane were interviewed. They revealed that although South Dublin County Council insisted that they were only dumping inert construction and demolition waste, they were also dumping domestic waste.

There was public anger and opposition to the use of this site as a dump. The Liffey Valley Defence Alliance Group tried to use Section 4 of the Local Government Act to overturn the decision of South Dublin County Council to use this land fill but this failed.

The residents also confirmed that there was once an explosion in a 40ft container on site which was used by Council for storage 15 years ago . This was due to a build up of methane gas in the container. After this explosion, Council constructed some landfill gas boreholes to release the Methane gas. Evidence of this landfill gas borehole could be seen on site as shown in the photograph below.



The boundary between the landfill and residential houses is indicated by the trees shown behind the landfill borehole.

A surface water drain made of open jointed pipes could be seen on the landfill. The outfall of this ends in a depression at the bottom of the landfill. The run-off from the landfill through this pipes seeps into the ground. Hence there is no direct connection between the drainage and the surface water body.





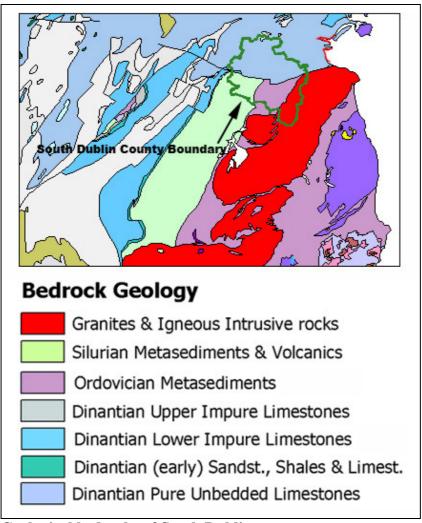
The landfill is about 9m deep and is now capped. The topography of the landfill is gentle and undulating with steep sides built up to 5m high. At the edge of the landfill is the Mill Race stream which flows in southerly direction. This stream is 30 m away from the edge of the landfill. Down stream water quality in this location appears to be poor.

The site is now generally covered with scrubs and there are signs of some vegetation die- off as shown below.

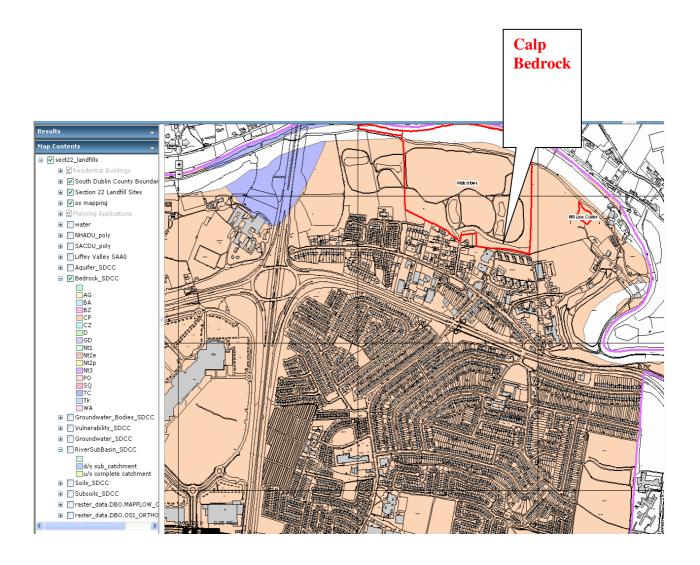


#### 3 Geology

The geology of South Dublin is comprised mainly of limestone with section of Granites and Igneous Intrusive Rocks and Silurian and Ordovician Meta-sediments. This is shown below. Waterstown landfill in particular is underlain by Calp bed rock. In terms of geological timescale it is a Dinantian Pure Unbedded Limestones. It is important to note that the Geological Survey of Ireland has identified M50/N4 Interchange and Liffey Valley Centre Road Sections as geologically sensitive and important. These areas are in closed proximity to Waterstown landfill and they all lie in the same geological formation. According to South Dublin County Development Plan these areas are classified as potential Natural Heritage Area. Hence Waterstown Landfill is in closed proximity to potential Natural Heritage Area. This has an important bearing on risk assessment.

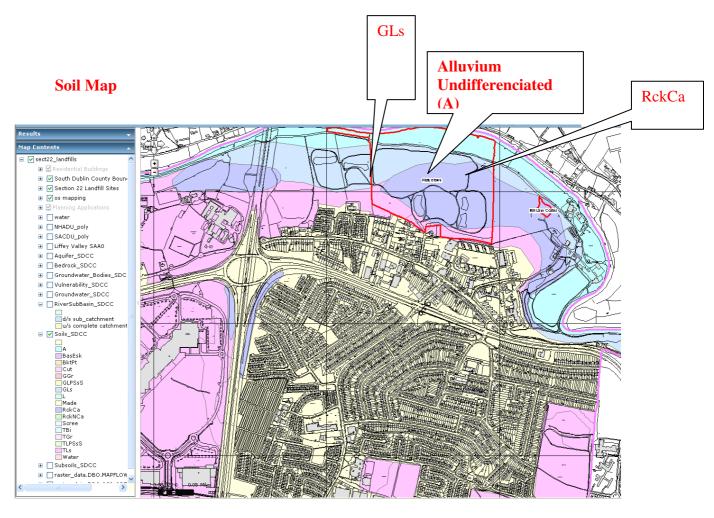


Geological bedrocks of South Dublin

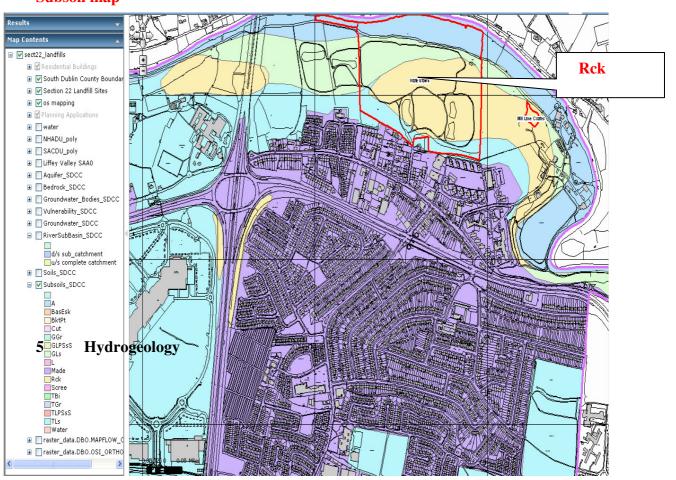


#### 4 Soils and Subsoil

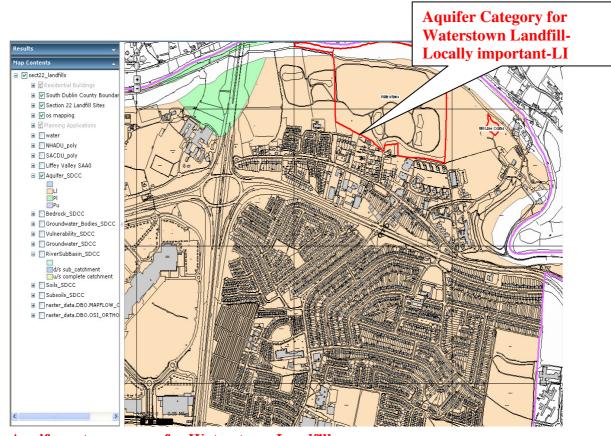
The soil cover within South Dublin has developed from combination of the parent material from which the soils are derived, terrain, climate and vegetation cover. The short distances which glacial material was transported mean that overlying soils are generally similar to underlying bedrock. Hence in the case of Waterstown landfill site the overlying soil and subsoils are the same. The soils and subsoils of this site comprise Alluvium undifferentiated (A), limestone sand and gravel (GLs) on the peripheral of the site and Bedrock at surface (RcKCa) where the bulk of the waste was deposited. These are shown in soil and subsoil maps below. The significance of this in our risk assessment is the fact that during the quarrying operation all the soil and subsoil being sand and gravel were removed until they hit the calp bed rock which is a limestone. The bed rock at surface which might have been rock outcrop was also removed. Hence the waste is sitting directly on the bed rock. This has a significant bearing on pollutant pathway.



#### **Subsoil map**



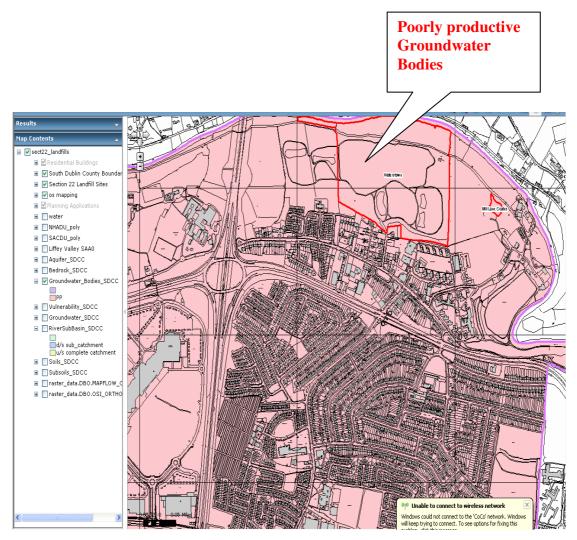
Waterstown landfill site is underlain by Locally Important Sand/Gravel Aquifers (LI). This is shown below in the aquifer category map. This actually means that the sand and gravel subsoil is water bearing unconsolidated material from which groundwater can be extracted using water well. It also means that the waste was deposited above sand and gravel aquifer which is an important source of groundwater but this will be confirmed by further site investigation. The sand /gravel subsoil exhibits an intragranular permeability which means that it is highly permeable. This has an important bearing on contaminant movement and attenuation and groundwater vulnerability. It is also important to note that during the quarrying operation there most have been excessive dewatering. This may have led to the lowering of the groundwater table. It is also possible that this may have induced some groundwater flow towards the surface water body like the Liffey River or some flow from the Liffey River to the Quarry. The topography of the area is such that the land slopes steeply towards the low lying area through which Liffey River flows. Hence the flow direction of groundwater is in the southerly direction towards the Liffey River.



Aquifer category map for Waterstown Landfill.

The site is also characterised by poorly productive groundwater bodies as shown below. According to the Environmental Protection Agency (EPA) Code of Practice for Environmental Risk Assessment for Unregulated Waste Disposal Site, the flow regime associated with poorly productive bedrock groundwater bodies indicates shallow fissure flow, low transmissivity, and low base flow contribution to streams, high surface water drainage density and general short groundwater flow paths. Hence it is possible that the pathway through which the contaminant in this case the leachate

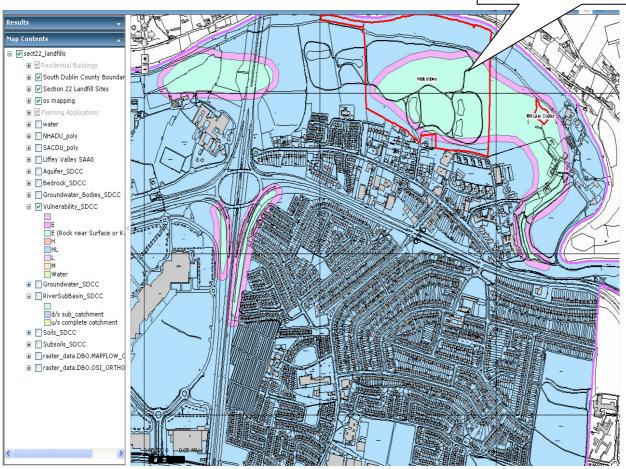
travels to the receptor (Liffey River) may not have a very serious effect on Liffey River or Mill Race stream. However, to reach such a conclusion, it is very important to understand the issue of groundwater flow characterization because groundwater is the main pathway through which contaminants from waste body can be transported to a receptor.



**Groundwater Bodies Map for Waterstown** 

The aquifer vulnerability of this site shown in the map below is rated by Geological Survey Ireland as extremely high. This is further confirmed by the geology of the area which shows that the waste is placed directly on the Calp bedrock. The quarry operation led to the loss of any protective subsoil. The subsoil in the area is sand and gravel and this is highly permeable. Due to the groundwater vulnerability being very high, there is every possibility for the contaminant to migrate vertically to the aquifer. This aspect has an important bearing on the risk assessment.

Aquifer Vulnerability map Showing Extremely Vulnerable Aquifer for Waterstown (E)



#### 6 Development of the Conceptual Site Model for Waterstown Landfill.

According to EPA Code of Practice, the development of a Conceptual Site Model involves defining the nature of the landfill and its hydrogeological setting. It is the development of an understanding of a system which is used for waste related activity /landfill site in its surroundings and the initial consideration of risks from the site. Conceptual site model development is mandatory for all risk assessments. The conceptual model of this site is illustrated below.

The walkover survey undertaken at Waterstown Landfill has revealed the following: It was an old quarry approximately 10-15 m deep which was later used for depositing Construction and Demolition Waste and Municipal waste. The walkover survey has also shown that there is no direct connection between drainage ditches associated with the waste body and adjacent surface water body. However, there are paved

tracks on the landfill as it is now developed into a recreational park. This will improve the drainage in the form of surface water run-off. An open jointed pipe collects surface water run-off and directs into a flat field at the bottom of the bank of the landfill. It does not discharge directly into the surface water body which is the Liffey River.

The geological setting has revealed that this waste was directly placed on Calp bedrock which is a thick limestone. This will need further verification during the Tier 2 when intrusive site investigation is undertaken .The soil and subsoils are limestone sand and gravel .The hydrogeological setting shows that sand and gravel formation is a locally important aquifer. However the groundwater may be poorly productive.

Liffey River is within 150 m and Mill race stream is within approximately 50m from the bank of the site. From the above description the Source, Pathway and Receptor linkages can be easily identified.

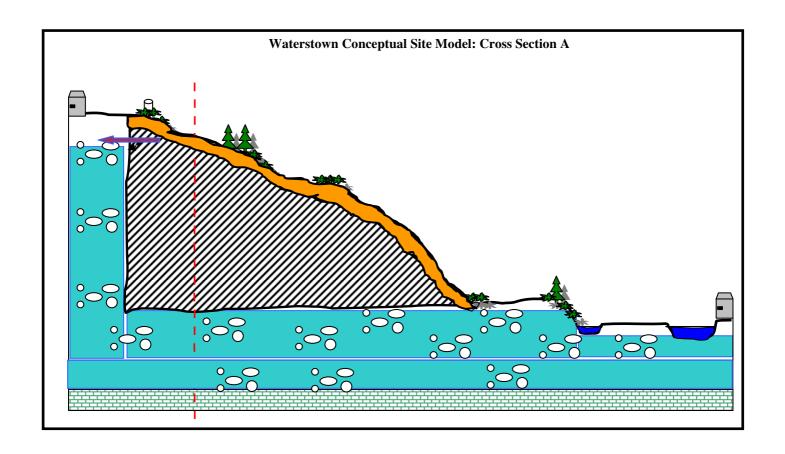
The main receptors are the sand/gravel aquifer which has locally important groundwater, poorly productive bedrock groundwater bodies, the Mill Race stream, and Liffey River and Residential houses.

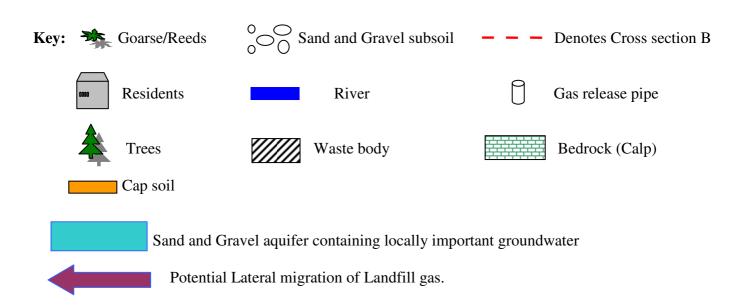
In order to determine whether the landfill represents, or potentially represents a hazard to ground and surface water receptors as well as human beings the following possible linkages can be examined in the process of initial risk screening:

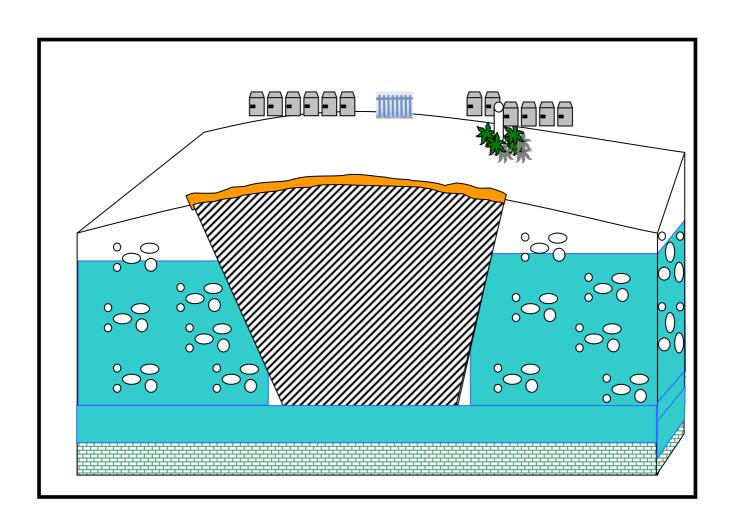
#### Risk of leachate migration to Liffey River and Mill Race Stream through Groundwater:

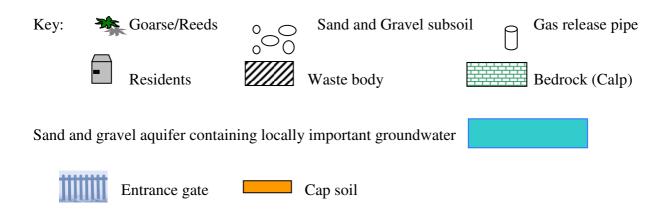
This landfill was operated from 1983 to 1987. It was closed 22 years ago. As it had municipal waste deposited, it still has the capacity to generate leachate. Information from local residents reveals that this landfill started as a quarry and it came into existence because they wanted to fill the hole in the ground. Drawings obtained from SDCC show a proposed landfall to be lined with geotextile material. But so far this has not been verified. In fact the waste was placed directly on top of the bed rock and into the sand/ gravel aquifer. The hydrogeological characteristic of this site from our desk study has revealed that the aquifer is highly vulnerably because of high permeability of sand and gravel subsoil. The Calp bed rock being limestone has fractures and faults which may allow the leachate to penetrate through it. However, intragranular (primary ) primary porosity is absent. Although the site has been capped and is now covered by grass, there is possibility of some infiltration of rainwater/surface water through the waste body. This will lead to generation of Hence we have a scenario where leachate may migrate vertically downwards through the subsoil (function of groundwater vulnerability) to an aquifer and then migrates horizontally(function of groundwater flow regime) through the aquifer to receptors such as well, stream or river.

There is a high possibility of the sand/gravel aquifer to be polluted by leachate. This aquifer is locally important bedrock aquifer which is Moderately Productive only Local Zone(LI) .The aquifer is comprised of Calp limestone which is very impure limestone .Groundwater flow through this bedrock is via fractures and faults(secondary porosity) and sometimes along bedding planes









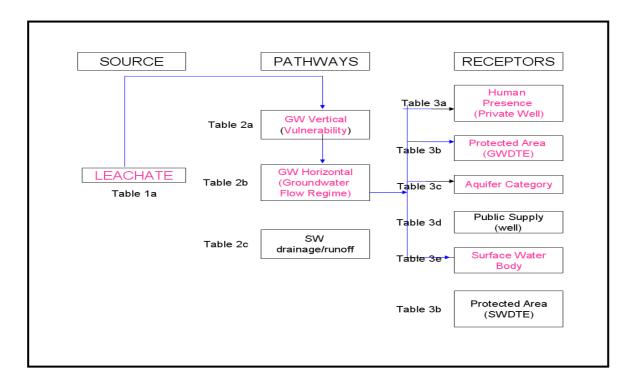
#### Risk of Landfill Gas Lateral Migration to Human Presence.

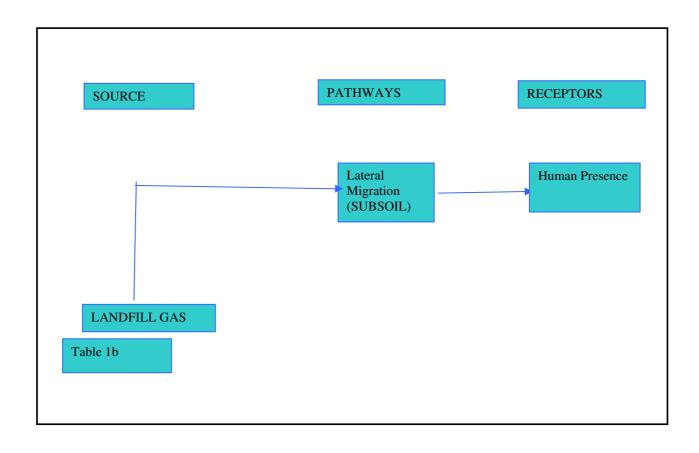
As there are no residential houses directly built on top of the landfill, the only risk this landfill gas migration can cause is lateral migration to nearby residential buildings. This is highly possible because the site is underlain by limestone ,sand and gravel. The Calp limestone bedrock has fractures and hence the landfill gas will migrate through these fractures. There is an old gas borehole installed at site which points to the fact there may have been a problem of landfill gas in the past.

#### 7 Risk screening and S-P-R Linkage Prioritisation

The risk analysis in Risk screening report below has shown that the main S-P-R linkage that poses the greatest risk is the scenario where the landfill gas migration is likely to take place laterally through the subsoil to the residential areas, S-P-R 10. The normalised S-P-R linkage score is 100%. This puts this landfill into high risk category. The site investigation in the second stage which is Tier 2 should concentrate on landfill gas migration.

The other S-P-R linkages which require further investigation during the site investigation stage are the scenarios where leachate migrate through groundwater pathway to protected Groundwater Dependent Terrestrial Ecosystem (GWTE), Surface Water body and private wells. These linkages are SPR3, SPR4 and SPR7. The normalised score for each of these linkages is 50%. This puts the landfill in a moderate risk position. In terms of site investigation these linkages are considered to be the same. SPR3 which indicate the presence of water well because of the presence of Human is actually a precautionary measure. Since there is no private well in this instance, this can be ignored. Hence the other linkages that are to be investigated in Tier 2 are SPR4 and SPR7 which are related to risk of Groundwater and surface water pollution by leachate.





## Risk ranking report for Waterstown - South Dublin County Council (S22-02167) Page 1 of 3

Date: 29/09/2011





# Risk ranking report for Waterstown - South Dublin County Council (\$22-02167) Date: 29/09/2011

Page 2 of 3

Table	Points available	Rationale
1a	10.00	Type: Municipal, Area >5 Ha)
1b	10.00	Type: Municipal, Area >5 Ha
2a	3.00	Extreme Vulnerability
2b	1.00	Poorly Productive Bedrock Groundwater Bodies (LI, PI, Pu)
2c	0.00	No direct connection
2d	3.00	Sand and gravel, made ground, urban, karst
2e	0.00	Sand and gravel, made ground, urban, karst
3a	3.00	On or within 50m of the waste body
3b	3.00	On or within 50m of the waste body
3с	3.00	Locally important aquifers (LI, Lm, Lg)
3d	0.00	Greater than 1km (No Karst Aquifer)
3e	3.00	Within 50m of site boundary
3f	5.00	On Site or within 50m of site boundary

SPRLinkage	Linkage Score	Norm Score	
SPR1	120.00	40.00	
SPR2	120.00	40.00	
SPR3	120.00	50.00	
SPR4	120.00	50.00	
SPR5	120.00	30.00	
SPR6	0.00	0.00	
SPR7	120.00	50.00	
SPR8	0.00	0.00	
SPR9	0.00	0.00	
SPR10	150.00	100.00	
SPR11	0.00	0.00	
Risk Classification: A: Highest Risk			

#### 8 Tier 2: Exploratory Site Investigation and Sampling

The overall objectives of carrying out a site investigation at Waterstown Landfill are two folds:

- a) To confirm whether there are risks of landfill gas migration to boardering residential homes, and leachate migration to nearby surface water(River Liffey, Mill stream) and groundwater.
- b) To regularise the site by applying to EPA for the Certificate of Authorisation in accordance with Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.

Tier 1 site investigation which is the first part of this report has been completed. This has led to the development of Conceptual Site Model, determination of Source, Pathway and Receptor Linkages and classification of the risks posed by this landfill. The objective of this Tier 2 Exploratory Site Investigation and Sampling is to obtain information that confirms or refines the conceptual site model and the SPR linkages. The information obtained from Tier 1 will inform the scope of work for exploratory site investigation

#### 9 Scope of Tier 2 Exploratory Investigation and Sampling

In the course of development of Conceptual Site Model, the following SPR linkages have been determined:

SPR10: Source-Landfill Gas

Pathway-Lateral Migration (Subsoil)

Receptor-Human Presence

SPR4: Source-Leachate

Pathway-Vertical and Horizontal Groundwater migration

Receptor-Groundwater Protected Area (GWDTE)

SPR7: Source-Leachate

Pathway-Vertical and Horizontal Groundwater migration

Receptor- surface water body

The score for SPR 10 linkage is 100% which puts the Waterstown Landfill to a high risk category. It is this linkage that will define the scope of work for exploratory investigation and sampling during the Tier2 Risk Assessment.

Since surface water body is also present it is important to consider the possibility of Leachate migration to surface water and ground water .Hence SPR4 and SPR7 will also be considered during the Tier 2 investigation as they also put the landfill to moderate risk

In line with the decision making matrix developed by EPA, the following scope of work for exploratory investigation and sampling will be undertaken:

- 1 Assessment of Waste types /Composition to confirm what is reported in Tier 1 study through trial pitting.
- 2 Waste sampling to determine leachability
- 3 Leachate testing for List 1 and list 2 substances contamination

- 4 Soil sampling to assess permeability potential of surrounding materials ,use of material for capping and for contamination
- 5 Surface and Ground water sampling as per suite of parameters in Table.C2 of EPA Landfill Monitoring Manual 2003
- 6 Geophysical survey to determine waste extent and volume calculation.

#### 10 Conclusion

The hydrogeological characteristic of this site from our desk study has revealed that the aquifer is highly vulnerably because of high permeability of sand and gravel subsoil. The desk study also shows that the hydrogeological setting of sand and gravel formation is a locally important aquifer. However the groundwater may be poorly productive. The geological setting has revealed that this waste was directly placed on Calp bedrock which is a thick limestone. This will need further verification during the Tier 2 when intrusive site investigation is undertaken .The soil and subsoils are limestone sand and gravel. The Calp bed rock being limestone has fractures and faults which may allow the leachate to penetrate through it. However, intragranular (primary ) primary porosity is absent. The site is also characterised by poorly productive ground water bodies.

Liffey River and Mill race stream are also within approximately 50m from the bank of the site. From the above description the Source, Pathway and Receptor linkages can be easily identified.

The main receptors are the sand/gravel aquifer which has locally important groundwater, poorly productive bedrock groundwater bodies, the Mill Race stream, Liffey River and Residential houses.

From the Conceptual Site Model three main Source-Pathway- Receptor linkages have been identified. These are:

- Risk of leachate migration to Liffey River and Mill Race Stream through Groundwater
- Risk of leachate migration to Aquifer Category through Groundwater.
- Risk of Landfill Gas Lateral Migration to Human Presence.

These were further subjected to Risk Screening and Prioritisation. This process revealed that Landfill gas lateral migration to human presence posses the highest risk. This is shown by SPR10. Leachate migration to Liffey River, Mill Race Stream and the Protect Area (GWDTE) posses a moderate risk. These are shown by SPR7 and 4 with scores of 50%. This risk screening and prioritisation results are in line with our desk sturdy. According to the Environmental Protection Agency (EPA) Code of Practice for Environmental Risk Assessment for Unregulated Waste Disposal Site, the flow regime associated with poorly productive bedrock groundwater bodies indicates shallow fissure flow, low transmissivity, and low base flow contribution to streams, high surface water drainage density and general short groundwater flow paths. This is the reason why both SPR4 and 7 have moderate risk because of the nature of flow of groundwater which is carrying the contaminant, in this case the leachate. This aspects however needs to be proved during the exploratory site investion. There is also the dilution effect of the Liffey River. Hence our assessment in Tier 1 stage is correct.

Walkover Survey Checklist. Waterstown, 09-04-09						
Information	Information Checked Comment (include Distances from site boundary)					
1. What is current land	Checheu	Recreational				
use?						
2. What are the		Residential				
neighbouring land uses?		1100100111111				
neigne curing faire acces						
3. What is the size of the		25.17 Ha				
site?						
4. What is the topography?		Gently undulating				
5. Are there potential	-	Houses				
receptors? (if yes give						
details)						
Houses		Yes				
Surface water features (if		Stream – Mill Race stream at the edge, southerly Liffey about 30m				
yes give distance and						
direction of flow)						
Any wetland or protected		Yes within 50m				
areas?						
Public Water Supplies		No				
Private Wells		No				
Services		Yes				
Other buildings		Small Shed: Residential Building along the boundary				
Other						
6. Are there any potential		Waste body				
sources of contamination						
(if yes, give details)?						
Surface Waste (if yes, what		Yes exposed municipal/C&D				
type?)						
Surface ponding of		No				
leachate						
Leachate seepage		Yes but not visible during the walkover				
Landfill gas odours		Yes: There are gas release pipe				
7. Are there any outfalls to		There is a surface water outfall collecting rainwater from the tip				
surface water? (If yes, are		head down to the bottom and water was allowed to seep into the				
there discharges are these		ground.				
discharges and what is the						
nature of the discharge?)						
8. Are there any signs of		Yes – change of grass.				
impact on the		Surface water delivered to depression in the landfill				
environment? (If yes, take						
photographic evidence)		N.				
Vegetation die off, bare		Yes				
ground		Dec. 21. 1. 4 and 2.21.				
Leachate seepages		Possible but not visible				
Odours		No No				
Litter		No				
Gas bubbling through		No				
water Signs of settlement		Voc				
Signs of settlement,		Yes				
Subsidence, water logged		Yes				
areas						

Drainage or hydraulic issues	Surface water in depression
Downstream water quality appears poorer than upstream water quality	Yes
9. Are there any indications of remedial measures? (Provide detail)	Capping and there were also gas release pipes for releasing the landfill gas into the air.
Capping	Yes
Landfill gas collection	No
Leachate collection	No
10. Describe fences and security features (if any)	Fencing along residential boundary
Any other relevant information?	15 years ago methane built up in an on-site container, subsequently constructed gas release pipe on-site.  Old gravel pit quarry, developed in to a park over last 30 years.

#### **References:**

EPA 2007, CODE OF PRACTICE, Environmental Risk Assessment for unregulated Waste Disposal Sites.

Environmental Agency 2003a, Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Levels

Department of Environment: A framework for Assessing the Impact of Contaminated Land on Groundwater and Surface Water.

Table 1a: Leachate: Source/hazard Scoring Matrix

Waste Type	Waste Footprint (ha)		
	≤ 1 ha	> 1 ≤ 5 ha	>5
C&D <sup>1</sup>	0.5	1	1.5
Municipal <sup>2</sup>	5	7	10
Industrial <sup>3</sup>	5	7	10
Pre 1977 sites <sup>4</sup>	1	2	3
		Max	10
		Result (1a)	10

Table 1b: Landfill Gas: Source/hazard Scoring Matrix

Waste Type		Waste Footprint (ha)		
	≤ 1 ha	> 1 ≤ 5 ha	>5	
C&D <sup>1</sup>	0.5	0.75	1	
Municipal <sup>2</sup>	5	7	10	
Industrial <sup>3</sup>	3	5	7	
Pre 1977 sites⁴	0.5	0.75	1	
		Max	10	
		Result (1b)	10	

Table 2a: Leachate Migration: Pathways

Davers de la Chate Migration. Patriways		Deinte Aveileble
Parameters		Points Available
Charles de victor Medicana hilitar		
Groundwater Vulnerability		
(Vertical Pathway)		
Extreme Vulnerability		3
High Vulnerability		2
Moderate Vulnerability		1
Low Vulnerability		0.5
High – Low Vulnerability		2
	Max	3
	Result (2a)	3

Table 2b: Leachate Migration: Pathways

Damas de la Constante Migration: Pathways		Deinte Assellate
Parameters		Points Available
Groundwater Flow Regime		
(Horizontal Pathway)		
Karstified Groundwater Bodies (Rk) <sup>5</sup>		5
Productive Fissured Bedrock Groundwater Bodies		3
(Rf and Lm) <sup>5</sup>		
Gravel Groundwater Bodies (Rg and Lg) <sup>5</sup>		2
Poorly Productive Bedrock Groundwater Bodie	S	1
(Li, Pl, Pu) <sup>5</sup>		
	5	
	Result (2b)	1

1 Predominantly inert waste with low biodegradable fraction and/or small industrial waste fraction.

<sup>&</sup>lt;sup>2</sup> Typically non-hazardous domestic waste (highly biodegradable) with potentially small hazardous waste

fraction and/or small industrial waste fraction, e.g. town dump.

Generally industrial waste where hazardous waste was known to have been deposited or there is a strong likelihood that hazardous waste was deposited due to the close proximity of such industries.

Pre 1977 wastes would have been substantially degraded within the landfill.

<sup>&</sup>lt;sup>5</sup> Refer to DEHLG/EPA/GSI 1999, Groundwater Protection Scheme.

**Table 2c: Leachate Migration: Pathways** 

Parameters		Points Available
Surface Water Drainage <sup>6</sup> (surface water pathway)		
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
	Max	2
	Result (2c)	0

Table 2d: Landfill Gas: Pathways (assuming receptor within 250m of source)

rable 2d. Landin Ods. rathways (assuming receptor within 20011 or source)				
Parameters		Points Available		
Landfill Gas Lateral Migration Potential				
Sand and Gravel, Made ground, urban, karst		3		
Bedrock		2		
All other tills (including limestone, sandstone etc - moderate		1.5		
permeability)				
All Namurian or Irish Sea Tills (low permeability)		1		
Clay, Alluvium, Peat		1		
	Max	3		
	Result (2d)	3		

Table 2e: Landfill Gas: Pathways (assuming receptor located above source)

rable 2e. Landini Gas. Patriways (assuming receptor located above source)				
Parameters		Points Available		
Landfill Gas Vertical (upwards) Potential				
Sand and Gravel, Made ground, urban, karst		5		
Bedrock		3		
All other tills (including limestone, sandstone etc – moderate permeability)		2		
All Namurian or Irish Sea Tills (low permeability)		1		
Clay, Alluvium, Peat		1		
	Max	5		
	Result (2e)	5		

**Table 3a: Leachate Migration: Receptors** 

Table 3a. Leachate Migration. Neceptors			
Parameters		Points Available	
Human Presence (presence of a house indicates potential private			
wells)			
On or within 50m of the waste body		3	
Greater than 50m but less than 250m of the waste body		2	
Greater than 250m but less than 1km of the waste body		1	
Greater than 1km of the waste body		0	
	Max	3	
	Result (3a)	3	

<sup>&</sup>lt;sup>6</sup> This element needs to be determined during the site inspection (including walkover survey). The presence of a direct link between surface water drainage from the waste body and any adjacent surface water body implies the existence of a pathway.

Waterstown Landfill Tier II Risk Assessment Exploratory Site Investigation South Dublin County Council

**Table 3b: Leachate Migration: Receptors** 

Parameters	Points Available	
Protected Areas (SWDTE or GWDTE)		
Within 50m of the waste body		3
Greater than 50m but less than 250m of the wa	ste body	2
Greater than 250m but less than 1km of the was	ste body	1
Greater than 1km of the waste body	0	
Undesignated sites within 50m of site of the wa	1	
Undesignated sites greater than 50m but le waste body	0.5	
Undesignated sites' greater than 250m of the w	0	
Max		3
	Result (3b)	3

**Table 3c: Leachate Migration: Receptors** 

Parameters	Points Available	
Aquifer Category <sup>8</sup> (resource potential)		
Regionally Important Aquifers (Rf, Rk, Rg)	5	
Locally Important Aquifers (Li, Lm, Ls)	3	
Poor Aquifers (PI, Pu)		1
	Max	5
	Result (3c)	3

Rk Regionally Important Karstified Aquifers Regionally Important Fissured Bedrock Aquifers Rf Regionally Important Extensive Sand/Gravel Aquifers Rg Locally Important Sand/Gravel Aquifers LI Locally Important Bedrock Aquifers - Generally Moderately productive Lm Locally Important Bedrock Aquifers – Generally productive only in local zones Lg ΡĪ Poor Bedrock Aguifers - Generally unproductive except in local zones Pu Poor Bedrock Aquifers - Generally unproductive

**Table 3d: Leachate Migration: Receptors** 

- a.c c. = c c a.c g. a.c c p. c c			
Public Water Supplies (other than private wells)			
Within 100m of site boundary	7		
Greater than 100m but less than 300m or with	Greater than 100m but less than 300m or within Inner SPA (SI) for		
GW supplies			
Greater than 300m but less than 1km or within	3		
GW supplies			
Greater than 1km (karst aquifer)	3		
Greater than 1km (no karst aquifer)		0	
	Max	7	
	Result (3d)	0	

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<sup>&</sup>lt;sup>7</sup> The term "Undesignated sites" refers to wetland sites that are not designated under the Habitats or Bird Directive or Wildlife Act but are considered on a local scale. Consultation with NPWS is required to identify such sites.

8 (PDM) O(FRA) (SO) 1000 (Consultation Provided Consultation Provided Consul

<sup>8 (</sup>DOHLG/EPA/GSI 1999) Groundwater Protection Scheme

**Table 3e: Leachate Migration: Receptors** 

Parameters		Points Available
Surface Water Bodies		
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
	Max	3
	Result (3e)	3

**Table 3f: Leachate Gas: Receptors** 

Parameters		Points Available
Human Presence		
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
	Max	5
	Result (3f)	5

# AGL12073\_06

**REPORT ON THE** 

**GEOPHYSICAL SURVEY** 

AT

**W**ATERSTOWN

LANDFILL

For

**MALONE O'REGAN** 



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# PRIVATE AND CONFIDENTIAL

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

PROJECT NUMBER	AGL12073		
AUTHOR	CHECKED REPORT STATUS DATE		
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#### 1. EXECUTIVE SUMMARY

APEX Geoservices Limited was requested by Malone O'Regan Environmental Consultancy to carry out a geophysical survey as part of the ground investigation to delineate the extent of a historic landfill at Waterstown Park, Palmerstown, Dublin.

The geophysical survey comprises Conductivity Mapping, Electrical Resistivity Tomography and Seismic Refraction Profiling, within the central area of the park (approx. 900m x 430m).

The results indicate material which contains waste within an area which measures approx. 570m x 350m.

The waste body has been subdivided into 1. Mainly gravelly clay and municipal & C & D waste, 2. mainly municipal & C & D waste and clay and 3. mixed municipal and C & D waste. The mainly municipal waste body is generally located within the centre of the overall waste body, and measures approx. 380x200m. The thickest zones of waste are interpreted as to c. 17.0m thick, with the lower parts of these thicker zones comprising native material that may have been impacted by the waste. The boreholes carried out on site do not generally show the presence of leachate within the native material underlying the waste.

The waste is mainly hosted within a matrix of silty gravelly clay/gravelly clay. Clayey/gravel is located in the west of the park, and silt/clay/silty gravelly clay is located in the north of the park along the river bank.

Bedrock has been interpreted as Calp limestone & shale, and has generally been interpreted as ranging from 10-20m bgl for the area of the main body of waste.

Four boreholes to bedrock depth are recommended in the north of the waste body to determine the extent/absence of possible leachate within the soil material between the waste and bedrock. The results indicate that leachate is not present within the bedrock.



### 2. INTRODUCTION

APEX Geoservices Limited was requested by Malone O'Regan Environmental Consultancy to carry out a geophysical survey as part of the ground investigation to delineate the extent of a historic landfill at Waterstown Park, Palmerstown, Dublin.

# 2.1 Survey Objectives

The objectives of the survey were to:

- 1.Identify the extent of the waste body
- 2. Identify the thickness of the waste body and presence of any anomalous features
- 3. Identify the soil and bedrock types
- 4.Identify any leachate plumes outside of or below the waste body
- 5. Assess the depth to bedrock

# 2.2 Site Background

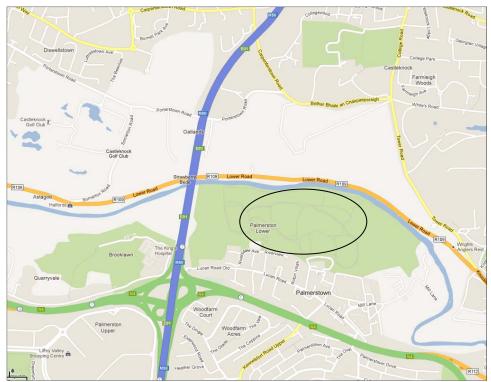


Fig. 2.1. Site Location.

The site is located immediately east of the M50 roadway in Palmerstown, Co Dublin and comprises open parklands. The survey was carried out over an area that measures approx.  $900m \times 430m$ .



# 2.2.1 Topography

The topography of the survey area is undulating and ranges from approx. 10-44.2 mOD. The site generally slopes towards the River Liffey, which flows along the northern boundary of the park.

# 2.2.2 Geology

The GSI Bedrock Geology map for the area (Fig.2.2) indicates that the site is underlain by Calp dark limestone & shale. Outcrop is present 200m to the east of the survey area, with bedrock dipping by 20° to the south-east.

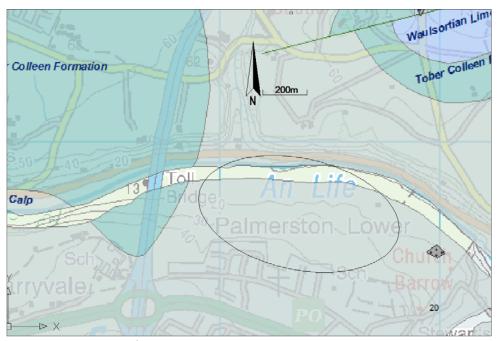


Fig.2.2. Geological map for the site.

# 2.2.3 Soils

The Teagasc soils map (Fig.2.3) shows that the survey area comprises alluvium along the bank of the river, followed by sand and gravel, bedrock and limestone till to the south.



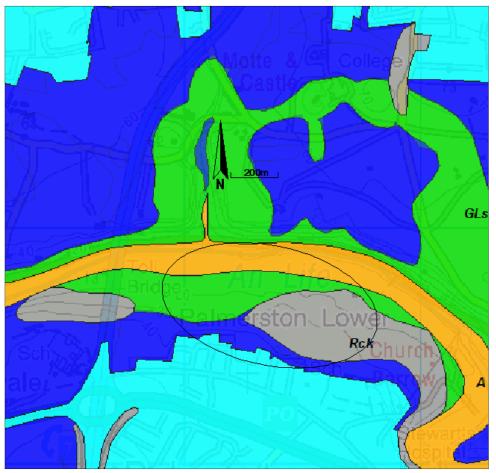


Fig. 2.3. Soils map for the site, with alluvium in orange, glaciofluvial sands and gravels in green, outcrop in grey, limestone till in blue and made ground in cyan.

# 2.2.4 Historical Data

The historical 6" Sheet (Figure 2.4) for the area shows  $\mathbf{1}^{\text{st}}$  and  $\mathbf{2}^{\text{nd}}$  river terraces to the south of the Liffey, and the outcrop of black limestone and shale to the east.

A map has been supplied by the client which shows possible waste distribution at the site around the year 1985, and a possible quarry in the north-east of the park.



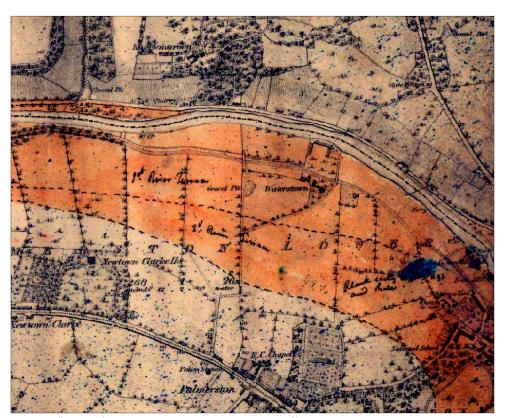


Fig.2.4. 6" Sheet for the survey area, between the Liffey and the Lucan Road to the south.

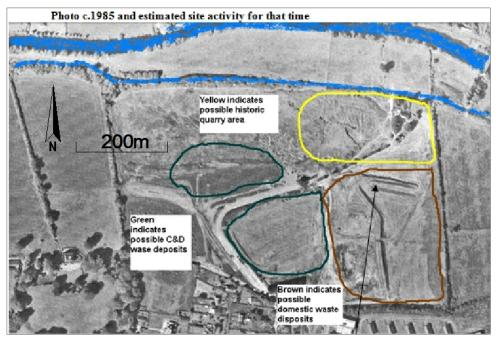


Fig. 2.5. Map showing site activity c. 1985



### 2.2.5 Site Investigation

No. 3 boreholes, no. 3 monitoring wells and no. 6 trial pits were carried out in and around the historic landfill area. The boreholes recorded made ground comprising sandy gravelly clay to 0.2-1.4m bgl followed by domestic/municipal waste to 7.1m bgl, followed by boulder clay. BH1 recorded grey staining from 7.4-7.8m bgl.

Monitoring wells MW4 and MW5 recorded no evidence of contamination and recorded sandy gravelly clay and /or gravel to 8.7-10.4m bgl, with weathered limestone at 10.4m bgl on MW4. MW6 recorded made ground to 5.7m bgl comprising plastics, glass and wood.

Five of the trial pits recorded some level of municipal, domestic and/or C & D waste, ranging from TP02 (domestic/municipal waste from 0-1.6m bgl) to TP05A (mixed waste from 0.9-3.0m bgl). The material at TP1 was made ground [0-1.6m] overlying clay with some minor (<5%) brick, plastic etc.



### 2.3 Survey Rationale

Electrical Resistivity Tomography (ERT) soundings will image the resistivity of the materials in the subsurface along a profile to produce a pseudo-section showing the variation in resistivity with increasing depth. Each pseudo-section will be interpreted to determine the material type along the profile at increasing depth, based on the typical resistivities returned for Irish ground materials. Waste materials will have a generally low resistivity (approx. 10-50 ohm-m), clayey overburden will have a higher resistivity (approx 50-250 ohm-m), and shaly limestone bedrock will have a relatively high resistivity (approx. 100-400 ohm-m).

Conductivity Mapping works on the same geophysical principle as ERT, and in this case materials with a low resistivity will have a high conductivity. Conductivity mapping is carried out using an EM31 Conductivity Meter, which is carried across the ground in a set pattern, to provide conductivity values for the materials from 0-6.0m bgl. Waste can be expected to have a high conductivity (20-100 mS/m), whilst overburden and bedrock will have a lower resistivity. It may be possible to subdivide waste types based on the conductivity results after ground-truthing has been carried out.

Seismic Refraction Profiling measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph. This method should allow us to profile the depth to the top of the bedrock, along profiles across the site.



# 3. RESULTS & INTERPRETATION

# 3.1 Conductivity Mapping

The conductivity results are indicative of the bulk conductivity of the ground materials from 0-6.0m bgl and have been generally interpreted as follows:

Conductivity (mS/m)	Interpretation	
2.5-10	Mainly Clayey GRAVEL / GRAVEL and or LIMESTONE & SHALE	
10-17.5	Mainly Silty gravelly CLAY / Gravelly CLAY	
17.5-22.5 (near the river bank)	Mainly SILT/CLAY/Silty gravelly CLAY	
17.5-30	Mainly Gravelly CLAY & Municipal and C & D Waste	
30-60	Mainly Municipal and C & D Waste	
60-100	Mainly Municipal Waste	

The conductivity results are presented on Drawing 12073\_06, and the above interpretation of the results is provided on Drawing 12073\_07.

# 3.2 2D Electrical Resistivity Tomography (ERT)

2-D ERT Profiles R1-R15 have been acquired across the site (Drawings 12073\_01). The profiles have been generally interpreted on the following basis (Drawings 12073\_02, 03, 04 & 05):

Resistivity (Ohm.m)	Interpretation		
10 - 30	Municipal Waste & Clay		
30 - 56	Municipal and C & D Waste in clay matrix / Sandy Silty Gravelly Clay that may have been impacted by the waste		
44 - 56	SILT / CLAY		
56 - 92	Silty Gravelly CLAY		
92 - 193	Gravelly CLAY		
193 - 405	Clayey GRAVEL / GRAVEL		
93 - 405	LIMESTONE & SHALE		



## 3.3 Seismic Refraction Profiling

Four seismic refraction spreads (Profiles S1-S4) were recorded throughout the site. Each of the profiles were 69m in length which have a depth of investigation of approx. 23m.

The seismic data has outlined four velocity layers and has been generally interpreted on the following basis:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Average Thickness (m)	Interpretation	Stiffness/Rock Quality
1	213-600	413	1.7	Overburden / Waste	Soft/Loose
2	549-1151	745	6.7	Overburden / Waste	Firm-Stiff/Medium Dense-Dense
3	1604-2182	1873	8.1	Overburden / Waste	Very Stiff/Very Dense
4	1973-4545	3345		Slightly Weathered – Fresh Bedrock	Fair-Good

Note that Layer 3 is interpreted as absent for Profile S3.

#### 3.4 Discussion

#### 3.4.1 Waste

Material with conductivities (0-6.0m bgl) of 60-100 and 30-60 mS/m has been interpreted as mainly municipal waste; and municipal and C & D waste respectively. Material with conductivities of 17.5-30 mS/m (0-6.0 mbgl) has been interpreted as mainly gravelly clay and municipal & C & D waste.

The results indicate (Drawing 12073\_06) that material which is waste or includes waste extends over an area of approx. 570m (east to west) x 350m (north to south). The results indicate that the southern, south-western and south-eastern extents of the waste body have not been reached during the survey.

The area interpreted as mainly municipal waste measures approx. 380x200m in the south-centre of the waste body.

Materials with resistivities of 10-30 and 30-56 ohm-m have been interpreted as mainly municipal waste and municipal and C & D waste respectively. Where present at geater depths resistivities of 30-56 ohm-m are interpreted as sandy silty gravelly clay that may have been impacted by the waste.

The zones of thickest combined waste are located on Profiles R1, R4, R5, R6 and R12 (up c. 17.0m on R12). Note that the lower portions of these thicker waste zones may comprise native material that may have been impacted by the waste. The boreholes do not generally show the presence of leachate within the native material underlying the waste but grey and black staining is recorded in boreholes BH1 and BH3.



In general, the results indicate that leachate does not extend into the bedrock beneath the waste body.

The interpreted waste zones generally correlate well with the site investigation results.

#### 3.4.2 Overburden

Material with conductivities (0-6.0m bgl) of 2.5-10, 10-17.5 and 17.5-22.5 (near river bank) mS/m has been interpreted as mainly clayey gravel/gravel and limestone/shale; mainly silty gravelly clay/gravelly clay; and mainly silt/clay/silty gravelly clay.

The results (Drawing 12073\_06) indicate that clayey gravel/gravel and limestone/shale is present in the area to the west of the park. Silty gravelly clay/gravelly clay is mainly present along the river bank, and silt/clay/gravelly clay is interpreted for an area in the north-centre of the park approx. 50m south of the river.

Material with resistivities of 44-56, 56-92, 92-193 and 193-405 ohm-m has been interpreted as silt/clay, silty gravelly clay, gravelly clay and clayey gravel/gravel respectively. Profile R14 shows some silt/clay, whilst Profiles R2, R3, R5 and R10 shows zones of clayey gravel/gravel. The remainder of the profiles, and the borehole data, indicate that the waste is mainly hosted within silty gravelly clay/gravelly clay.

The seismic refraction results indicate that overburden material ranges in stiffness from soft-very stiff / loose-very dense.

### 3.4.3 Bedrock

Material with a resistivity of 93-405 ohm-m has been interpreted as limestone & shale of the Calp. The seismic refraction results indicate that bedrock is slightly weathered-fresh.

Bedrock has been interpreted for each of the Profiles R1-R15, with the shallowest bedrock interpreted for the southern part of Profile R3 (2.0m bgl in the south-west of the park). Bedrock depth has generally been interpreted as ranging from 10-20m bgl for the area of the main body of waste. There is evidence of a possible old quarry face at c.95m along Profile R10 as shown on Drawing 12073\_04.



# 4. RECOMMENDATIONS

Boreholes are recommended at the following locations to confirm the geophysical interpretation and to determine the extent or absence of leachate in the vicinity of the River Liffey. These boreholes should be drilled to bedrock depth;

Borehole	Easting	Northing
PBH1	308464.4	235727
PBH2	308662.6	235707.4
РВН3	308325	235709.4
PBH4	308589	235824.4



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#### 6. APPENDIX A: DETAILED METHODOLOGY

# 6.1 Seismic Refraction Profiling

### 6.1.1 Principles

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

#### 6.1.2 Data Collection

Four seismic spreads were recorded on the 14-15<sup>th</sup> November 2012 using a Geode high-resolution 24 channel digital seismograph with geophone spacings of 3m. The source of the seismic waves was a sledgehammer.

### 6.1.3 Data Processing

The recorded data was interpreted using the ray-tracing and intercept time methods, to acquire depths to layer boundaries and the P-wave velocities of these layers, using the FIRSTPIX and GREMIX programs.

GREMIX interprets seismic refraction data as a laterally varying layered earth structure. It incorporates the slope-intercept method, parts of the Plus-Minus Method of Hagedoorn (1959), Time-Delay Method, and features the Generalized Reciprocal Method (GRM) of Palmer (1980). Up to four layers can be mapped, one deduced from direct arrivals and three deduced from refractions. Phantoming of all possible travel time pairs can be carried out by adjusting reciprocal times of off shots.

### 6.1.4 Relocation

All data were referenced using a Pro-XS Differential GPS system with c.1m accuracy.

### 6.2 Electrical Resistivity Tomography (ERT)

### 6.2.1 Principles

This surveying technique makes use of the Wenner resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of 1-32 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

#### 6.2.2 Data Collection

Profiles R1-R15 were recorded on 13-16<sup>th</sup> November 2012 using a Tigre resistivity meter, imaging software, one 32 takeout multicore cable and up to 32 stainless steel electrodes.



Each of the profiles were 155m in length with an electrode spacing of 5m, with the exception of R15 (93m in length with a 3m spacing). Saline solution was used at the electrode\ground interface in order to gain a good electrical contact required for the technique to work effectively. The recorded data were processed and viewed immediately after the survey.

#### 6.2.3 Data Processing

The field readings were stored in computer files and inverted using the RES2DINV package (Campus Geophysical Instruments, 1997) with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed on the accompanying drawings. Distance is indicated along the horizontal axis of the profiles. Profiles have been contoured using the same contour intervals and colour codes.

#### 6.2.4 Relocation

All data were referenced using a Pro-XS Differential GPS system with c.1m accuracy.

### 6.3 Ground Conductivity Mapping

### 6.3.1 Principles

This is an electromagnetic technique used to investigate lateral variations in overburden material and to assist with the indication of the depth to bedrock.

This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). Readings over material such as organic waste and peat give high conductivity values while readings over dry materials with a low clay mineral content such as gravels, limestone or quartzite give low readings.

The EM31 survey technique determines the apparent conductivity of the ground material from 0-6m bgl depending on the dipole mode used. Depending on the dipole mode used, the measured conductivity is a function of the different overburden layers and/or rock from 0 to 6m below ground level.

### 6.3.2 Data Collection

The EM31 equipment used was a GF CMD-4 conductivity meter equipped with data logger. This instrument features a real time graphic display of the previous 20 measurement points to monitor data quality and results. Conductivity and in-phase values were recorded one each side of the roadway which surrounds the TMF. Local conditions and variations were recorded.



### 6.3.3 Data Processing

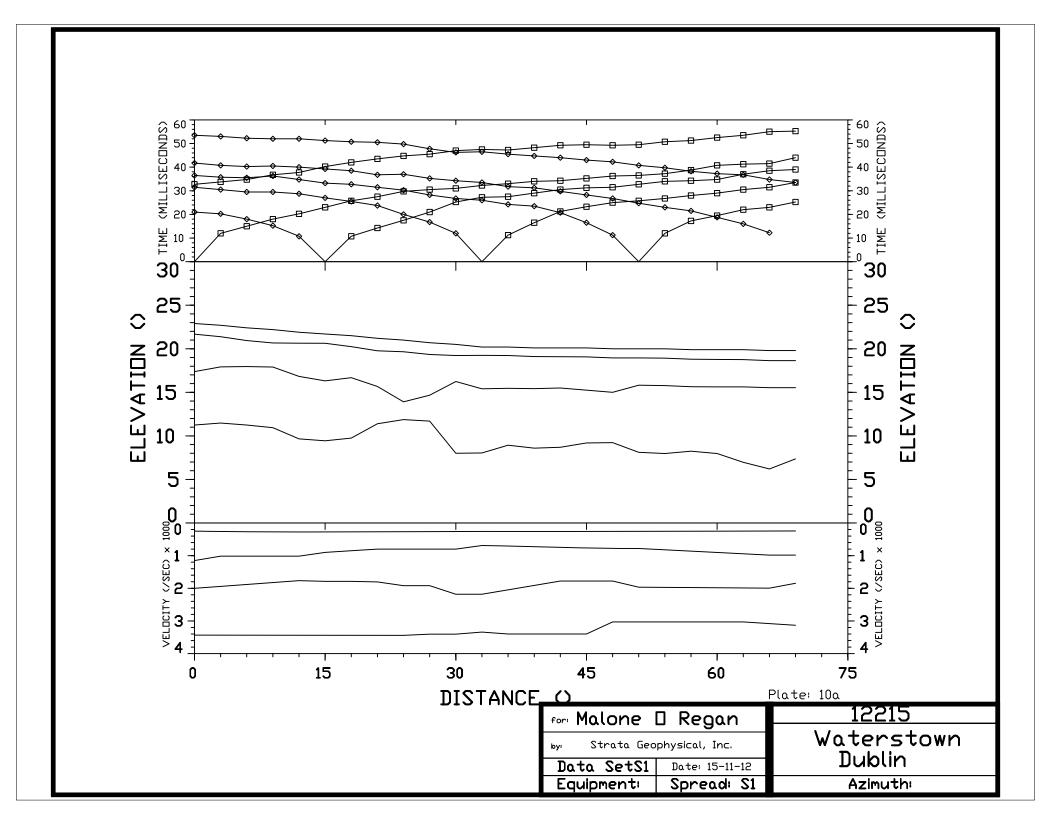
The conductivity and inphase field readings were downloaded, contoured and plotted using the SURFER 8 program (Golden Software, 2008). Data which was affected by metallic objects was removed. Assignation of material types and possible anomaly sources was carried out, with cross-reference to other data. The contoured conductivity data are displayed on Drawing 12073\_06.

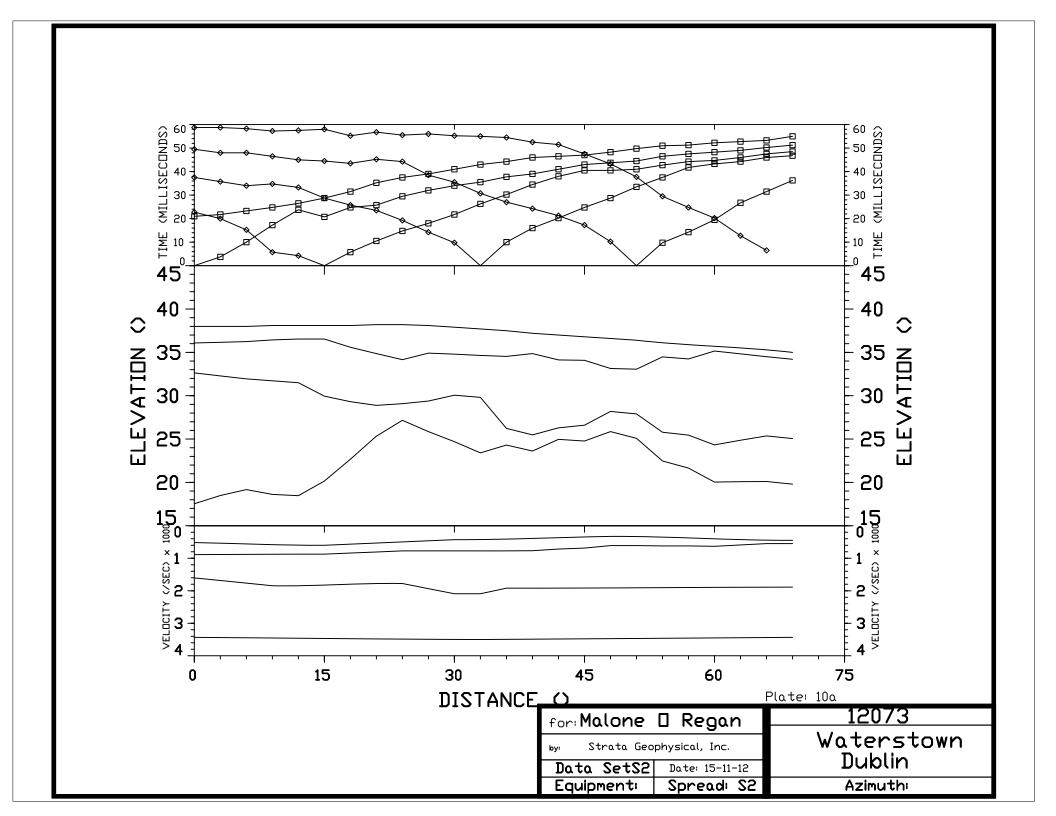
### 6.3.4 Relocation

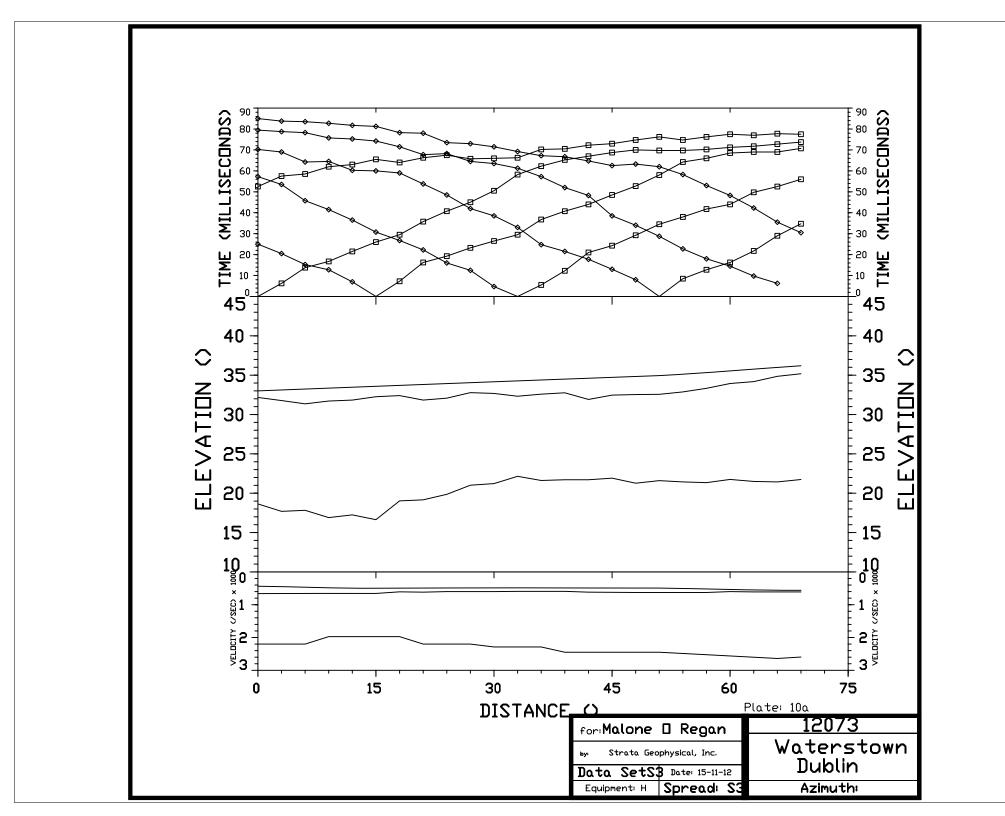
All data were referenced using a Garmin handheld system with sub 3m accuracy. All positions are given in Irish National Grid coordinates.

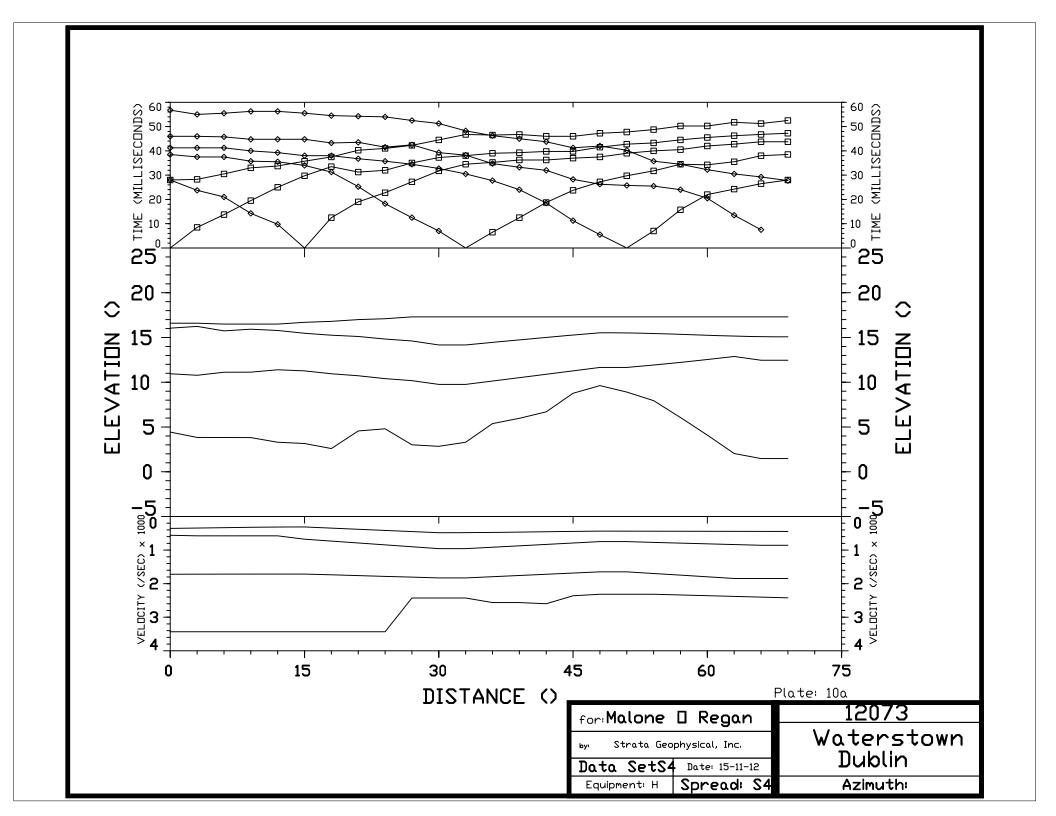


7. APPENDIX B: SEISMIC REFRACTION PLATES









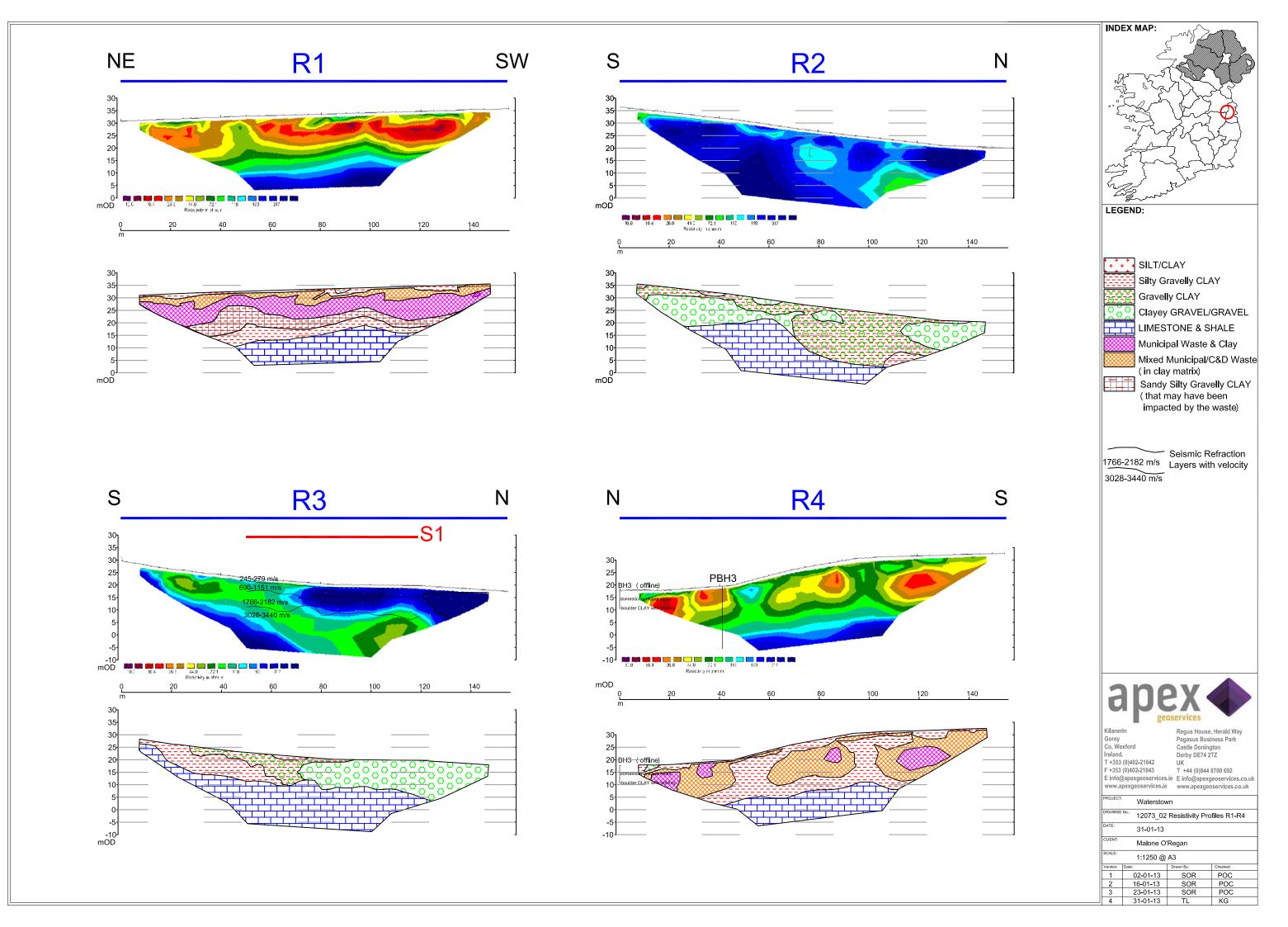


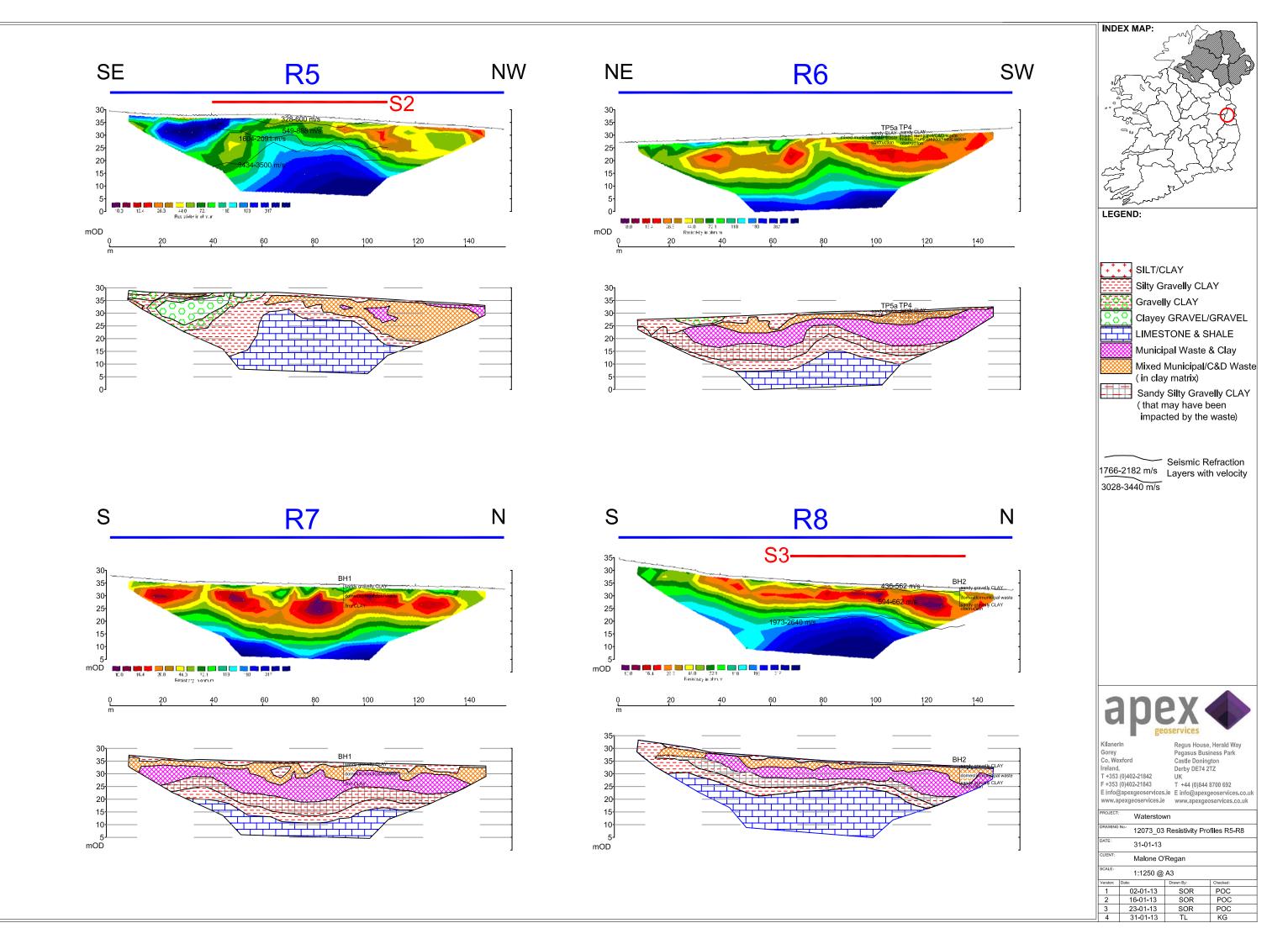
# 8. APPENDIX C: DRAWINGS

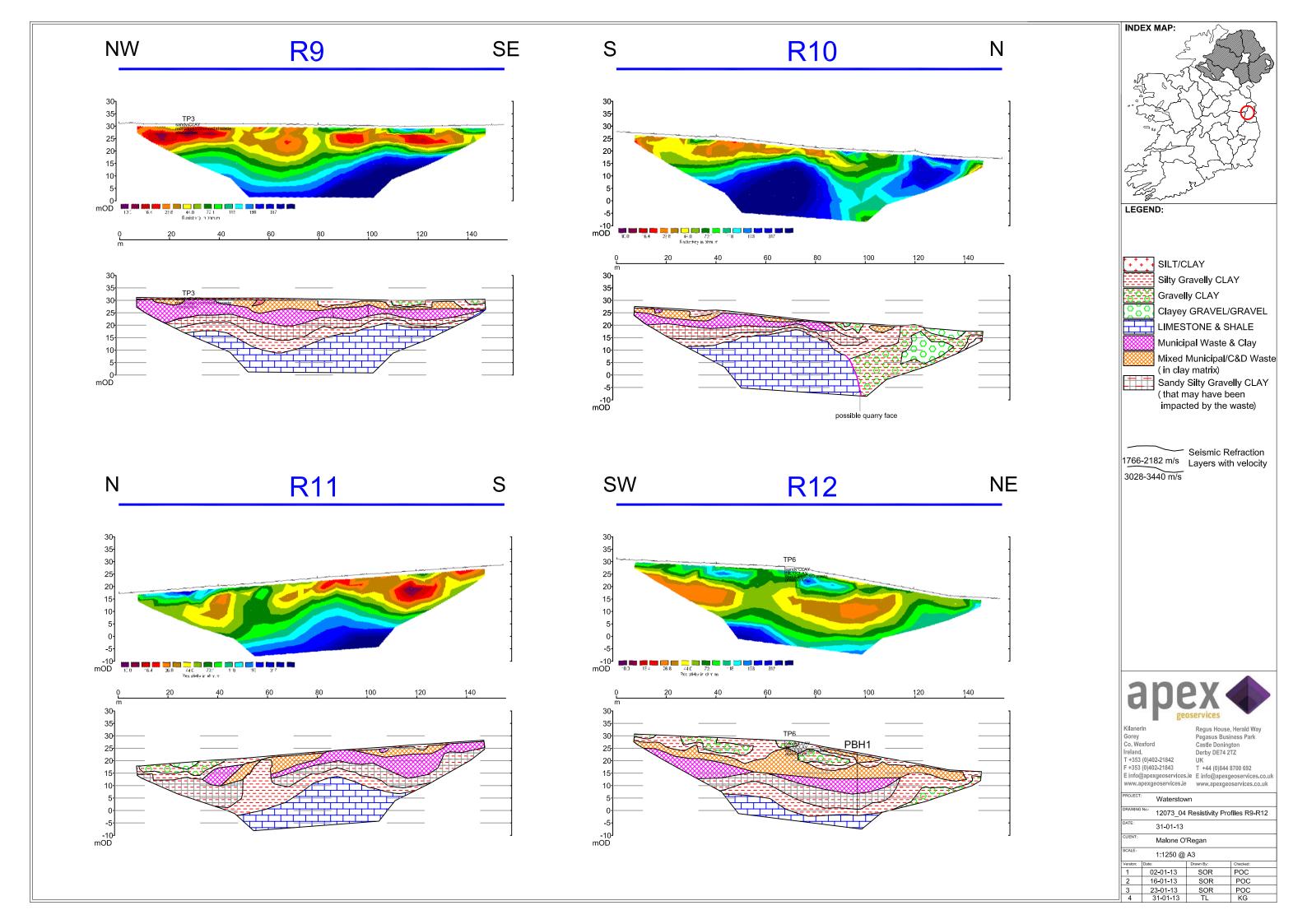
The information derived from the geophysical investigation is presented in the following drawings:

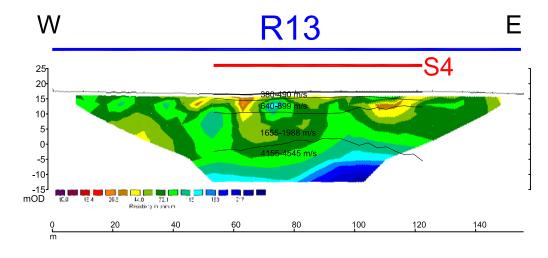
12073_01	Geophysical Location Map	1:2500	@ A3
12073_02	Interpreted Resistivity Profiles R1-R4	1:1250	@ A3
12073_03	Interpreted Resistivity Profiles R5-R8	1:1250	@ A3
12073_04	Interpreted Resistivity Profiles R9-R12	1:1250	@ A3
12073_05	Interpreted Resistivity Profiles R13-R15	1:1250	@ A3
12073_06	Conductivity Results	1:2500	@ A3
12073_07	Conductivity Interpretation & Summary	1:2500	@ A3

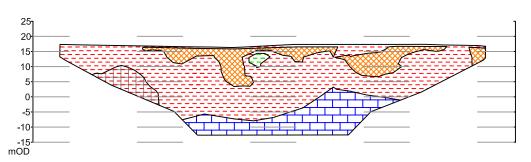


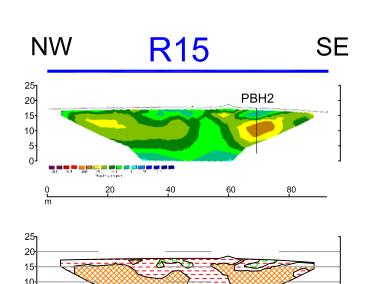




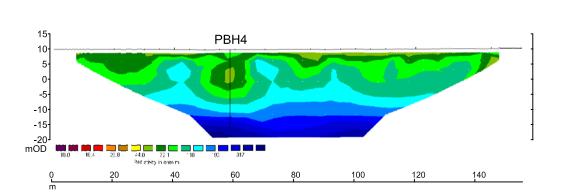


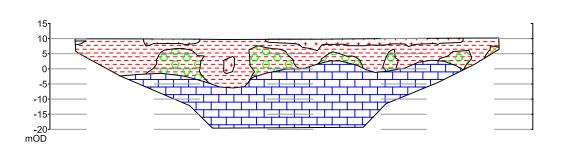


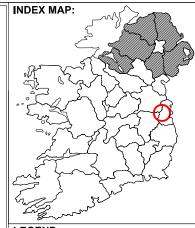












LEGEND:

+ + + + SILT/CLAY Silty Gravelly CLAY Gravelly CLAY Clayey GRAVEL/GRAVEL

LIMESTONE & SHALE

Municipal Waste & Clay Mixed Municipal/C&D Waste (in clay matrix)

Sandy Silty Gravelly CLAY (that may have been impacted by the waste)

3028-3440 m/s

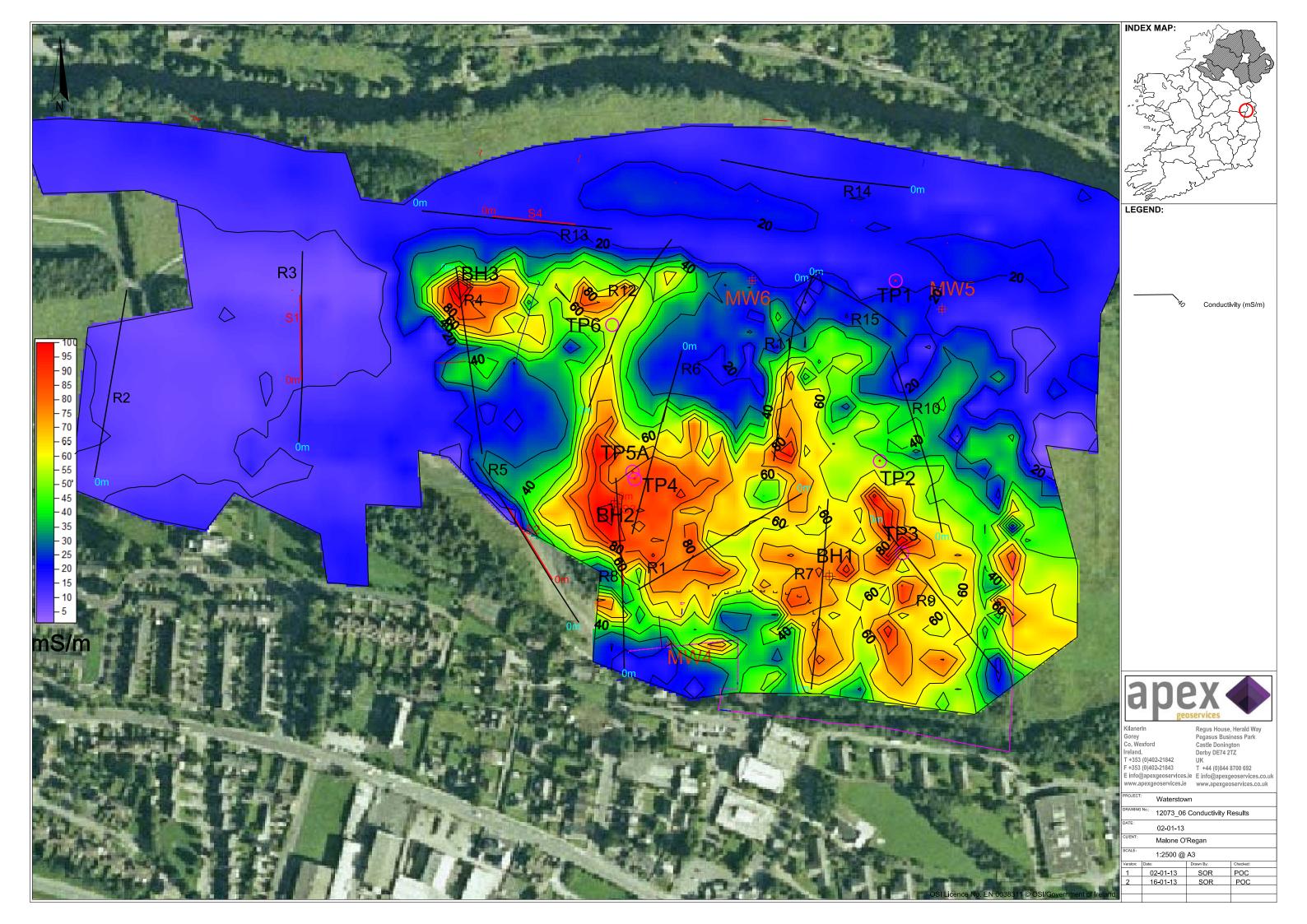
 Seismic Refraction 1766-2182 m/s Layers with velocity

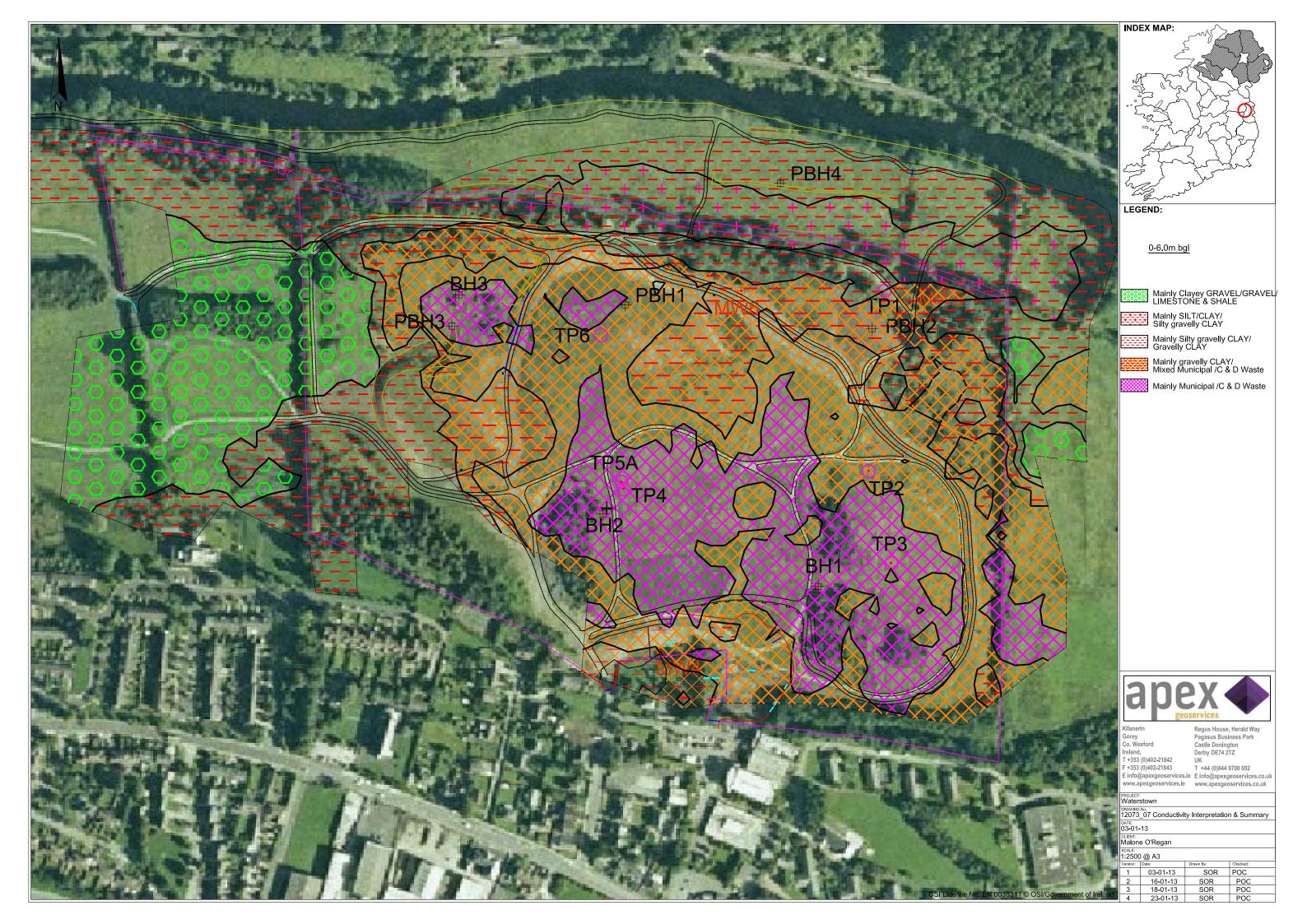
Gorey Co, Wexford

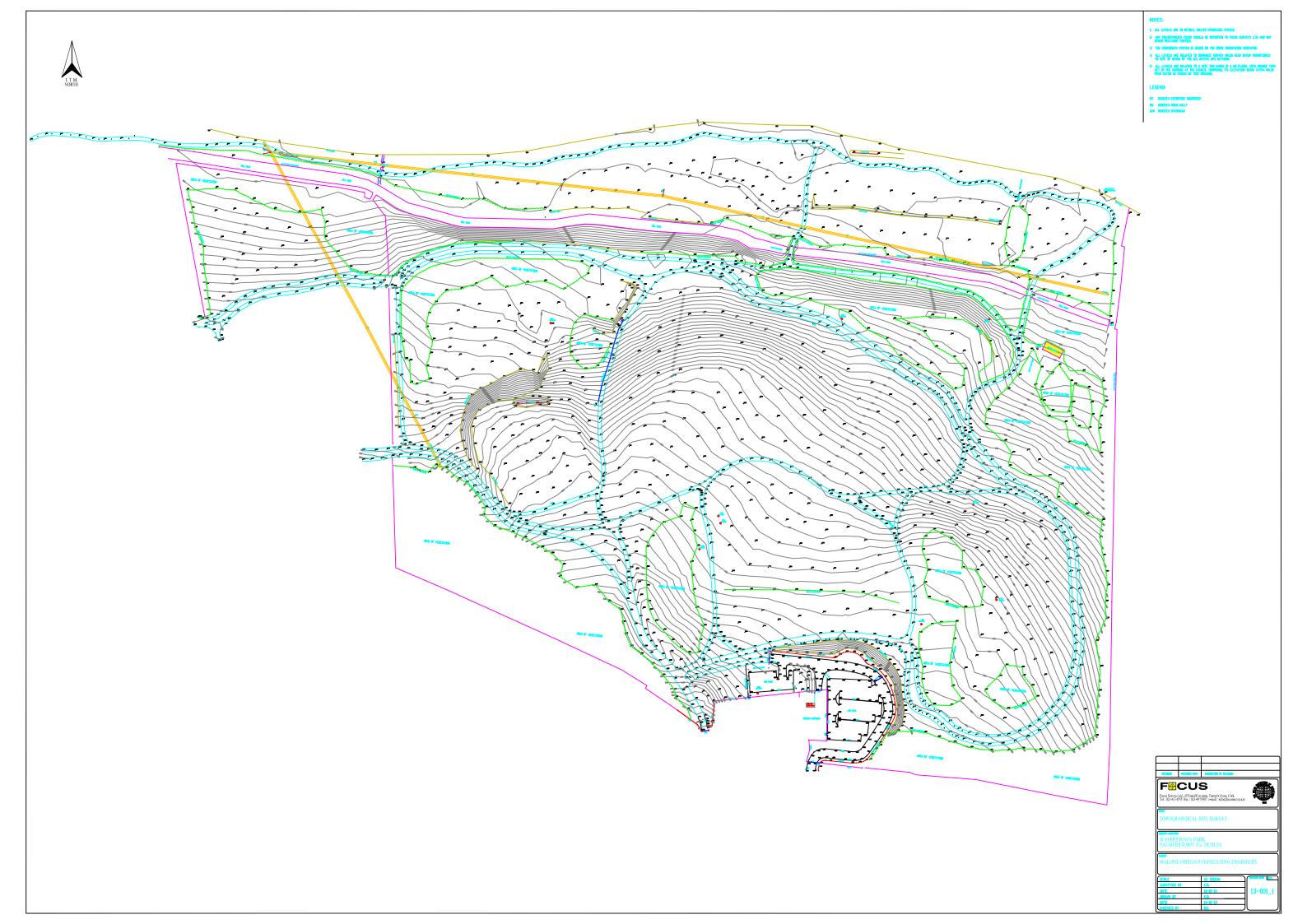
Regus House, Herald Way Pegasus Business Park Castle Donington Derby DE74 2TZ

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www.apexgeoservices.ie www.apexgeoservices.co.uk

PROJECT	Waterstov	vn			
DRAWING No.: 12073_05 Resistivity Profiles R13-R15					
DATE:	31-01-13				
CLIENT:	Malone O	Malone O'Regan			
scale: 1:1250 @ A3					
Version:	Date:	Drawn By:	Checked:		
1	02-01-13	SOR	POC		
2	16-01-13	SOR	POC		
3	18-01-13	SOR	POC		
-	00 04 40	000	500		









2B Richview Office Park **BOREHOLE LOG** Project Number: E0937 Client: South Dublin County Council **BOREHOLE NO: BH 1** Project Title: Waterstown Landfill Site Location: Palmerstown, Co. Dublin SAMPLE SUBSURFACE CONDITIONS INSTALLATION DETAILS WATER PID SYMBOL DESCRIPTION COMMENTS (mbgl) (mbgl) (mbgl) (ppm) Bentonite (0.0-1.0mbgl) TOP SOIL MADE GROUND Firm, brown, slightly sandy, gravelly CLAY with rare plastic, rootlets, brick and limestone cobbles. 1.4-7.2mbgl: Municipal Waste: plastic, timber, fabric, glass, metal, brick, paper MADE GROUND/WASTE Black/brown, slightly sandy, gravelly CLAY matrix with plastic, timber, some fabric and glass fragments. Some metal fragments. Black staining. 0 Pea gravel (1.0-7.4mbgl) Screen (1.4-7.4mbgl) 4.0 0 MADE GROUND/WASTE Black, sandy, CLAY/SILT matrix with some coarse limestone gravel and waste comprising of brick, copper wire, plastic, some timber, metal, paper and glass. Damp. 7.0 MADE GROUND/WASTE Grey, silty, gravelly SAND with limestone cobbles and some timber and paper. Dry. 7.4-7.8mbgl: Grey staining CLAY Firm, grey-brown, slightly gravelly, slightly sandy, SILT/CLAY. Dry. CLAY Firm, brown, slightly sandy CLAY with some lenses of grey, fine to medium sand and rare gravel. Rare cobbles. Dry. 8.5 0 Dark brown, slightly sandy, gravelly CLAY with 9.1mbgl: EOH in native material cobbles. Dry Drill Date: 05.12.12 Water Strike: Reference Datum: GL Drill Method: Inspection pit (0-1.2mbgl), Shell and Auger (0.2-9.1mbgl) Elevation: 0 Strike: 🔽 Level: Drilled By: Causeway Geotechnical Easting: 0 Logged By: CC Checked By: CC

Northing: 0

Page: 1 of 1

Revision:



		SUBSURFACE CON	DITIONS		SAN	IPLE	INSTALLATION DETAILS
epth nbgl)	SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)	
0		MADE GROUND Grass cover over slightly sandy, slightly gravelly CLAY with some rootlets. Gravel is angular to subrounded limestone.			0.2-0.9		Bentonite (0.0-1.3mbd)
1-		MADE GROUND Stiff, black, slightly gravelly CLAY with rare plastic, some timber, glass and brick. Gravel is angular to subrounded limestone.	207 Ambal Wasta Mard		0.9	0	Bentonite
<del>,</del>		MADE GROUND/WASTE Black, slightly sandy, slightly gravelly, SILT/CLAY matrix with white plastic sheeting, some timber, rare metal and metal pipe.	0.8-7.1mbgl: Waste: Mixed domestic/municipal: plastic, timber, metal, paper, fabric, rubber.				
2		MADE GROUND/WASTE Black, slightly gravelly, slightly sandy, SILT/CLAY matrix with timber, paper, plastic, rubber rings and copper pipe.			2.0	0	
3 - 3					3.0-3.5	0	Screen (1.5-7.0mbgl)
4		MADE GROUND/WASTE Slightly gravelly, sandy SILT/CLAY with fabric and paper.					Screen (1.5-7.0mbgl)
5		MADE GROUND/WASTE Slightly gravelly, slightly sandy SILT/CLAY with minor plastic, newspaper, some domestic waste and rare timber. Dry.					Scree
7 7 7 7		MADE GROUND/WASTE Mostly plastic recovered with minor black, slightly gravelly, slightly sandy SILT/CLAY matrix. Dry. MADE GROUND/WASTE		ute	5.2-5.6	0	
6		Mostly plastic, timber, metal in a minor gravelly CLAY matrix. Dry but becomes wet from 6.5mbgl.		.td 6.5mbgl: leachate			1 1 T T T T T
7		CLAY	7.2mbgl: EOH due to obstruction		6.8-7.1	0	
- - -		Brown, slightly sandy, gravelly CLAY with possible cobbles. Dry.					1000
8							d
9-							
-							
rill Me	ate: 07.12.12 ethod: Shell	I and Auger	Reference Datum: GL Elevation: 0		Water Strike:		Level: ▼
	ву: Causev d By: СС	vay Geotechnical	Easting: 0		Revision		<del>_</del>



		SUBSURFACE CON	DITIONS		SAN	IPLE	INICTALL ATION DETAIL O
Depth (mbgl)	SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)	INSTALLATION DETAILS
1		MADE GROUND Dark brown, silghtly sandy CLAY with much organic material and rootlets.  MADE GROUND Firm, dark brown, silty CLAY with some gravel, brick, limestone, glass, rare plastic. Dry.  MADE GROUND Firm, black, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded limestone with some fragments of brick. Rare plastic and paper. Damp with some orange flecks. Dry.  MADE GROUND/WASTE Black, slightly gravelly CLAY/SILT matrix. Much plastic, some timber, rare glass and brick fragments. Moist.	1.5-7.0mbgl: Waste: Mixed municipal and C&D: plastic, timber, glass, brick, metal	.≰1.1mbgl: water seepage	0.2-0.7	0	Cover   Cove
3-4		MADE GROUND/WASTE			2.2	0	
5		Black matrix of slightly sandy, gravelly CLAY/SILT with much glass and brick, some plastic and timber, rare metal. Moist becoming wet.	6.0-7.0mbgl: black/grey leachate	44 6, 0mbgl: leachate	5.6	0	Screen (1.5-7.0mbgl)  - Serven (1.5-7.0mbgl)  - Pea gravel (1.4-7.0mbgl)
7 — 8 — 9 — —		CLAY Firm, brown, silghtly sandy CLAY with rare subangular to subrounded limestone gravel. Dry.	7.0-7.05mbgl: some black staining 7.4mbgl: EOH in native material				Bentonite (7.0-7.2mbgl)
Drill Me Drilled	ate: 10.12.12 ethod: Shell By: Causew d By: CC		Reference Datum: GL Elevation: 0 Easting: 0		Water Strike:		Level: ¥



**BOREHOLE LOG** Project Number: E0937 Client: South Dublin County Council **BOREHOLE NO: MW 4** Project Title: Waterstown Landfill Site Location: Palmerstown, Co. Dublin SAMPLE SUBSURFACE CONDITIONS INSTALLATION DETAILS WATER Depth PID SYMBOL DESCRIPTION COMMENTS (mbgl) (mbgl) (mbgl) (ppm) 0-14.5mbgl: No evidence of contamination MADE GROUND Dark brown, slightly silty, sandy and gravelly CLAY with few cobbles. Trace rootlets and organic matter. Moist. MADE GROUND Dark brown slightly silty, sandy CLAY with small angular fragments of limestone gravel. Minor brick. Damp. CLAY Medium brown, slightly silty, slightly sandy, gravelly CLAY. Bentonite (0.0-10.2mbgl) CLAY Medium brown, gravelly CLAY/SILT. Sub-angular gravel fragments of light to dark grey limestone. Increase in gravel content with depth. Damp. CLAY Grey-brown, very gravelly, CLAY. Damp. ٥ GRAVEL Light to dark grey and brown, silty/clayey GRAVEL. Damp. 200 9 0 0 0 0 0 0 GRAVEL Grey, slightly sandy GRAVEL with some clay/silt. Gravel is angular to subangular. Damp. ß 40 G ß οg 90°G

Reference Datum: GL

Elevation: 0

Easting: 0

Northing: 0

Drill Date: 06.12.12

Logged By: JA Checked By: CC

Drilled By: Causeway Geotechnical

**Drill Method:** Inspection pit (0.0-1.2mbgl), Air rotary (1.2-14.5mbgl)

Level:

Page: 1 of 2

Water Strike: 11.3mbg

Strike: 💟

Revision:



Seguin Manage St. 122  100 A Seguin and Seguin Association and Seguina and Seguina and Seguina and Seguina and Seg	Project Title: Water	erstown Landfill	Site Location: Palmerstown, Co. Dubli	n			E NO. WW 4
The property of the property		SUBSURFACE CO	NDITIONS		SAN	IPLE	
WEATHERED BEDROCK - Limestone  Design - regular imperence of inectore with office of the control of the contro	(mbgi)	DESCRIPTION	COMMENTS				INSTALLATION DETAILS
	11	on pit (0.0-1.2mbgl), Air rotary (1.2-14.5mbgl)	Reference Datum: GL	1 1	Water	Strike: 11	
.ogged By: JA Easting: 0 Revision: Final Page: 1 of 2	Drilled By: Causeway ( Logged By: JA Checked By: CC	Geotechnical	Easting: 0				



Project Title: \	Project Title: Waterstown Landfill	Site Location: Palmerstown, Co. Dublin				1	
	SUBSURFACE CO	NDITIONS		SAN	MPLE		
Depth (mbgl) SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)	INSTALLATION DETAILS ້ອ	
	MADE GROUND Grey-brown, medium to coarse grained SAND and GRAVEL with clay, and abundant cobbles of mostly limestone. Minor clay and silt. Clay proportion increases slightly with depth.Moist.  SAND and GRAVEL Grey to brown, slightly clayey SAND and GRAVEL. Gravel is sub-angular and sub-rounded of limestone. Dry.  GRAVEL Light to medium grey, slightly clayey, angular to sub-angular GRAVEL of limestone with minor sandstone chips. Damp. GRAVEL Mostly limestone GRAVEL, with a sandy (medium to coarse) and a very slighly Silt.T/CLAY matrix. Damp. SAND Grey-brown, gravelly, medium to coarse grained SAND. Gravel is sub-angular to sub-rounded limestone. Damp. SAND Medium to coarse, slightly silty, gravelly SAND. Wet. SAND and GRAVEL. Silty SAND and GRAVEL. Wet. SAND Silty coarse SAND with minor gravel. GRAVEL Dark grey, GRAVEL with minor silt/clay lenses. Gravel is angular to subrounded limestone and calcite. Wet.	0.0-8.7mbgl: No evidence of contamination  8.7mbgl: EOH in native material	-44.2mbgi vaere srike				
10 Drill Date: 07.12.1	2	Reference Datum: GL		Water	Strike: 4.2	2. 4.9 mbal	
Drill Method: Insp Drilled By: Cause	ection pit (0.0-1.2mbgl), Air rotary (1.2-8.7mbgl)	Elevation: 0		Strike:		Level: <u>\</u>	



Proje	ect Title: \	Waterstown Landfill	Site Location: Palmerstown, Co. Dublin		BURI	EHOLE	E NO: MW 6
		SUBSURFACE COM	IDITIONS		SAN	IPLE	
Depth (mbgl)	SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)	INSTALLATION DETAILS
(mbgl)  0		MADE GROUND Dark brown, gravelly CLAY, with cobbles and boulders. Fragments of lignite-like and charcoal material, roots, brick and rare pieces of plastic and ceramics. Moist.  MADE GROUND Dark brown, slightly silty, gravelly CLAY with few brick fragments. Moist.  MADE GROUND Dark brown, slightly gravelly CLAY with medium brown clay inclusions. Moist.  MADE GROUND Inferred limestone boulder with minor clay. Dry.  MADE GROUND Grey-brown, sandy GRAVEL with minor silt/clay. Fragments of glass and plastic . Dry.  MADE GROUND Fragments of concrete, clear plastic and trace brick fragments in a minor silty sandy and gravel matrix.  SAND Light brown to grey, slightly silty, gravelly SAND. Damp.	COMMENTS	*47.2mbgl: water level	(mbgI)	(ppm)	
10 —	ate: 10.12.1	GRAVEL Coarse GRAVEL of subrounded to subangular	Reference Datum: GL		Water	Strike: 1.2	2, 7.2, 10.2
Drill M Drilled	ethod: Insp By: Cause	ection pit (0.0-1.2mbgl), Air rotary (1.2-14mbgl) way Geotechnical	Reference Datum: GL Elevation: 0 Easting: 0		Strike:	$\overline{\Sigma}$	Level: 🕎
	d By: JA ed By: CC		Northing: 0		Revision	on: Fina	al Page: 1 of 2



Proj	ect Title: \	Naterstown Landfill	Site Location: Palmerstown, Co. Dublin				
		SUBSURFACE COM	IDITIONS		SAN	/IPLE	- INSTALLATION DETAILS
Depth (mbgl)	SYMBOL	DESCRIPTION	COMMENTS	WATER of mbgl) u	Depth (mbgl)	PID (ppm)	INSTALLATION DETAILS
Depth (mbgl)		SAND and GRAVEL Grey-brown, clayey/silty, sandy, medium to coarse, GRAVEL  CLAY Soft, dark brown, slightly sandy (fine), gravelly, CLAY, Gravel is sub-angular to sub-rounded limestone and mudstone. Wet.  GRAVEL Dark brown, clayey coarse GRAVEL of angular limestone. CLAY Dark brown to grey, gravelly CLAY.	14mbgl: EOH in native material	WATER (mbgl) (mbgl)	Depth (mbgl)		Bentonite (9.8-14mbg)
	Pate: 10.12.1		Reference Datum: GL		Water	Strike: 1.2	2, 7.2, 10.2
Drille	d By: Cause	ection pit (0.0-1.2mbgl), Air rotary (1.2-14mbgl) way Geotechnical	Elevation: 0 Easting: 0		Strike:	$\overline{\Delta}$	Level: 🕎
Logge Check	ed By: JA ed By: CC		Northing: 0		Revisi	on: Fina	al Page: 1 of 2



**TRIAL PIT NO: TP01** 

Project Number: EO937 Client: South Dublin County Council

Project Title: Waterstown Landfill

Site Location: Palmerstown, Co. Dublin

		SUBSURFACE COM	IDITIONS		SAM	PLE
Depth (mbgl)	SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)
0-		MADE GROUND Dark brown, sandy gravelly CLAY with many roolets, some plastic, wrappers and bottles. Damp. MADE GROUND Light brown, slightly sandy, slightly gravelly CLAY with rare cobbles. Rare plastic. Damp.	0.0-0.8mbgl: Some plastic			
-		MADE GROUND	0.8-1.6mbgl: Some peat moss, plastic, brick, timber and tyre.		0.6	0
1— - -		Dark brown, sandy, gravelly CLAY with some cobbles. Rare inclusions of soft brown peat moss and orange/black flecks. Minor plastic, brick, timber and one tyre.			1-1.2	0
-	3 3 S	TOPSOIL Dark brown, slightly sandy CLAY with many rootlets. Dry to damp.	1.6-1.85mbgl: Likely former ground level		1.8	0
2 -		Light brown/grey, slightly silty, gravelly SAND.  Moist.  SAND  Moist to wet, light brown, very gravelly SAND with many subangular to round limestone and sandstone cobbles and boulders. Moist to wet.		.42.4mbgl: water strike.		
-	0 g		2.6mbgl: EOH due to collapse.			
3						
4-						
- -						
5	ration Date:	04.12.12	Defense Detail		West-Scill To Scill	
Excav	ation Metho	useway Geotechnics	Reference Datum: Elevation: 0		Water Strike: 2.4mbgl Strike:	el: 💆
Logge	ed By: CC red By: CC		Easting: 0 Northing: 0		Revision: FINAL	<b>Page 1</b> of 1



Client: South Dublin County Council Project Number: EO937

Proj	ect Numbe	er: EO937	Client: South Dublin County Council		TRIAL PIT NO:	TP02
Proj	ect Title: V	Vaterstown Landfill	Site Location: Palmerstown, Co. Dublin		INIAL FIT NO.	11 02
		SUBSURFACE CO	NDITIONS		SAI	MPLE
Depth (mbgl)	SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)
0-		MADE GROUND Soft, brown slightly sandy CLAY with rare gravel and rootlets. Damp.				
-		MADE GROUND Soft, brown, silghtly sandy, slightly gravelly CLAY with rare pockets of soft, orange/grey, gravelly, sandy SILT, occasional rootlets. Damp.	0.5-4.05mbgl: Waste: Mixed municipal/domestic and C&D waste			
-		MADE GROUND/WASTE Black ashy material with some concrete, cobbles, plastic, metal springs and timber, twigs and corregated cardboard in a clay matrix.	0.5-1.0mbgl: Waste: Soil matrix 40%, plastic 30%, timber 20%, metal <5% and paper <5% (dated c. 1986).			
1 — -		MADE GROUND/WASTE Domestic. Bags of refuse, black degraded waste in a sandy matirx, Dry.	1.5-3.9mbgl: Waste: Soil matrix 40%, plastic		1.2	0
- 2- - -		MADE GROUND/WASTE Mixed domestic and C&D waste. Plastic, foam packing, rare metal, glass, timber, bricks and concrete, metal and rubber tyre. Minor fabric. Decomposed waste in a black ashy, sandy matrix. Damp becoming wet.	20%, rubber 10%, timber 10%, concrete 5%, fabric 5%, metal 5% and glass 5%.			
3-					2.9-3.0	0
-		MADE ODOUNDAMANTE	3.5mbgl: Becoming wet.	«4.0mbgl: leachate		
4		MADE GROUND/WASTE Grey/black, sandy CLAY/SILT with some plastic, glass and timber. Few cobbles. Wet.	4.05mbgl: EOH in made ground due to collapse	å 4.	4.0	0
5— Excav	ration Date: (	04.12.12	Reference Datum:		Water Strike:	
Excav Excav	ration Methorated By: Cau	d: Tracked excavator (Rubber) useway Geotechnics	Elevation: 0			vel: 💆
	ed By: CC ced By: CC		Easting: 0 Northing: 0		Revision: FINAL	Page 1 of 1



Project Number: EO937 Client: South Dublin County Council

Project Title: Waterstown Landfill

Site Location: Palmerstown, Co. Dublin

TRIAL PIT NO: TP03

	SUBSURFACE (		NDITIONS		SAMPLE		
Depth (mbgl)	SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)	
0-		MADE GROUND Soft, brown, slightly sandy CLAY with rare gravel and rootlets. Some orange/black flecks. Damp.					
-		MADE GROUND Compacted black, slightly clayey, GRAVEL and cobble. Some timber, plastic and rare metal (<5%).	0.4-0.8mbgl: Some timber, plastic and metal				
1-		MADE GROUND/WASTE Black, gravelly, slightly sandy, CLAY/SILT matrix with decomposing domestic and municipal/C&D waste of timber, tyres, plastic, fabric, full paint tins, wavin pipe and containers.	0.8-2.5mbgl: Waste: Mixed municipal and commercial waste      0.8-1.7mbgl:Waste: Soil matrix 40%, plastic 30%, timber 10%, fabric 5%, rubber 5%, metal 5%		1.15	0	
-							
-		MADE GROUND/WASTE Waste of bags, fabric, bundles of bottle seals, metal and paper.	1.7mbgl: Seepage of yellow liquid from waste material		1.85-1.95	0	
2-			1.7-2.5mbgl: Waste: plastic 40%, paper 20%, fabric 15%, metal 5%				
_			2.5mbgl: EOH due to obstruction				
3-	-						
-	_						
-	-						
4-	-						
-							
-							
	/ation Date:	04.12.12 d: Tracked excavator (Rubber)	Reference Datum:		Water Strike:		
Excav Logge	vated By: Ca ed By: CC	useway Geotechnics	Elevation: 0 Easting: 0		Strike:    Lev  Revision: FINAL	Page 1 of 1	
Check	ked By: CC		Northing: 0	DISCLAIME	R: This log is for environ		

Project Title: Waterstown Landfill



Project Number: EO937 Client: South Dublin County Council
TRIAL PIT NO: TP04

Site Location: Palmerstown, Co. Dublin

,		vaterstown Landfill	Site Location: Paimerstown, Co. Dublin			MPLE	
Depth		SUBSURFACE COI		WATER	Depth	PID	
(mbgl)	SYMBOL	DESCRIPTION	COMMENTS	(mbgl)	(mbgl)	(ppm)	
0		MADE GROUND Soft, brown slightly sandy, slightly gravelly CLAY with rootlets. Some orange/black flecks. Damp.	0.0-0.5mbgl: No evidence of contamination				
_		MADE GROUND Firm, dark brown to black, slightly sandy, gravelly, CLAY/SILT with some limestone cobbles, brick and concrete.	0.7-2.05mbgl: Mixed municipal and C&D waste: soil matrix 50%, plastic 40%, timber				
1 -		MADE GROUND/WASTE Brown/black, soft slightly sandy and gravelly CLAY matrix with some glass, metal, brick, timber, plastic sheeting, pipe. Some bundles of cardboard, plastic bags and perspex sheeting.	5%, glass and metal 5%				
- - 2-					1.45-1.55	0	
-		MADE GROUND/WASTE Mixed waste of concrete blocks, timber, some paper and plastic.	2.05-2.3mbgl: Waste: Mostly C&D waste				
_		MADE GROUND/WASTE Black matrix of degraded material. Some shredded plastics. Damp.	2.3-2.65mbgl: Waste: Municipal waste				
_			2.65mbgl: EOH due to obstruction		2.6-2.65	0	
3-							
_							
4							
_							
-							
Excav		04.12.12 d: Tracked excavator (Rubber) useway Geotechnics	Reference Datum: Elevation: 0		Water Strike: Strike: ∑ Lev	el: <u>▼</u>	
	d By: CC ed By: CC		Easting: 0 Northing: 0		Revision: FINAL	<b>Page 1</b> of 1	



Project Number: EO937 Client: South Dublin County Council
TRIAL PIT NO: TP05

Pro	ject Title: V	Vaterstown Landfill	Site Location: Palmerstown, Co. Dublin		TRIAL PIT NO:	TP05
		SUBSURFACE CO	NDITIONS		SAN	IPLE
Depth (mbgl)	SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)
o-		MADE GROUND Soft and brown slightly sandy, slightly gravelly CLAY. Dry.  MADE GROUND Firm, brown, slightly gravelly, sandy CLAY with some limestone gravel, cobbles, some concrete and rare glass. Dry.				
1		MADE GROUND/WASTE Black/grey, slightly gravelly, sandy CLAY/SILT matrix. Plastic sheeting, cartons, plastic discs, stained timber, black plastic sacks, glass bottles and rare metal. Dry.  MADE GROUND/WASTE Black matrix of sandy CLAY with plastic, paper and some rope. Rare metal, glass, timber.	0.9-3.0mbgl: Waste: Mixed municipal and C&D waste  0.9-1.2mbgl: Waste: Matrix 70%, metal 10%, plastic 10%, paper 5% and timber 5%  1.2-2.2mbgl: Waste: Matrix 40%, plastic 30%, paper 10%, glass/metal 10%, timber/rope 10%  1.55mbgl: leachate, black, no sheen	-∉ 1.55mbgl: leachate	1.2	0 0
- - 3- - - - -		MADE GROUND/WASTE Matrix of grey slightly sandy CLAY/SILT with plastic sacks of refuse, fabric and some metal. Some foam cushions and newspapers. Occasional boulders, cable and timber.	2.2-3.0mbgl: Mixed domestic and municipal waste. Dated from newspaper 15th June 1987.  2.2-3.0mbgl: Waste: Refuse bags (mixed degraded) 50%, matrix 20%, fabric 20%, plastic/metal 5%, timber/foam 5%  3.0mbgl: EOH due to obstruction			
Excav Excav		05.12.12 d: Tracked excavator (Rubber) useway Geotechnics	Reference Datum: Elevation: 0 Easting: 0 Northing: 0		Water Strike: Strike: ☑ Lev Revision: FINAL	rel: ▼ Page 1 of 1



	SUBSURFACE CO	POLITIONS		SAMPLE		
pth bgl) SYMBOL	DESCRIPTION	COMMENTS	WATER (mbgl)	Depth (mbgl)	PID (ppm)	
0	MADE GROUND Soft to firm, brown slightly gravelly, sandy CLAY with rootlets, rare orange flecks. Dry.					
	MADE GROUND Firm brown, slightly sandy and gravelly CLAY with angular to subrounded limestone cobbles. Rare brick, roots, branches and timber. Dry to damp.					
1-	MADE GROUND Stiff, brown, slightly sandy, gravelly CLAY with many cobbles and some boulders. Rare fragments of brick and timber. Some cobble size pockets of black sandy clay. Dry to damp.					
2-				1.6-1.65	0	
3-	MADE GROUND Soft, grey-brown, slightly sandy, SILT/CLAY with some gravel and cobbles. Some pockets of black sandy SILT. Some gravels, cobbles and boulders of calp limestone. Damp to moist.					
4	MADE GROUND/WASTE Soft, black-brown, slightly silty CLAY with gravel and some cobbles. Rare plastic bags and timber. Rare metal, brick, glass and concrete. Some pockets of black silty material. Moist.	3.5-4.0mbgl: Waste: Mixed municipal/C&D waste  3.9-4.0mbgl: Large boulders of concrete and limestone  4.0mbgl: EOH due to obstruction		3.7-3.75	0	
5— Ccavation Date:	05.12.12 <b>d:</b> Tracked excavator (Rubber)	Reference Datum: Elevation: 0		Water Strike: Strike: ▽ Leve	ı: <b>T</b>	

E0937/05

CHAIN OF CUSTODY															
CLIENT:			If Electronic File Re		SAMPL	FR:	C-LL	FFOR	63	NIT IN	11	300		Maria.	Jones
ADDRESS: AD RICHVIEW DEFICE	DV-		please select file for below	ormat	MOBIL			AFF							Laboratory Laboratory
CLUNSNEHUH BUSUN	14		EQUIS		EMAIL	REPOR	RT TO:	burk	RPME	or ce	vie	2			
PROJECT MANAGER (PM):			CROSSTAB		cc REF	PORTT	0:		No. 34						
MOBILE:			CLIENT		INVOIC	CE TO:	(if different	to report)							
PROJECT ID:			AGS (please also fill in	1	QUOTE	E NUME	BER:	The way		P.0	No:				Chain of Custody sheet page of
SITE:			AGS SAMP_TYPE & SAMP_REF below)		1 4 4		ANAL	YSIS REQ	UIRED inc	luding	SUITE	names		792	Chair of Custody sheet page or
TURNAROUND - please tick	All waters - tick for	FOR LABORATORY USE ONL	Y								3/4				SOILS -We are MCERTS accredited for samples predominantly made up of sand,
10 DAY 4 DAY Other	samples to be tested shaken or	AVERAGE COOL BOX TEMP.(	if required):		Asbe										loam and clay (no other matrices). Please
5 DAY 3 DAY	settled	SAMPLE RECIEPT CONDITION	N:												request an MCERTS report if required.  WATERS - we are accredited for surface
MATRIX:- S=Soil, GW=GroundWater, SW=SurfaceW	ater, L/E=Leacha	te/Effluent, OW=OtherWate	er, P=Product/Oil)	7	_ 3				WH FF						and groundwaters (leachates and effluents
Sample ID	Shaken Settled	S/GW/SW /L/E/OW/P	Time Depth in Metres	Presen		Low									are accredited for some tests, please see UKAS schedule). Please tick whether analysis is required on settled or shaken
The solution		4/12/12	0.6		N.										BEET TO SEE SEE SEE
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10000			108-1083		X	V									TEAR TO BE A CONTROLLED
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Name:			Date:	ar.	Name:		Soh				D	ate:	51	12/17	 Consignment note No:
Of:		NUMBER OF STREET	Time:	The same	Of:	ALC: N	Nr. of	0	H-L	Elenia		ime:	1	Su	Courier Company:
Health & Safety instructions including known hazards (eg suspect	ted asbestos). Ple	ase let us know if samples	are heavily contamir	nated, Hi	igh PAHs	expect	ed, provide	PID reading	s if availab	le			Lugie.		

CHAIN OF CUSTODY												Fa Sa		344	
CLIENT: MATCONE O REGAN			If Electronic F			IPLER:	- CL	IFK	-0 K	-0	Hillian			H Yan	Jones
ADDRESS:			please select below	file format	MOI	RII E			MAL.						Laboratory Laboratory
			EQUIS		EM4	All REPO	ORT TO:	bu	rke	ome	orce		e	1 0	
PROJECT MANAGER (PM):		PRINCIPLE AND A	CROSSTAB	The Ite	30,92	EPORT					TP. KA		4.018		
MOBILE:		OR THE STREET	CLIENT	17/10		7 - 1	: (if different	to repor	+\			0.5	19 19 12		
PROJECT ID:			AGS (please als	so fill in		OTE NUM	THOUSAND,	to repor	.,	-	2.0 No:	TO S.L.			1
SITE: WATCRSTOWN			AGS SAMP_TY SAMP_REF be	PE &	QUI	JIE NON		Vele Di	FOUNDER	DESCRIPTION OF THE PARTY OF THE	as lately little		7.17		Chain of Custody sheet page of
TURNAROUND - please tick				elow)			ANAI	1313 KI	EQUIREL	includin	g SUITE I	iames			SOILS -We are MCERTS accredited for
	All waters - tick fo samples to be				As	bestos									samples predominantly made up of sand,
10 DAY 4 DAY Other	tested shaken or settled	AVERAGE COOL BOX TEMP.				risk		100					6		loam and clay (no other matrices). Please request an MCERTS report if required.
5 DAY 3 DAY MATRIX:- S=Soil, GW=GroundWater, SW=SurfaceWa	tor I/E-I sacha	SAMPLE RECIEPT CONDITIO		NID.											WATERS - we are accredited for surface
WATKIA. 5-3011, GW-Groundwater, SW-Surfacewa	ter, L/E=Leacha				_ =	Med				MATE					and groundwaters (leachates and effluents are accredited for some tests, please see
Sample ID	Shaken Settled	S/GW/SW /L/E/OW/P Date	Time Dept			Low									UKAS schedule). Please tick whether analysis is required on settled or shaken
7.13 114 113		278787	- Meri	6.2		K									
4.1 6.41			14.2	5		No.	100		0				11-16		* 06
TP6 1.6-1.65			1.6-1.	65							0 93		ar e		HOLD
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		TOTAL TOTAL STREET		1/20 000											
RELINQUISHED BY:					REC	EVED E	BY: VAW	(1)			Barry.				METHOD of SHIPMENT
Name: C C (Front)		PERSONAL PROPERTY.	Date:	1/12/12		ne:	10				D	ate:	Je Ve	4199	Consignment note No:
Of: NOA		Les publications		14:46	Of:			1.11			Т	me:	الظايا	- 4	Courier Company:
Health & Safety instructions including known hazards (eg suspecte	ed asbestos). Ple	ease let us know if samples	are heavily con	taminated,	High PA	Hs expec	ted, provide	PID read	ings if ava	ailable					



Unit 3 Deeside Point

Zone 3

Deeside Industrial Park

Deeside CH5 2UA

Malone O'Regan 2b Richview Office Park Clonskeagh Dublin 14 Ireland

Tel: +44 (0) 1244 833780 Fax: +44 (0) 1244 833781





No.4225

Attention: Eleanor Burke

Date: 21st December, 2012

Your reference : E0937

Our reference: Test Report 12/9568 Batch 1

Location: Dublin

Date samples received: 6th December, 2012

Status: Final report

Issue:

Eleven samples were received for analysis on 6th December, 2012. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Where Waste Acceptance Criteria Suite (EC Decision of 19 December 2002 (2003/33/EC)) has been requested, all analyses have been performed using the relevant EN methods where they exist.

Compiled By:

**Bruce Leslie** 

**Project Co-ordinator** 

Bob Millward B.Sc Principal Chemist

Rjuiellward

Client Name: Malone O'Regan Report : Solid

Reference: E0937

**Location:** Dublin Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Contact: Eleanor Burke

J E Sample No.	13-15	23-25	29-31						
Sample ID T	P2 2.9-3.0M	TP3 1.15M	TP4 1.45-1.55M						
Depth	2.9-3.0	1.15	1.45-1.55				Please se	e attached n	otes for all
COC No / misc								ations and a	
Containers	VJT	VJT	VJT						
Sample Date 0	04/12/2012	04/12/2012	04/12/2012						
Sample Type	Soil	Soil	Soil						
Batch Number	1	1	1				LOD	Units	Method No.
Date of Receipt 0	06/12/2012	06/12/2012	06/12/2012						110.
PAH MS #			0.40						T1445140
Naphthalene #	0.23	0.49	<0.40				<0.04	mg/kg	TM4/PM8
Acenaphthylene #	<0.03	0.17	<0.30				<0.03	mg/kg	TM4/PM8
Acenaphthene #	0.23	0.34	<0.50				<0.05	mg/kg	TM4/PM8
Fluorene #	0.23	0.34	<0.40				<0.04	mg/kg	TM4/PM8
Phenanthrene #	1.45	2.01	<0.30				<0.03	mg/kg	TM4/PM8
Anthracene #	0.23	0.61	<0.40				<0.04	mg/kg	TM4/PM8
Fluoranthene #	1.14	3.32	<0.30				<0.03	mg/kg	TM4/PM8
Pyrene #	0.74	2.86	3.18				<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	0.32	1.68	<0.60				<0.06	mg/kg	TM4/PM8
Chrysene #	0.20	1.80	0.33				<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	0.40	2.98	<0.70				<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	0.25	1.52	<0.40				<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	0.12	0.96	<0.40				<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	0.16	<0.40				<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	0.13	0.94	<0.40				<0.04	mg/kg	TM4/PM8
Coronene	<0.04	0.09	<0.40				<0.04	mg/kg	TM4/PM8
PAH 6 Total #	2.04	9.72	<2.20				<0.22	mg/kg	TM4/PM8
PAH 17 Total	5.67	20.27	<6.40				<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	0.29	2.15	<0.50				<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.11	0.83	<0.20				<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	100	104	91				<0	%	TM4/PM8
Mineral Oil (C8-C40)	183	571	7065				<30	mg/kg	TM5/PM16
MTBE #	<5	<5	<5				<5	ug/kg	TM31/PM12
Benzene #	<5	18	<5 <5				<5	ug/kg ug/kg	TM31/PM12
Toluene #	7	66	9				<5		TM31/PM12
	39	107	11				<5 <5	ug/kg	TM31/PM12
Ethylbenzene # m/p-Xylene #	135	275	8				<5 <5	ug/kg ug/kg	TM31/PM12
o-Xylene #	155	95	28				<5	ug/kg	TM31/PM12
.o-Ayiene	13	95	20					ug/kg	TIVIST/T IVITZ
PCB 28 #	20	<5	<5				<5	ug/kg	TM17/PM8
PCB 52 #	<5	<5 <5	<5 <5				<5	ug/kg	TM17/PM8
PCB 101 #	<5	<5 <5	<5 <5				<5	ug/kg	TM17/PM8
PCB 101	<5 <5	<5 <5	<5 <5				<5 <5	ug/kg ug/kg	TM17/PM8
PCB 118 PCB 138 #	<5 <5	<5 <5	<5 <5				<5 <5	ug/kg ug/kg	TM17/PM8
PCB 138 PCB 153 #	<5 <5	<5 <5	<5 <5						TM17/PM8
PCB 153 PCB 180 #	<5 <5	<5 <5	<5 <5				<5 <5	ug/kg	TM17/PM8
Total 7 PCBs <sup>#</sup>	<35	<35	<35				<35	ug/kg ug/kg	TM17/PM8
Total / POBS	\33	<b>\</b> 33	<b>\</b> 33				<b>\33</b>	ug/kg	TIVIT//FIVIO
Mass of raw test portion	0.0968	-	0.1055					kg	NONE/PM17
	0.09	-	0.09					kg	NONE/PM17

Client Name: Malone O'Regan Report : Solid

Reference: E0937

**Location:** Dublin Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Contact: Eleanor Burke

JE Job No.: 12/9568 23-25 J E Sample No. 13-15 29-31 Sample ID TP2 2.9-3.0M TP3 1.15M TP4 1.45-1.55N 2.9-3.0 1.45-1.55 Please see attached notes for all abbreviations and acronyms COC No / misc Containers VJT VJT VJT Sample Date 04/12/2012 04/12/2012 04/12/2012 Sample Type Batch Number Method LOD Units Date of Receipt 06/12/2012 06/12/2012 06/12/2012 % Dry Matter 105°C 93.5 88.3 85.7 <0.1 NONE/PM4 TM21/PM24 Total Organic Carbon # 1.6 2.4 12.9 <0.2

Client Name: Malone O'Regan Report : NRA Leachate

Reference: E0937

**Location:** Dublin Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Contact: Eleanor Burke

JE Job No.: 12/9568 J E Sample No 23-25 TP3 1.15M Sample ID 1.15 Please see attached notes for all abbreviations and acronyms COC No / misc Containers VJT Sample Date 04/12/2012 Sample Type Batch Number Method ם ח Units Date of Receipt 06/12/2012 <2 ug/l TM30/PM14 Dissolved Antimony Dissolved Arsenic <2.5 <2.5 ug/l TM30/PM1 TM30/PM1 Dissolved Barium 109 <3 ug/l TM30/PM1 Dissolved Cadmium <0.5 <0.5 ug/l TM30/PM1 Dissolved Chromium <1.5 <1.5 ug/l TM30/PM1 Dissolved Copper <7 <7 ug/l TM30/PM1 Dissolved Lead <5 <5 ug/l TM30/PM1 Dissolved Molybdenum 10 <2 ug/l TM30/PM1 Dissolved Nickel 2 <2 ug/l TM30/PM1 Dissolved Selenium <3 <3 ug/l TM30/PM1 Dissolved Zinc <3 <3 ug/l TM61/PM38 0.05 Mercury Dissolved by CVAF < 0.01 ug/l TM26/PM0 < 0.01 < 0.01 mg/l Phenol TM27/PM0 < 0.3 <0.3 Fluoride mg/l TM27/PM0 Chloride 2.5 < 0.3 mg/l TM27/PM0 139.12 < 0.05 Sulphate mg/l TM60/PM0 15 <2 Dissolved Organic Carbon mg/l TM20/PM0 372 <35 mg/l Total Dissolved Solids

Client Name: Malone O'Regan Report : CEN 10:1 1 Batch

Reference: E0937

**Location:** Dublin Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Contact: Eleanor Burke

Contact.	Lication	2									
JE Job No.:	12/9568	ı	ı	ı	ı	ı	ı	1	ì		
J E Sample No.	13-15	29-31									
Sample ID	TP2 2.9-3.0M	TP4 1.45-1.55M									
Depth	2.9-3.0	1.45-1.55								e attached n	
COC No / misc									abbrevi	ations and a	cronyms
Containers	VJT	VJT									
Sample Date	04/12/2012	04/12/2012									
Sample Type	Soil	Soil									
Batch Number	1	1									Method
Date of Receipt	06/12/2012	06/12/2012							LOD	Units	No.
Dissolved Antimony (A10) #	<0.02	<0.02							<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10) #	<0.025	<0.025							<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10) #	1.00	0.31							<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005							<0.005	mg/kg	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015							<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07							<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10) #	0.05	<0.05							<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum (A10) #	0.23	0.17							<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10) #	0.17	<0.02							<0.02	mg/kg	TM30/PM17
Dissolved Selenium (A10) #	<0.03	<0.03							<0.03	mg/kg	TM30/PM17
Dissolved Zinc (A10) #	0.11	<0.03							<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	0.0001	0.0001							<0.0001	mg/kg	TM61/PM38
Fluoride	<3	<3							<3	mg/kg	TM27/PM0
Chloride	118	29							<3	mg/kg	TM27/PM0
Sulphate	7409.1	560.7							<0.5	mg/kg	TM27/PM0
Mass of raw test portion	0.0968	0.1055								kg	NONE/PM17
Leachant Volume	0.894	0.885								I	NONE/PM17
Eluate Volume	0.795	0.79								I	NONE/PM17
Dissolved Organic Carbon	190	170							<20	mg/kg	TM60/PM0
Phenol Index	37.1	7.6							<0.5	mg/kg	TM101/PM0
Total Dissolved Solids	10542	1820							<350	mg/kg	TM20/PM0
											i

		Murphy Result Report			
Mass of sample taken (kg)	0.0968	Dry Matter Content Ratio (%) =		93.5	
Mass of dry sample (kg) =	0.09	Leachant Volume (I)		0.894	
Particle Size <4mm =	>95%	Eluate Volume (I)		0.795	
JEFL Job No	<u> </u>	12/9568	Land	fill Waste Ac	ceptance
Sample No		15		Criteria Lin	nits
Client Sample No		TP2 2.9-3.0M			
Depth/Other		2.9-3.0			
Sample Date		04/12/2012	Inert	Stable Non-reactive	Hazardou
Batch No		1			
Solid Waste Analysis					
Total Organic Carbon (%)	1.6		3	5	6
Sum of BTEX (mg/kg)	0.196		6	-	-
Sum of 7 PCBs (mg/kg)	<0.035		1	-	-
Mineral Oil (mg/kg)	183		500	-	-
PAH Sum of 6 (mg/kg)	2.04		-	-	-
PAH Sum of 17 (mg/kg)	5.67		100	-	-
	10:1		Limit	values for co	ampliance
	concn			eaching test	•
Eluate Analysis	leached			12457-2 at	
	A10				
	mg/kg			mg/kg	1
Arsenic	<0.025		0.5	2	25
Barium	1.00		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	0.0001		0.01	0.2	2
Molybdenum	0.23		0.5	10	30
Nickel	0.17		0.4	10	40
	0.05		0.5	10	50
	0.05		0.00		<b>5</b>
Antimony	<0.02		0.06	0.7	5
Antimony Selenium	<0.02 <0.03		0.1	0.5	7
Antimony Selenium Zinc	<0.02 <0.03 0.11		0.1	0.5 50	7 200
Antimony Selenium Zinc Chloride	<0.02 <0.03 0.11 118		0.1 4 800	0.5 50 15000	7 200 25000
Antimony Selenium Zinc Chloride Fluoride	<0.02 <0.03 0.11 118 <3		0.1 4 800 10	0.5 50 15000 150	7 200 25000 500
Antimony Selenium Zinc Chloride Fluoride Sulphate as SO4	<0.02 <0.03 0.11 118 <3 7409.1		0.1 4 800 10 1000	0.5 50 15000 150 20000	7 200 25000 500 50000
Antimony Selenium Zinc Chloride Fluoride Sulphate as SO4 Total Dissolved Solids	<0.02 <0.03 0.11 118 <3 7409.1 10542		0.1 4 800 10 1000 4000	0.5 50 15000 150	7 200 25000 500
Lead Antimony Selenium Zinc Chloride Fluoride Sulphate as SO4 Total Dissolved Solids Phenols Monohydric Dissolved Organic Carbon	<0.02 <0.03 0.11 118 <3 7409.1		0.1 4 800 10 1000	0.5 50 15000 150 20000	7 200 25000 500 50000

Mass of sample taken (kg) Mass of dry sample (kg) = Particle Size <4mm =  JEFL Job No Sample No	0.1055 0.09 >95%	Dry Matter Content Ratio (%) = Leachant Volume (I) Eluate Volume (I)		85.7 0.885	
Particle Size <4mm =				0.885	
JEFL Job No	>95%	Fluate Volume (I)			
		Lidato Volumo (I)		0.79	
Sample No		12/9568	Land	fill Waste Ac	ceptance
		31		Criteria Lim	nits
Client Sample No		TP4 1.45-1.55M			
Depth/Other		1.45-1.55			
Sample Date		04/12/2012	Inert	Stable Non-reactive	Hazardous
Batch No		1			
Solid Waste Analysis					
Fotal Organic Carbon (%)	12.9		3	5	6
Sum of BTEX (mg/kg)	0.056		6	-	-
Sum of 7 PCBs (mg/kg)	<0.035		1	-	-
Mineral Oil (mg/kg)	7065		500	-	-
PAH Sum of 6 (mg/kg)	<2.20		-	-	-
PAH Sum of 17 (mg/kg)	<6.40		100	-	-
Eluate Analysis	10:1 concn leached		le	values for co eaching test 1 12457-2 at l	using
	mg/kg			mg/kg	
Arsenic	<0.025		0.5	2	25
Barium	0.31		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	0.0001		0.01	0.2	2
Molybdenum	0.17		0.5	10	30
Nickel	<0.02		0.4	10	40
_ead	<0.05		0.5	10	50
Antimony	<0.02		0.06	0.7	5
Selenium	< 0.03		0.1	0.5	7
Zinc	< 0.03		4	50	200
Chloride	29		800	15000	25000
Fluoride	<3		10	150	500
Sulphate as SO4	560.7		1000	20000	50000
Total Dissolved Solids	1820		4000	60000	100000
Phenols Monohydric	7.6		1	-	-
Dissolved Organic Carbon	170		500	800	1000

#### NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

**JE Job No.:** 12/9568

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Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

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As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

#### **DEVIATING SAMPLES**

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

#### **SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

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### **ABBREVIATIONS and ACRONYMS USED**

#	UKAS accredited.
В	Indicates analyte found in associated method blank.
DR	Dilution required.
М	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
СО	Suspected carry over
NFD	No Fibres Detected

**JE Job No** 12/9568

Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Solid Results expressed on Dry/Wet basis
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction			AR	DRY
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction	Yes		AR	DRY
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction			AR	
TM5	EPH by GC-FID, modified USEPA 8015	PM16	Aliphatic/Aromatic fractionation			AR	DRY
TM17	PCB 7 Congeners and WHO 12 PCBs by GC-MS	PM8	End Over End extraction	Yes		AR	DRY
TM20	TDS, TSS and TS - gravimetric	PM0	No Preparation			AR	DRY
TM20	TDS, TSS and TS - gravimetric	PM0	No Preparation			AR	WET
TM21	TOC and TC by Combustion	PM24	Eltra preparation	Yes		AD	DRY
TM26	PhenoIs by HPLC	PM0	No Preparation			AR	WET
TM27	SO4,CI,NO3,NO2,F,PO4 by Dionex	PM0	No Preparation			AR	DRY
TM27	SO4,CI,NO3,NO2,F,PO4 by Dionex	PM0	No Preparation			AR	WET
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)			AR	WET
TM30	Metals by ICP-OES	PM17	CEN PR12457-2 10:1 1 batch leach	Yes		AR	DRY
TM31	BTEX/MTBE by GC-FID, modified USEPA 8015	PM12	GRO GC-FID			AR	DRY
TM31	BTEX/MTBE by GC-FID, modified USEPA 8015	PM12	GRO GC-FID	Yes		AR	DRY
TM60	TOC/DOC by NDIR	PM0	No Preparation			AR	DRY
TM60	TOC/DOC by NDIR	PM0	No Preparation			AR	WET
TM61	Mercury - low level CVAF	PM38	Mercury CVAF	Yes		AR	DRY
TM61	Mercury - low level CVAF	PM38	Mercury CVAF			AR	WET
TM101	Phenol Index 4-aminoantipyrine spectrophotometric	PM0	No Preparation			AR	DRY
NONE	No Method Code	PM17	CEN PR12457-2 10:1 1 batch leach				
NONE	No Method Code	PM17	CEN PR12457-2 10:1 1 batch leach			AR	
NONE	No Method Code	PM4	Moisture Content			AR	



Unit 3 Deeside Point

Zone 3

Deeside Industrial Park

Deeside CH5 2UA

Malone O'Regan 2b Richview Office Park Clonskeagh Dublin 14 Ireland

Tel: +44 (0) 1244 833780 Fax: +44 (0) 1244 833781





No.4225

Attention: Eleanor Burke

Date: 19th December, 2012

Your reference : E0937

Our reference : Test Report 12/9571 Batch 1

**Location :** Waterstown

**Date samples received :** 6th December, 2012

Status: Final report

Issue:

Four samples were received for analysis on 6th December, 2012. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Bruce Leslie

**Project Co-ordinator** 

Bob Millward B.Sc Principal Chemist

Rjuiellward

Client Name: Malone O'Regan Report : Solid

E0937 Reference:

Location: Waterstown Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Eleanor Burke Contact:

JE Job No.:	12/9571									
J E Sample No.	1-3									
Sample ID	TP5 1.2-1.3									
Depth	1.2-1.3									
_									e attached n ations and a	
COC No / misc										•
Containers	VJT									
Sample Date	05/12/2012									
Sample Type	Soil									
Batch Number	1									Method
Date of Receipt	06/12/2012							LOD	Units	No.
PAH MS										
Naphthalene #	0.08							<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03							<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05							<0.05	mg/kg	TM4/PM8
Fluorene #	0.08							<0.04	mg/kg	TM4/PM8
Phenanthrene #	0.30							<0.03	mg/kg	TM4/PM8
Anthracene #	0.05							<0.04	mg/kg	TM4/PM8
Fluoranthene #	0.40							<0.03	mg/kg	TM4/PM8
Pyrene #	0.32							<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	0.20							<0.06	mg/kg	TM4/PM8
Chrysene #	0.22							<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	0.39							<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	0.17							<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	0.15							<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04							<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	0.16							<0.04	mg/kg	TM4/PM8
Coronene PAH 6 Total #	<0.04							<0.04 <0.22	mg/kg	TM4/PM8 TM4/PM8
	2.52							<0.22	mg/kg mg/kg	TM4/PM8
PAH 17 Total  Benzo(b)fluoranthene	0.28							<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.11							<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	98							<0	%	TM4/PM8
7 The Carrogate 75 Thooders										
Mineral Oil (C8-C40)	331							<30	mg/kg	TM5/PM16
,										
MTBE #	<5							<5	ug/kg	TM31/PM12
Benzene #	<5							<5	ug/kg	TM31/PM12
Toluene #	11							<5	ug/kg	TM31/PM12
Ethylbenzene #	11							<5	ug/kg	TM31/PM12
m/p-Xylene #	22							<5	ug/kg	TM31/PM12
o-Xylene <sup>#</sup>	13							<5	ug/kg	TM31/PM12
#										
PCB 28 #	9							<5	ug/kg	TM17/PM8
PCB 52 #	<5							<5	ug/kg	TM17/PM8
PCB 101 #	<5 <5							<5 <5	ug/kg	TM17/PM8
PCB 118 #	<5 <5							<5 -5	ug/kg	TM17/PM8 TM17/PM8
PCB 138 <sup>#</sup> PCB 153 <sup>#</sup>	<5 <5							<5 <5	ug/kg ug/kg	TM17/PM8
PCB 180 <sup>#</sup>	<5 <5							<5 <5	ug/kg ug/kg	TM17/PM8
Total 7 PCBs #	<35							<35	ug/kg	TM17/PM8
									. 5.13	
% Dry Matter 105°C	87.0							<0.1	%	NONE/PM4
Total Organic Carbon #	2.4							<0.2	%	TM21/PM24
	2.7	l .	l .	l .	l .	l .	l .	<b>70.2</b>	70	

Client Name: Malone O'Regan Report: NRA Leachate

Reference: E0937

Location: Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Contact: Eleanor Burke

	Eleanor E	surke							
JE Job No.:	12/9571								
J E Sample No.	1-3								
Sample ID	TP5 1.2-1.3								
Depth	1.2-1.3						Please se	e attached r	otes for all
COC No / misc								ations and a	
Containers	VJT								
Sample Date	05/12/2012								
Sample Type	Soil								
Batch Number	1						LOD	Units	Method
Date of Receipt	06/12/2012						LOD	Units	No.
Dissolved Antimony	<2						<2	ug/l	TM30/PM14
Dissolved Arsenic	<2.5						<2.5	ug/l	TM30/PM14
Dissolved Barium	63						<3	ug/l	TM30/PM14
Dissolved Cadmium	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Chromium	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Copper	<7						<7	ug/l	TM30/PM14
Dissolved Lead	<5						<5	ug/l	TM30/PM14
Dissolved Molybdenum	13						<2	ug/l	TM30/PM14
Dissolved Nickel	3						<2	ug/l	TM30/PM14
Dissolved Selenium	<3						<3	ug/l	TM30/PM14
Dissolved Zinc	<3						<3	ug/l	TM30/PM14
Mercury Dissolved by CVAF	0.81						<0.01	ug/l	TM61/PM38
Phenol	<0.01						<0.01	mg/l	TM26/PM0
Fluoride	0.5						<0.3	mg/l	TM27/PM0
Chloride	0.5						<0.3	mg/l	TM27/PM0
Sulphate	4.01						<0.05	mg/l	TM27/PM0
Dissolved Organic Carbon	9						<2	mg/l	TM60/PM0
Total Dissolved Solids	130						<35	mg/l	TM20/PM0
Total Dissolved Solids							100	9	111120/11110

#### NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

**JE Job No.:** 12/9571

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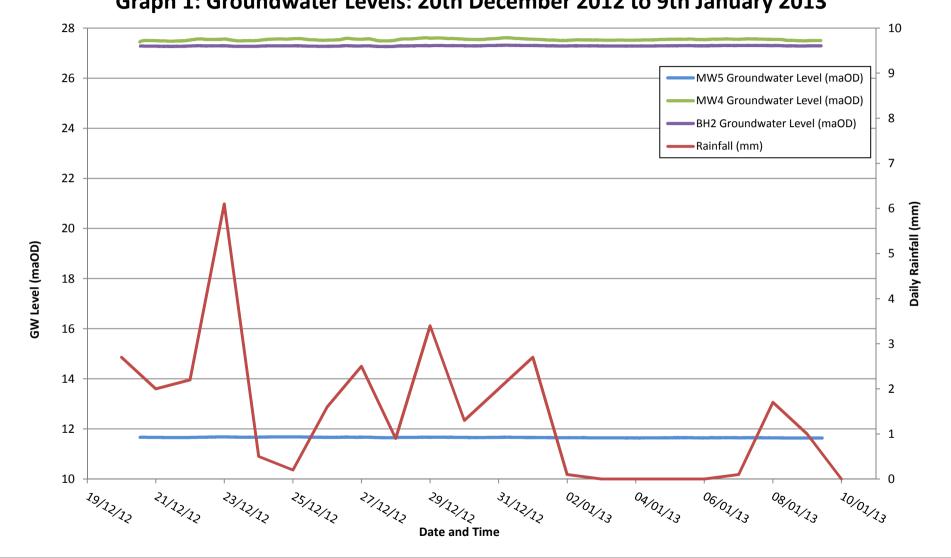
### **ABBREVIATIONS and ACRONYMS USED**

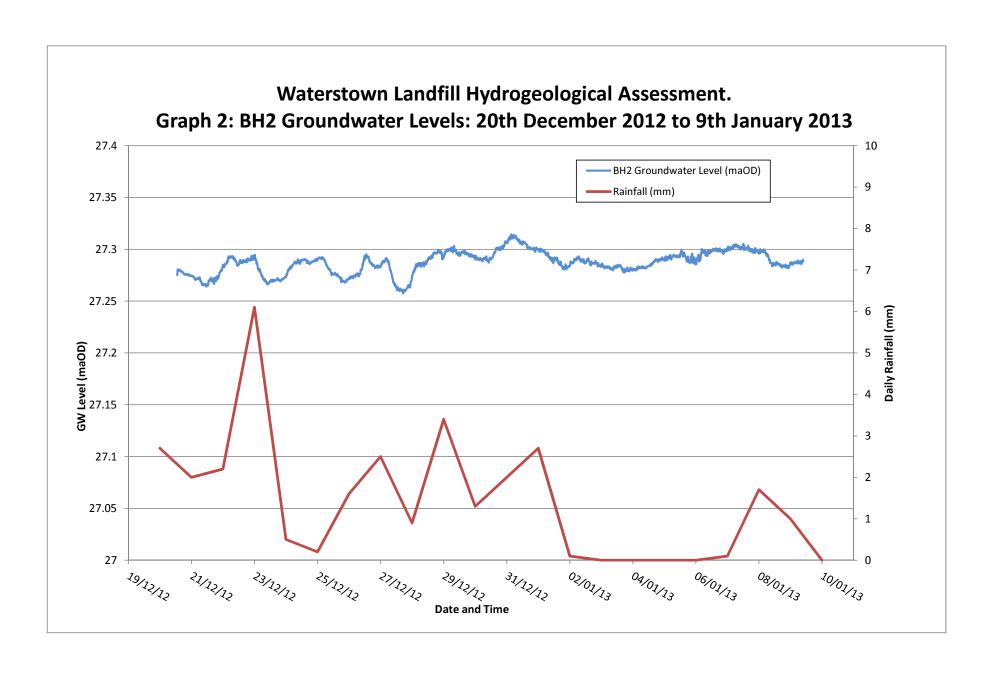
	,
#	UKAS accredited.
В	Indicates analyte found in associated method blank.
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ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
CO	Suspected carry over
NFD	No Fibres Detected

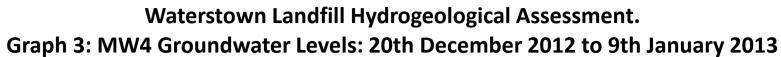
**JE Job No** 12/9571

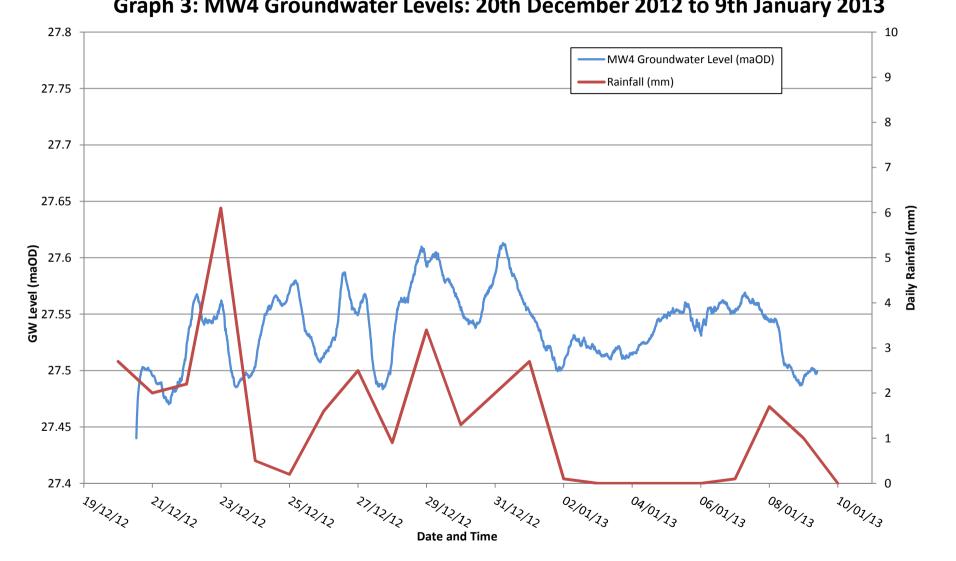
JE JOD NO	12/95/1						
Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Solid Results expressed on Dry/Wet basis
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction			AR	DRY
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction	Yes		AR	DRY
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction			AR	
TM5	EPH by GC-FID, modified USEPA 8015	PM16	Aliphatic/Aromatic fractionation			AR	DRY
TM17	PCB 7 Congeners and WHO 12 PCBs by GC-MS	PM8	End Over End extraction	Yes		AR	DRY
TM20	TDS, TSS and TS - gravimetric	PM0	No Preparation			AR	WET
TM21	TOC and TC by Combustion	PM24	Eltra preparation	Yes		AD	DRY
TM26	Phenols by HPLC	PM0	No Preparation			AR	WET
TM27	SO4,CI,NO3,NO2,F,PO4 by Dionex	PM0	No Preparation			AR	WET
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)			AR	WET
TM31	BTEX/MTBE by GC-FID, modified USEPA 8015	PM12	GRO GC-FID			AR	DRY
TM31	BTEX/MTBE by GC-FID, modified USEPA 8015	PM12	GRO GC-FID	Yes		AR	DRY
TM60	TOC/DOC by NDIR	PM0	No Preparation			AR	WET
TM61	Mercury - low level CVAF	PM38	Mercury CVAF			AR	WET
NONE	No Method Code	PM4	Moisture Content			AR	

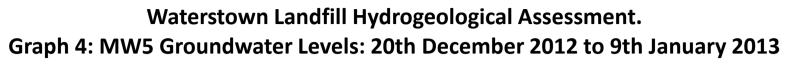


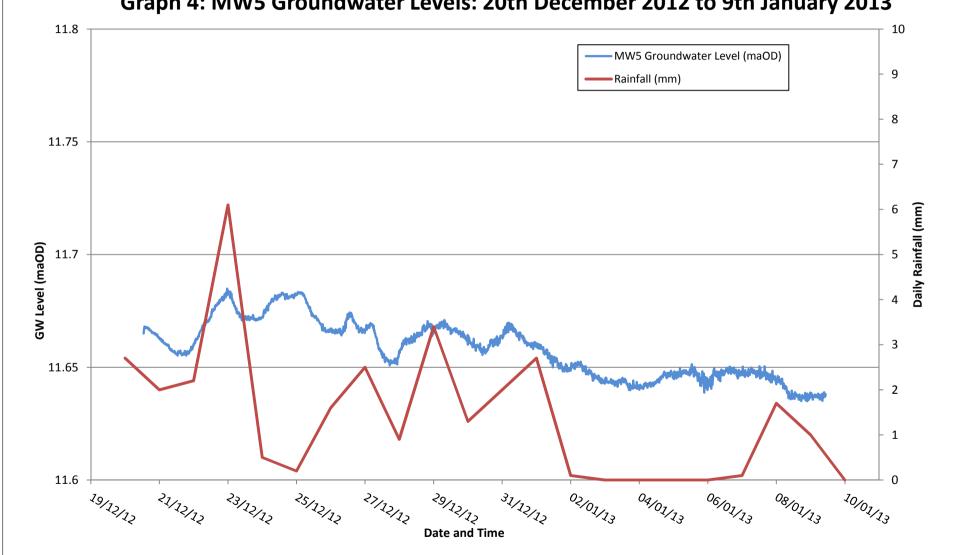












CHAIN OF CUSTODY					0.00			
CLIENT: Malace O' learn	If Electronic File Re	equired	SAMPLER:	0	13 / 1	1-0.	, ,	Jones
ADDRESS: 28 Oid VIOW OFFICE Park	please select file for below	ormat	MOBILE:	76	Jelst,	16/40	Gell	Environmental Laboration
Clarificad Dull 14	EQUIS		THE RESERVE OF THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS NAMED IN COLUMN TW	ODT TO	870 7	8375	-64	Laboratory
PROJECT MANAGER (PM):			EMAIL REPO	William Colors	1 W Cal	34 00	morce.ie	
MOBILE: 01 260 2655	Burlee CROSSTAB		cc REPORT	T. 12 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	e 64	rkel	c) morce ie	-
	CLIENT		INVOICE TO					
	AGS (please also fill in AGS SAMP_TYPE &		QUOTE NUM	-	3846	(W) P.ON		Chain of Custody sheet page of
	SAMP_REF below)			ANAL	SIS REQUIRE	D including St	JITE names	1
samples to be	RATORY USE ONLY		Asbestos					<u>SOILS</u> -We are MCERTS accredited for samples predominantly made up of sand,
settled	COOL BOX TEMP.(if required):		risk					loam and clay (no other matrices). Please
5 DAY 3 DAY SAMPLE RI	ECIEPT CONDITION:	3 4 (1)			100			request an MCERTS report if required.  WATERS - we are accredited for surface
MATRIX:- S=Soil, GW=GroundWater, SW=SurfaceWater, L/E=Leachate/Effluent,	OW=OtherWater, P=Product/Oil)		_ M					and groundwaters (leachates and effluents
Sample ID Shaken Settled S/GW/SW /L/E/OW/F		Preserv ation	Low Medium High					are accredited for some tests, please see UKAS schedule). Please tick whether analysis is required on settled or shaken
5 W 1 SW	12-12-12							*0 - 1
5 U 2 SW	12.12-12	100						Garanetes
S W 53 SW	12-12-12							for Anchisis
CDU	120-12		2 31					will se sent
503 56	12-12-12		13 (4)					en Jaler.
5 W 5 SW	1200	1149						
	10101							
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RELINQUISHED BY:			RECIEVED B	Y:				METHOD of SHIPMENT
Name: Y W at 1	Date:		Name:				Date:	Consignment note No:
dealth & Safety instructions including known hazards (eg suspected asbestos). Please let us k	Time:		Of:	ad marild- D	D and disc. 16	.11.1.1.	Time:	Courier Company:
1-3 - 1-1-1-1-1 assettes), i i dasa let us i		ateu, nign	r Ans expect	eu, provide P	readings if av	allable		

CHAIN OF CUSTODY															
CLIENT: Malone O'Pegan	If Electronic File R	COLUMN TOWNS TO SERVICE TO SERVIC	SAMI	PLER:	? w	salsh/	5. A	llen		FISH S					Jones
ADDRESS: 2B Richview Office Park, (lons wagh	please select file f below	format				02655					Y-N		uri di		Laboratory
Dablin 14	EQUIS	A ENLE	EMA	IL REPO	RT TO	Ebu	-lee 1	e m	صرو	116		M			
PROJECT MANAGER (PM): Eleanor Burke	CROSSTAB	Burn	cc RE	EPORT	0:	CMC	ron	ath	(@m	rce			100	100	
MOBILE: 01 2602655	CLIENT					erent to repo	40113								
PROJECT ID: FO37	AGS (please also fill	in	QUO	TE NUM	BER:		Wild I	Y	P.O N	lo:			V. F.	2014	
SITE: £.0937	AGS SAMP_TYPE & SAMP_REF below)	ž.			1	NALYSIS F	EQUIR	ED inclu	ding SU	IITE na	mes				Chain of Custody sheet page of
TURNAROUND - please tick All waters - tick for FOR LABORATORY USE	ONLY														SOILS -We are MCERTS accredited for
10 DAY 4 DAY Other samples to be tested shaken or AVERAGE COOL BOX TE	MP (if required):		100000000000000000000000000000000000000	pestos risk	14	10 TO									samples predominantly made up of sand, loam and clay (no other matrices). Please
5 DAY 3 DAY settled SAMPLE RECIEPT COND			1	ISK											request an MCERTS report if required.
MATRIX:- S=Soil, GW=GroundWater, SW=SurfaceWater, L/E=Leachate/Effluent, OW=Other		No.													WATERS - we are accredited for surface and groundwaters (leachates and effluents
Sample ID Shaken Settled S/GW/SW /L/E/OW/P Date	Time Depth in Metres	Preserv	High	Low				Pale				186			are accredited for some tests, please see UKAS schedule). Please tick whether analysis is required on settled or shaken
B H 2 1 13-12	2	N Selle													
00000+6 C-W 13-D-	2	1200													
MW5 CW 13-12-	2					300									
MW4 GW 13-12	(2														
										10 0					
										6		14			
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															<b>中华学院</b> (1) 12 12 15 16 17 12 16 17
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RELINQUISHED BY:			REC	IEVED E	Y:	NL	7								METHOD of SHIPMENT
Name: Patrick Walsh	Date: 3	12/12	Nam	e:		11				Dat	e:				Consignment note No:
of: Malone o'Regan	Time:		Of:		1	/				Tim	ne:	111			Courier Company:
Health & Safety instructions including known hazards (eg suspected asbestos). Please let us know if sam	oles are heavily contami	inated, Hig	gh PAH	Hs expec	ed, pro	vide PID rea	dings if	available							

CHAIN	10	F	CU	ST	0	DY										为国际																						
CLIENT:	Mo	do	50	e	T. A	0	Pe	40	ne					134	Maria.			ronic File Re		SA	AMPI	FR.	2.6	50	Sh	1:	5.1	114	00									Jones
ADDRESS	3: )	F	3	R	do	wie	20	K	86	-Cic	08	laru		4			please : below	select file for	rmat						26	-					911		197	H.T.				Environmental Laboratory
CI	on.	31	va	a	h	N. Y.	0	w	tion								EQUIS								E				3 6	200	((0	1.	9					
PROJECT	MAN	NAG	ER	(PM	:	EL	ec	476	- E	35	lee						CROSS	STAB		СС	REF	PORT	TO:	P	w	NS	h	0	NO	-10	· iv	2			145	4		
MOBILE:	0	(	21	50	26	5	5						14-14				CLIENT	г				100000			ent to	010												
PROJECT	ID:		E	39	37	)												lease also fill in		QI	JOTI	E NUI	ИВЕ	R:			Tan		14.17	P.0	O No:		18	AL.	File			
SITE:	FC	99	139	P							16.74							AMP_TYPE & _REF below)			100		M	AN	IALYS	SIS R	REQU	IRED	inclu	ıding	SUIT	E na	mes				7010	Chain of Custody sheet page of
TURNARO	DUNE	) - p	oleas	se tie	k			Ti.						or FO	R LABOR	ATORY USE ONLY	Y															-						SOILS -We are MCERTS accredited for
10 DAY			41	DAY					Other		163		les to be shaken or	AV	/ERAGE CO	OOL BOX TEMP.(if	f required)			A	sbe ris	stos																samples predominantly made up of sand, loam and clay (no other matrices). Please
5 DAY			31	DAY				1				se	ettled			CIEPT CONDITION					113	or.									10							request an MCERTS report if required.
	MAT	TRIX	(:- S	=Soi	I, G	W=G	roun	dWa	ter, SI	N=Sur	rfaceW	ater, L/E	=Leach	_	_	OW=OtherWater		oduct/Oil)		1			1															WATERS - we are accredited for surface and groundwaters (leachates and effluents
				5	Samp	ole ID						Shaken	Settle		/GW/SW /E/OW/P	Date	Time	Depth in Metres	Prese		Medium	Low							X									are accredited for some tests, please see UKAS schedule). Please tick whether analysis is required on settled or shaken
MW	6						7								GW			Parent I																				
											19					MITHIE						7																
																															4	1		The state of				
			10															Market All																				
S Wall																														1				1				
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	1.3																																					
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14																																						
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16										4	14.0					1401				_	(8)			1	1	1	9											
RELINQU				1		6-1					7 150	200								_	_	VED	BY:	1	1	1			-									METHOD of SHIPMENT
Name:		_				_						500		List.	CONTRACTOR OF THE PARTY OF THE			Date: BID	2/12	-	me:	1	47.0	11		90				401		Date		REC.		VIR		Consignment note No:
	Ma	_	_	_	_													Time:	Sec.	Of	_			V								Tim	e:		1			Courier Company:
Health & Sa	rety i	ınstı	ructi	ons	nclu	iding	kno	wn h	azards	(eg s	suspect	ted asbes	tos). Pl	ease	let us kn	now if samples a	are heavi	ily contamina	ated, F	ligh P	AHs	expec	ted,	, provi	de PID	) read	dings	if ava	ilable									



Unit 3 Deeside Point

Zone 3

Deeside Industrial Park

Deeside CH5 2UA

Malone O'Regan 2b Richview Office Park Clonskeagh Dublin 14 Ireland

Tel: +44 (0) 1244 833780 Fax: +44 (0) 1244 833781





Rjuiellward

Eleanor Burke Attention:

Date: 3rd January, 2013

Your reference: E0937

Test Report 12/9793 Batch 1 Our reference:

E0937 Location:

Date samples received : 13th December, 2012

Status: Final report

Issue:

Six samples were received for analysis on 13th December, 2012. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

**Phil Sommerton B.Sc** 

**Bob Millward B.Sc Project Manager Principal Chemist** 

Client Name: Malone O'Regan Report : Liquid

Reference: E0937 Location: E0937

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.:	12/9793					H=H <sub>2</sub> SO <sub>4</sub> , 2		-giass botti HN∩-	-, - р.ш		
J E Sample No.	1-8	9-16	33-40	41-48		11=112004, 2	 14011, 1114	111103	Ì		
Sample ID	SW1	SW2	SW5	SW6							
Depth									Please se	e attached r	otes for all
COC No / misc									abbrevi	ations and a	cronyms
Containers	V H N P BOD G										
Sample Date											
Sample Type	Surface Water	Surface Water	Surface Water	Surface Water							
Batch Number	1	1	1	1						Units	Method
Date of Receipt	13/12/2012	13/12/2012	13/12/2012	13/12/2012					LOD	Units	No.
Dissolved Arsenic #	-	-	5.8	4.2					<2.5	ug/l	TM30/PM14
Dissolved Boron	-	-	16	<12					<12	ug/l	TM30/PM14
Dissolved Cadmium #	-	-	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Calcium #	-	-	81.5	70.2					<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	-	-	8.4	8.6					<1.5	ug/l	TM30/PM14
Dissolved Copper #	-	-	<7	<7					<7	ug/l	TM30/PM14
Total Dissolved Iron #	-	-	84	53					<20	ug/l	TM30/PM14
Dissolved Lead #	-	-	7	6					<5	ug/l	TM30/PM14
Dissolved Magnesium #	-	-	6.8	5.8					<0.1	mg/l	TM30/PM14
Dissolved Manganese #	-	-	3	4					<2	ug/l	TM30/PM14
Dissolved Mercury #	-	-	<1	<1					<1	ug/l	TM30/PM14
Dissolved Nickel #	-	-	<2	<2					<2	ug/l	TM30/PM14
Dissolved Potassium #	1.8	2.0	2.0	1.6					<0.1	mg/l	TM30/PM14
Dissolved Sodium #	11.6	11.1	12.1	9.9					<0.1	mg/l	TM30/PM14
Dissolved Zinc #	-	-	<3	<3					<3	ug/l	TM30/PM14
MRP as Total Phosphorus	-	-	69	39					<5	ug/l	TM30/PM14
#				_							
Methyl Tertiary Butyl Ether #	-	-	<1	<1					<1	ug/l	TM15/PM10
Benzene # Toluene #	-	-	<1	<1					<1	ug/l	TM15/PM10 TM15/PM10
Ethylbenzene #	-	-	<2 <2	<2 <2					<2 <2	ug/l	TM15/PM10
p/m-Xylene #	-	-	<3	<3					<3	ug/l ug/l	TM15/PM10
o-Xylene #	-	-	<2	<2					<2	ug/l	TM15/PM10
Surrogate Recovery Toluene D8		-	103	103					<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	-	-	118	114					<0	%	TM15/PM10
Surrogate Necovery 4-Distribution Delizarie											

Client Name: Malone O'Regan Report : Liquid

E0937 Reference: Location: E0937

Eleanor Burke Contact: Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.:	12/9793					H=H <sub>2</sub> SO <sub>4</sub> , 2	Z=ZnAc, N=	NaOH, HN=	HN0 <sub>3</sub>			
J E Sample No.	1-8	9-16	33-40	41-48								
Sample ID	SW1	SW2	SW5	SW6								
Depth										Please se	e attached n	notes for all
COC No / misc											ations and a	
	V H N P BOD G	V H N P BOD G	V H N P ROD G	V H N P BOD G								
Sample Date												
Sample Type	Surface Water	Surface Water	Surface Water	Surface Water							r	
Batch Number	1	1	1	1						LOD	Units	Method
Date of Receipt	13/12/2012	13/12/2012	13/12/2012	13/12/2012						101	<b>5</b>	No.
Pesticides MS												
Organochlorine Pesticides												
Aldrin	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Alpha-BHC	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Beta-BHC	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Chlorothalonil	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
cis-Chlordane	-	-	<0.01 <0.01	<0.01 <0.01						<0.01	ug/l	TM42/PM30 TM42/PM30
Dieldrin	-	-	<0.01	<0.01						<0.01	ug/l ug/l	TM42/PM30
Endosulphan I		-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Endosulphan II Endosulphan sulphate	-	_	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Endrin	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Gamma-BHC	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Heptachlor	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Heptachlor Epoxide	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Hexachlorobenzene	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Isodrin	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
o,p'-DDE	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
o,p'-DDT	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
o,p'-Methoxychlor	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
o,p'-TDE	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
p,p'-DDE	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
p,p'-DDT	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
p,p'-Methoxychlor	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
p,p'-TDE	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Pendimethalin	-	-	<0.01	<0.01 <0.01						<0.01	ug/l	TM42/PM30 TM42/PM30
Permethrin I		-	<0.01 <0.01	<0.01						<0.01 <0.01	ug/l ug/l	TM42/PM30
Permethrin II  Quintozene	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Tecnazene	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Telodrin	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
trans-Chlordane	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Triadimefon	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Triallate	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Trifluralin	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
												ļ
											l	

Client Name: Malone O'Regan Report : Liquid

E0937 Reference: Location: E0937

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.:	12/9793					H=H <sub>2</sub> SO <sub>4</sub> , 2	Z=ZnAc, N=	NaOH, HN=	:HN0 <sub>3</sub>	•		
J E Sample No.	1-8	9-16	33-40	41-48								
Sample ID	SW1	SW2	SW5	SW6								
Depth										5.		
COC No / misc											e attached n ations and a	
Containers	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G								
Sample Date	12/12/2012	12/12/2012	12/12/2012	12/12/2012								
Sample Type	Surface Water	Surface Water	Surface Water	Surface Water								
Batch Number	1	1	1	1								Method
Date of Receipt	13/12/2012	13/12/2012	13/12/2012	13/12/2012						LOD	Units	No.
Pesticides MS												
Organophosphorus Pesticides												
Azinphos ethyl	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Azinphos methyl	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Carbophenothion	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Chlorfenvinphos	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Chlorpyrifos	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Chlorpyrifos-methyl	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Diazinon	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Dichlorvos	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Dimethoate	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Ethion	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Ethyl Parathion (Parathion)	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Etrimphos	-	-	<0.01 <0.01	<0.01 <0.01						<0.01	ug/l	TM42/PM30 TM42/PM30
Fenitrothion	-	-	<0.01	<0.01						<0.01	ug/l ug/l	TM42/PM30
Fenthion Malathian		_	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Malathion  Methyl Parathion	_	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Mevinphos	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Phosalone	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Pirimiphos Methyl	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Propetamphos	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Triazophos	-	-	<0.01	<0.01						<0.01	ug/l	TM42/PM30
·												
Benazolin	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Bentazone	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Bromoxynil	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Clopyralid	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
4- CPA	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
2,4 – D	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
2,4 –DB	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Dicamba	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Dichloroprop	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Diclofop	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Fenoprop	-	-	<0.1 <0.1	<0.1 <0.1						<0.1 <0.1	ug/l ug/l	TM16/PM30 TM16/PM30
Flamprop	-	<u>-</u>	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Flamprop – isopropyl loxynil	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
MCPA	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
MCPB	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Mecoprop	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Picloram	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Pentachlorophenol	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30
2,4,5 – T	-	-	<0.1	<0.1						<0.1	ug/l	TM16/PM30

Client Name: Malone O'Regan Report : Liquid

E0937 Reference: Location: E0937

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.:	12/9793				 	H=H <sub>2</sub> SO <sub>4</sub> , Z	Z=ZnAc, N=	NaOH, HN=	HN0 <sub>3</sub>	•		
J E Sample No.	1-8	9-16	33-40	41-48								
Sample ID	SW1	SW2	SW5	SW6								
Depth										Please se	e attached n	otes for all
COC No / misc											ations and a	
Containers	V H N P BOD G											
Sample Date												
Sample Type												
Batch Number	1	1	1	1						LOD	Units	Method No.
Date of Receipt												
2,3,6 – TBA	-	-	<0.1 <0.1	<0.1 <0.1						<0.1 <0.1	ug/l ug/l	TM16/PM30 TM16/PM30
Triclopyr	-	-	<b>V</b> 0.1	<b>V</b> 0.1						<b>VO.1</b>	ug/i	TWTO/FW30
Atrazine	-	-	<1	<1						<1	ug/l	TM39/PM30
Simazine	-	-	<1	<1						<1	ug/l	TM39/PM30
EPH (C8-C40) #	-	-	<10	<10						<10	ug/l	TM5/PM30
Elwarida	-	-	<0.3	<0.3						<0.3	mg/l	TM27/PM0
Fluoride	-	-	۷۰.۵	<0.3						₹0.3	mg/I	TIVIZ//FIVIU
Sulphate #	16.70	17.34	15.78	13.14						<0.05	mg/l	TM38/PM0
Chloride #	16.5	16.6	17.1	13.9						<0.3	mg/l	TM38/PM0
Total Oxidised Nitrogen as N #	-	-	1.7	1.6						<0.2	mg/l	TM38/PM0
#												T1 400 / T1 40
Total Cyanide #	-	-	<0.01	<0.01						<0.01	mg/l	TM89/PM0
Ammoniacal Nitrogen as N #	0.05	0.05	0.09	0.05						<0.03	mg/l	TM38/PM0
Total Alkalinity as CaCO3 #	-	-	220	200						<1	mg/l	TM75/PM0
4												
BOD (Settled) #	<1	1 -	2 <7	1 <7						<1 <7	mg/l	TM58/PM0 TM57/PM0
COD (Settled) Total Suspended Solids	-	-	<10	<10						<10	mg/l mg/l	TM37/PM0
Total ousperided dollas			-	-						-		

Client Name: SVOC Report : Liquid

**Reference:** E0937 **Location:** E0937

Contact: Eleanor Burke

JE Job No.:	12/9793							_		
J E Sample No.	33-40	41-48								
Sample ID	SW5	SW6								
Depth									e attached n	
COC No / misc								abbrevi	ations and a	cronyms
Containers	V H N P BOD G	V H N P BOD G								
Sample Date										
Sample Type		Surface Water								
Batch Number	1	1						LOD	Units	Method
Date of Receipt	13/12/2012	13/12/2012								No.
SVOC MS										
Phenols	4.0	4.0								
2-Chlorophenol	<10	<10						<10	ug/l	TM16/PM30
2-Methylphenol	<10	<10						<10	ug/l	TM16/PM30
2-Nitrophenol	<10	<10						<10	ug/l	TM16/PM30
2,4-Dichlorophenol	<10	<10						<10	ug/l	TM16/PM30 TM16/PM30
2,4-Dimethylphenol	<10	<10						<10	ug/l	TM16/PM30
2,4,5-Trichlorophenol	<10 <10	<10 <10						<10 <10	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<10	<10						<10	ug/l	TM16/PM30
4-Chloro-3-methylphenol	<10	<10						<10	ug/l ug/l	TM16/PM30
4-Methylphenol	<10	<10						<10	ug/l	TM16/PM30
4-Nitrophenol Pentachlorophenol	<10	<10						<10	ug/l	TM16/PM30
Phenol	<10	<10						<10	ug/l	TM16/PM30
PAHs	-10	-10						-10	~g/1	
2-Chloronaphthalene	<10	<10						<10	ug/l	TM16/PM30
2-Methylnaphthalene	<10	<10						<10	ug/l	TM16/PM30
Naphthalene	<10	<10						<10	ug/l	TM16/PM30
Acenaphthylene	<10	<10						<10	ug/l	TM16/PM30
Acenaphthene	<10	<10						<10	ug/l	TM16/PM30
Fluorene	<10	<10						<10	ug/l	TM16/PM30
Phenanthrene	<10	<10						<10	ug/l	TM16/PM30
Anthracene	<10	<10						<10	ug/l	TM16/PM30
Fluoranthene	<10	<10						<10	ug/l	TM16/PM30
Pyrene	<10	<10						<10	ug/l	TM16/PM30
Benzo(a)anthracene	<10	<10						<10	ug/l	TM16/PM30
Chrysene	<10	<10						<10	ug/l	TM16/PM30
Benzo(bk)fluoranthene	<10	<10						<10	ug/l	TM16/PM30
Benzo(a)pyrene	<10	<10						<10	ug/l	TM16/PM30
Indeno(123cd)pyrene	<10	<10						<10	ug/l	TM16/PM30
Dibenzo(ah)anthracene	<10	<10						<10	ug/l	TM16/PM30
Benzo(ghi)perylene	<10	<10						<10	ug/l	TM16/PM30
Phthalates										
Bis(2-ethylhexyl) phthalate	<10	<10						<10	ug/l	TM16/PM30
Butylbenzyl phthalate	<10	<10						<10	ug/l	TM16/PM30
Di-n-butyl phthalate	<10	<10						<10	ug/l	TM16/PM30
Di-n-Octyl phthalate	<10	<10						<10	ug/l	TM16/PM30
Diethyl phthalate	<10	<10						<10	ug/l	TM16/PM30
Dimethyl phthalate	<10	<10						<10	ug/l	TM16/PM30
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Client Name: SVOC Report : Liquid

 Reference:
 E0937

 Location:
 E0937

Contact: Eleanor Burke

JE Job No.:	12/9793								
J E Sample No.	33-40	41-48							
Sample ID		SW6							
Depth							Diagra co	e attached n	otos for all
								e allached h ations and a	
COC No / misc							abbievii	allono ana a	Ji Oriyinio
Containers		V H N P BOD G							
Sample Date									
Sample Type	Surface Water	Surface Water							
Batch Number	1	1							Method
Date of Receipt		13/12/2012					LOD	Units	No.
	10/12/2012	10/12/2012							
SVOC MS									
Other SVOCs									
1,2-Dichlorobenzene	<10	<10					<10	ug/l	TM16/PM30
1,2,4-Trichlorobenzene	<10	<10					<10	ug/l	TM16/PM30
1,3-Dichlorobenzene	<10	<10					<10	ug/l	TM16/PM30
1,4-Dichlorobenzene	<10	<10					<10	ug/l	TM16/PM30
2-Nitroaniline	<10	<10					<10	ug/l	TM16/PM30
2,4-Dinitrotoluene	<10	<10					<10	ug/l	TM16/PM30
									TM16/PM30
2,6-Dinitrotoluene	<10	<10					<10	ug/l	
3-Nitroaniline	<10	<10					<10	ug/l	TM16/PM30
4-Bromophenylphenylether	<10	<10					<10	ug/l	TM16/PM30
4-Chloroaniline	<10	<10					<10	ug/l	TM16/PM30
4-Chlorophenylphenylether	<10	<10					<10	ug/l	TM16/PM30
4-Nitroaniline	<10	<10					<10	ug/l	TM16/PM30
Azobenzene	<10	<10					<10	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane	<10	<10					<10	ug/l	TM16/PM30
	<10	<10					<10		TM16/PM30
Bis(2-chloroethyl)ether								ug/l	į.
Carbazole	<10	<10					<10	ug/l	TM16/PM30
Dibenzofuran	<10	<10					<10	ug/l	TM16/PM30
Hexachlorobenzene	<10	<10					<10	ug/l	TM16/PM30
Hexachlorobutadiene	<10	<10					<10	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<10	<10					<10	ug/l	TM16/PM30
Hexachloroethane	<10	<10					<10	ug/l	TM16/PM30
	<10	<10					<10	ug/l	TM16/PM30
Isophorone									
N-nitrosodi-n-propylamine	<10	<10					<10	ug/l	TM16/PM30
Nitrobenzene	<10	<10					<10	ug/l	TM16/PM30
									l l
									1

Client Name: Malone O'Regan VOC Report : Liquid

E0937 Reference: Location: E0937

Contact: Eleanor Burke

JE Job No.: J E Sample No.	12/9793 33-40	41-48										
Sample ID	SW5	SW6										
Sample ID Depth	3449	SVVO								Diagon or	ee attached r	notes for all
COC No / misc											iations and a	
Containers	VHNDBODG	V H N P BOD G										, ,
Sample Date												
-		Surface Water										
Batch Number	1	1										Method
Date of Receipt		13/12/2012								LOD	Units	No.
VOC MS	13/12/2012	13/12/2012										
Dichlorodifluoromethane	<2	<2								<2	ug/l	TM15/PM1
Methyl Tertiary Butyl Ether #	<1	<1								<1	ug/l	TM15/PM1
Chloromethane #	<3	<3								<3	ug/l	TM15/PM1
	<2	<2								<2	ug/l	TM15/PM1
Vinyl Chloride Bromomethane	<1	<1								<1	ug/l	TM15/PM1
Chloroethane #	<3	<3								<3	ug/l	TM15/PM1
Trichlorofluoromethane #	<3	<3								<3	ug/l	TM15/PM1
1,1-Dichloroethene #	<3	<3								<3	ug/l	TM15/PM1
Dichloromethane #	<3	<3								<3	ug/l	TM15/PM1
rans-1-2-Dichloroethene #		<3									-	TM15/PM1
1,1-Dichloroethane #	<3 <3	<3 <3								<3 <3	ug/l ug/l	TM15/PM1
cis-1-2-Dichloroethene #	<3	<3								<3	ug/l	TM15/PM1
2,2-Dichloropropane	<3 <1	<3 <1								<3 <1	-	TM15/PM1
2,2-Dichloropropane Bromochloromethane #	<1 <2	<1 <2								<1 <2	ug/l ug/l	TM15/PM1
Chloroform #	<2	<2								<2 <2	_	TM15/PM1
1,1,1-Trichloroethane #	<2	<2								<2 <2	ug/l ug/l	TM15/PM1
1,1-Dichloropropene #	<2 <3	<3								<2 <3	ug/l	TM15/PM1
Carbon tetrachloride #		<2									-	TM15/PM1
1,2-Dichloroethane #	<2	<2								<2	ug/l	TM15/PM10
Benzene #	<2	<1								<2	ug/l	TM15/PM1
Trichloroethene #	<1									<1	ug/l	TM15/PM1
1,2-Dichloropropane #	<3	<3								<3	ug/l	TM15/PM1
Dibromomethane	<2	<2								<2	ug/l	-
Dibromomethane #	<3	<3								<3	ug/l	TM15/PM1 TM15/PM1
	<2 <2	<2 <2								<2	ug/l	TM15/PM1
cis-1-3-Dichloropropene Toluene #										<2	ug/l	TM15/PM1
	<2	<2								<2	ug/l	TM15/PM1
trans-1-3-Dichloropropene 1,1,2-Trichloroethane #	<2 <2	<2 <2								<2 <2	ug/l	TM15/PM1
Tetrachloroethene #	<3	<3									ug/l	TM15/PM1
1,3-Dichloropropane #		<2								<3	ug/l	TM15/PM1
Dibromochloromethane #	<2 <2	<2								<2	ug/l	TM15/PM1
1,2-Dibromoethane #		<2								<2	ug/l	TM15/PM10
Chlorobenzene #	<2 <2	<2								<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane #	<2	<2								<2	ug/l	TM15/PM10
Ethylbenzene #										<2	ug/l	TM15/PM1
p/m-Xylene #	<2	<2 <3								<2	ug/l	TM15/PM10
o-Xylene #	<3	<3 <2								<3	ug/l	TM15/PM10
	<2									<2	ug/l	TM15/PM10
Styrene Bromoform <sup>#</sup>	<2 <2	<2 <2								<2 <2	ug/l	TM15/PM10
		<2 <3									ug/l	TM15/PM10
Isopropylbenzene **	<3									<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane Bromobenzene #	<4 <2	<4 <2								<4 <2	ug/l	TM15/PM10
1,2,3-Trichloropropane #											ug/l	TM15/PM10
1,2,3-Trichloropropane Propylbenzene #	<3	<3								<3	ug/l	TM15/PM10
Propyibenzene 2-Chlorotoluene #	<3	<3 <3								<3	ug/l	TM15/PM10
2-Chlorotoluene 1,3,5-Trimethylbenzene #	<3	<3 <3								<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3 <3	<3 <3								<3	ug/l	TM15/PM1
tert-Butylbenzene #	<3 <3	<3 <3								<3 <3	ug/l	TM15/PM1
1,2,4-Trimethylbenzene #	<3 <3	<3 <3									ug/l	TM15/PM1
sec-Butylbenzene	<3 <3	<3 <3								<3 <3	ug/l ug/l	TM15/PM1
4-Isopropyltoluene #	<3 <3	<3 <3								<3 <3	_	TM15/PM1
4-isopropyitoluene 1,3-Dichlorobenzene #											ug/l	TM15/PM1
1,3-Dichlorobenzene 1,4-Dichlorobenzene #	<3	<3								<3	ug/l	
1,4-Dichlorobenzene " n-Butylbenzene #	<3	<3								<3	ug/l	TM15/PM1 TM15/PM1
	<3	<3								<3	ug/l	· l
1,2-Dichlorobenzene #	<3	<3								<3	ug/l	TM15/PM1
1,2-Dibromo-3-chloropropane	<2	<2								<2	ug/l	TM15/PM1
1,2,4-Trichlorobenzene	<3	<3								<3	ug/l	TM15/PM1
Hexachlorobutadiene	<3	<3								<3	ug/l	TM15/PM1
1,2,3-Trichlorobenzene	<3	<3								<3	ug/l	TM15/PM1
Surrogate Recovery Toluene D8	103	103	l	ĺ	1	i	1	1	i	<0	%	TM15/PM10

Surrogate Recovery Toluene D8 ırrogate Recovery 4-Bromofluorobenze

103

103

TM15/PM10

#### NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

**JE Job No.:** 12/9793

#### SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

#### **WATERS**

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory . It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

#### **DEVIATING SAMPLES**

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

#### **SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

#### NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in an interim report but will remove the accreditation, in this instance results should be considered indicative only. Where possible samples will be re-extracted and a final report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

#### **ABBREVIATIONS and ACRONYMS USED**

#	UKAS accredited.
В	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
СО	Suspected carry over
NFD	No Fibres Detected

**JE Job No** 12/9793

JE JOD NO	12/0100						
Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Solid Results expressed on Dry/Wet basis
TM5	EPH by GC-FID, modified USEPA 8015	PM30	Magnetic stirrer extraction	Yes		AR	
TM15	VOC - Target by GC-MS, modified USEPA 8260	PM10	VOC GC-MS				
TM15	VOC - Target by GC-MS, modified USEPA 8260	PM10	VOC GC-MS	Yes			
TM16	SVOC - Target by GC-MS, modified USEPA 8270	PM30	Magnetic stirrer extraction				
TM27	SO4,CI,NO3,NO2,F,PO4 by Dionex	PM0	No Preparation				
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)				
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)	Yes			
TM37	Total Suspended Solids- gravimetric	PM0	No Preparation				
TM38	SO4,CI,NO3,NO2,F,PO4, Amm N2,ThioCN, Hex Cr by Aquakem	PM0	No Preparation	Yes			
TM39	Atrazine & Simazine by GC-MS	PM30	Magnetic stirrer extraction				
TM42	OC and OP Pesticides by GC-MS	PM30	Magnetic stirrer extraction				
TM57	COD by Colourimetric measurement	PM0	No Preparation				
TM58	BOD using DO meter	PM0	No Preparation	Yes			
TM75	Alkalinity by Metrohm	PM0	No Preparation	Yes			
TM89	Cyanide by FIA	PM0	No Preparation	Yes			



Unit 3 Deeside Point

Zone 3

Deeside Industrial Park

Deeside CH5 2UA

Malone O'Regan 2b Richview Office Park Clonskeagh Dublin 14 Ireland

Tel: +44 (0) 1244 833780 Fax: +44 (0) 1244 833781





No.4225

Attention: Eleanor Burke

Date: 2nd January, 2013

Your reference : E0937

Our reference: Test Report 12/9855 Batch 1

Location:

Date samples received: 14th December, 2012

Status: Final report

Issue:

One sample was received for analysis on 14th December, 2012. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

**Bruce Leslie** 

**Project Co-ordinator** 

Bob Millward B.Sc Principal Chemist

Rjuiellward

Client Name: Malone O'Regan Report : Liquid

Reference: E0937

Location:

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.: 12/9855 H=H<sub>2</sub>SO<sub>4</sub>, Z=ZnAc, N=NaOH, HN=HNO<sub>3</sub> J E Sample No MW6 Sample ID Please see attached notes for all abbreviations and acronyms COC No / misc Containers VHNPG Sample Date 13/12/2012 Sample Type Batch Number Method ם ח Units Date of Receipt 14/12/2012 Dissolved Arsenic 3.8 <2.5 ug/l TM30/PM14 Dissolved Boron <12 ug/l TM30/PM1 TM30/PM1 Dissolved Cadmium # <0.5 <0.5 ug/l TM30/PM1 Dissolved Calcium # 60.3 <0.2 mg/l TM30/PM1 Total Dissolved Chromium # 2.0 <1.5 ug/l TM30/PM1 Dissolved Copper # <7 <7 ug/l Total Dissolved Iron # TM30/PM1 <20 <20 ug/l TM30/PM1-Dissolved Lead # 6 <5 ug/l TM30/PM1-Dissolved Magnesium # <0.1 <0.1 mg/l TM30/PM1-Dissolved Manganese # <2 <2 ug/l TM30/PM1-Dissolved Mercury # <1 <1 ug/l TM30/PM1 Dissolved Nickel \* 23 <2 ug/l TM30/PM1 Dissolved Potassium # 26.4 <0.1 mg/l TM30/PM1 Dissolved Sodium # 61.1 <0.1 mg/l TM30/PM1 Dissolved Zinc # <3 <3 ug/l TM30/PM14 111 MRP as Total Phosphorus <5 ug/l

Malone O'Regan Client Name: Report : Liquid

E0937 Reference:

Location:

Eleanor Burke Contact: Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle JE Job No.: 12/9855 H=H<sub>2</sub>SO<sub>4</sub>, Z=ZnAc, N=NaOH, HN=HNO<sub>3</sub>

J E Sample No. 1-6

v = vp							i		
Sample ID	MW6								
Depth							Please se	e attached no	otes for all
COC No / misc								ations and ac	
Containers	VHNPG								
Sample Date	13/12/2012								
-									
Sample Type									
Batch Number	1						LOD	Units	Method No.
Date of Receipt	14/12/2012								NO.
Pesticides MS									
Organochlorine Pesticides									
Aldrin	<0.01						<0.01	ug/l	TM42/PM30
Alpha-BHC	<0.01						<0.01	ug/l	TM42/PM30
Beta-BHC	<0.01						<0.01	ug/l	TM42/PM30
Chlorothalonil	<0.01						<0.01	ug/l	TM42/PM30
cis-Chlordane	<0.01						<0.01	ug/l	TM42/PM30
Dieldrin	<0.01						<0.01	ug/l	TM42/PM30
Endosulphan I	<0.01						<0.01	ug/l	TM42/PM30
Endosulphan II	<0.01						<0.01	ug/l	TM42/PM30
Endosulphan sulphate	<0.01						<0.01	ug/l	TM42/PM30
Endrin	<0.01						<0.01	ug/l	TM42/PM30
Gamma-BHC	<0.01						<0.01	ug/l	TM42/PM30
Heptachlor	<0.01						<0.01	ug/l	TM42/PM30
Heptachlor Epoxide	<0.01						<0.01	ug/l	TM42/PM30
Hexachlorobenzene	<0.01						<0.01	ug/l	TM42/PM30
Isodrin	<0.01						<0.01	ug/l	TM42/PM30
o,p'-DDE	<0.01						<0.01	ug/l	TM42/PM30
o,p'-DDT	<0.01						<0.01	ug/l	TM42/PM30
o,p'-Methoxychlor	<0.01						<0.01	ug/l	TM42/PM30
o,p'-TDE	<0.01						<0.01	ug/l	TM42/PM30
p,p'-DDE	<0.01						<0.01	ug/l	TM42/PM30
p,p'-DDT	<0.01						<0.01	ug/l	TM42/PM30
	<0.01						<0.01	ug/l	TM42/PM30
p,p'-Methoxychlor	<0.01						<0.01	ug/l	TM42/PM30
p,p'-TDE	<0.01						<0.01	ug/l	TM42/PM30
Pendimethalin	<0.01						<0.01	-	TM42/PM30
Permethrin I	<0.01						<0.01	ug/l	TM42/PM30
Permethrin II								ug/l	TM42/PM30
Quintozene	<0.01						<0.01	ug/l	
Tecnazene	<0.01						<0.01	-	TM42/PM30
Telodrin	<0.01						<0.01	ug/l	TM42/PM30
trans-Chlordane	<0.01						<0.01	ug/l	TM42/PM30
Triadimefon	<0.01						<0.01	ug/l	TM42/PM30
Triallate	<0.01						<0.01	ug/l	TM42/PM30
Trifluralin	<0.01						<0.01	ug/l	TM42/PM30
								i	
1		1		1				1	

Client Name: Malone O'Regan Report : Liquid

E0937 Reference:

Location:

Eleanor Burke Contact: Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle H-H-SO, 7-7nAc N-NaOH HN-HNO.

							•
JE Job No.:	12/9855			H=H <sub>2</sub> SO <sub>4</sub> , 2	Z=ZnAc, N=	NaOH, HN=	=HN0 <sub>3</sub>
							1

JE Job No.:	12/9855			$H=H_2SO_4, I$	Z=ZNAC, N=	NaOH, HN=	HINU <sub>3</sub>			
J E Sample No.	1-6									
Sample ID	MW6									
Depth								1		
-									e attached rations and a	
COC No / misc										,
Containers	VHNPG									
Sample Date	13/12/2012									
Sample Type	Ground Water									
Batch Number	1									Made
Date of Receipt	14/12/2012							LOD	Units	Method No.
Pesticides MS	. ,									
Organophosphorus Pesticides										
Azinphos ethyl	<0.01							<0.01	ug/l	TM42/PM30
Azinphos methyl	<0.01							<0.01	ug/l	TM42/PM30
Carbophenothion	<0.01							<0.01	ug/l	TM42/PM30
Chlorfenvinphos	<0.01							<0.01	ug/l	TM42/PM30
Chlorpyrifos	<0.01							<0.01	ug/l	TM42/PM30
Chlorpyrifos-methyl	<0.01							<0.01	ug/l	TM42/PM30
Diazinon	<0.01							<0.01	ug/l	TM42/PM30
Dichlorvos	<0.01							<0.01	ug/l	TM42/PM30
Dimethoate	<0.01							<0.01	ug/l	TM42/PM30
Ethion	<0.01							<0.01	ug/l	TM42/PM30
Ethyl Parathion (Parathion)	<0.01							<0.01	ug/l	TM42/PM30
Etrimphos	<0.01							<0.01	ug/l	TM42/PM30
Fenitrothion	<0.01							<0.01	ug/l	TM42/PM30
Fenthion	<0.01							<0.01	ug/l	TM42/PM30
Malathion	<0.01							<0.01	ug/l	TM42/PM30
Methyl Parathion	<0.01							<0.01	ug/l	TM42/PM30
Mevinphos	<0.01							<0.01	ug/l	TM42/PM30
Phosalone	<0.01							<0.01	ug/l	TM42/PM30
Pirimiphos Methyl	<0.01							<0.01	ug/l	TM42/PM30
Propetamphos	<0.01							<0.01	ug/l	TM42/PM30
Triazophos	<0.01							<0.01	ug/l	TM42/PM30
Benazolin	<0.1							<0.1	ug/l	TM16/PM30
Bentazone	<0.1							<0.1	ug/l	TM16/PM30
Bromoxynil	<0.1							<0.1	ug/l	TM16/PM30
Clopyralid	<0.1							<0.1	ug/l	TM16/PM30
4- CPA	<0.1							<0.1	ug/l	TM16/PM30
2,4 – D	<0.1							<0.1	ug/l	TM16/PM30
2,4 –DB	<0.1							<0.1	ug/l	TM16/PM30
Dicamba	<0.1							<0.1	ug/l	TM16/PM30
Dichloroprop	<0.1							<0.1	ug/l	TM16/PM30
Diclofop	<0.1							<0.1	ug/l	TM16/PM30
Fenoprop	<0.1							<0.1	ug/l	TM16/PM30
Flamprop	<0.1							<0.1	ug/l	TM16/PM30
Flamprop – isopropyl	<0.1							<0.1	ug/l	TM16/PM30
loxynil	<0.1							<0.1	ug/l	TM16/PM30
MCPA	<0.1							<0.1	ug/l	TM16/PM30
МСРВ	<0.1							<0.1	ug/l	TM16/PM30
Mecoprop	<0.1							<0.1	ug/l	TM16/PM30
Picloram	<0.1							<0.1	ug/l	TM16/PM30
Pentachlorophenol	<0.1							<0.1	ug/l	TM16/PM30
2,4,5 – T	<0.1							<0.1	ug/l	TM16/PM30

Client Name: Malone O'Regan Report : Liquid

E0937 Reference:

Location:

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.:	12/9855	$H=H_2SO_4$ , $Z=ZnAc$ , $N=NaOH$ , $HN=HNO_3$
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JE Job No.:	12/9855			H=H <sub>2</sub> SO <sub>4</sub> , 2	Z=ZnAc, N=	NaOH, HN=	:HN0 <sub>3</sub>			
J E Sample No.	1-6									
Sample ID	MW6									
Depth								Please se	e attached n	otes for all
COC No / misc									ations and a	
Containers										
Sample Date										
Sample Type										
Batch Number								LOD	Units	Method No.
Date of Receipt	14/12/2012									
2,3,6 – TBA	<0.1							<0.1	ug/l	TM16/PM30
Triclopyr	<0.1							<0.1	ug/l	TM16/PM30
Atrazine	<1							<1	ug/l	TM39/PM30
Simazine	<1							<1	ug/l	TM39/PM30
Fluoride	<0.3							<0.3	mg/l	TM27/PM0
#										
Sulphate #	99.59							<0.05	mg/l	TM38/PM0
Chloride <sup>#</sup> Total Oxidised Nitrogen as N <sup>#</sup>	34.2 <0.2							<0.3 <0.2	mg/l mg/l	TM38/PM0 TM38/PM0
Total Oxidised Nitrogen as N	<b>VU.2</b>							<0.2	mg/i	TWISO/F WIO
Total Cyanide #	<0.01							<0.01	mg/l	TM89/PM0
Ammoniacal Nitrogen as N #	6.62							<0.03	mg/l	TM38/PM0
Total Alkalinity as CaCO3 #	124							<1	mg/l	TM75/PM0
Total Occupits Octavi	19							<2	mg/l	TM60/PM0
Total Organic Carbon  Total Dissolved Solids	386							<35	mg/l	TM20/PM0
Total Bissolved Collas									3	

Client Name: SVOC Report : Liquid

Reference: E0937

Location:

Contact: Eleanor Burke

JE Job No.:	12/9855	 	 	 	 			
J E Sample No.	1-6							
Sample ID	MW6							
Depth							e attached n	
COC No / misc						abbrevi	ations and a	cronyms
Containers	VHNPG							
Sample Date	13/12/2012							
Sample Type	Ground Water							
Batch Number	1					LOD	Units	Method
Date of Receipt	14/12/2012						00	No.
SVOC MS								
Phenols								
2-Chlorophenol	<10					<10	ug/l	TM16/PM30
2-Methylphenol	<10					<10	ug/l	TM16/PM30
2-Nitrophenol	<10					<10	ug/l	TM16/PM30
2,4-Dichlorophenol	<10					<10	ug/l	TM16/PM30
2,4-Dimethylphenol	<10					<10	ug/l	TM16/PM30
2,4,5-Trichlorophenol	<10					<10	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<10					<10	ug/l	TM16/PM30
4-Chloro-3-methylphenol	<10					<10	ug/l	TM16/PM30
4-Methylphenol	<10					<10	ug/l	TM16/PM30
4-Nitrophenol	<10 <10					<10	ug/l	TM16/PM30 TM16/PM30
Pentachlorophenol						<10	ug/l	TM16/PM30 TM16/PM30
Phenol	<10					<10	ug/l	TIVITO/PIVI30
PAHs	<10					<10	ug/l	TM16/PM30
2-Chloronaphthalene	<10					<10	_	TM16/PM30
2-Methylnaphthalene	<10					<10	ug/l ug/l	TM16/PM30
Naphthalene	<10					<10	ug/l	TM16/PM30
Acenaphthylene	<10					<10	ug/l	TM16/PM30
Acenaphthene Fluorene	<10					<10	ug/l	TM16/PM30
Phenanthrene	<10					<10	ug/l	TM16/PM30
Anthracene	<10					<10	ug/l	TM16/PM30
Fluoranthene	<10					<10	ug/l	TM16/PM30
Pyrene	<10					<10	ug/l	TM16/PM30
Benzo(a)anthracene	<10					<10	ug/l	TM16/PM30
Chrysene	<10					<10	ug/l	TM16/PM30
Benzo(bk)fluoranthene	<10					<10	ug/l	TM16/PM30
Benzo(a)pyrene	<10					<10	ug/l	TM16/PM30
Indeno(123cd)pyrene	<10					<10	ug/l	TM16/PM30
Dibenzo(ah)anthracene	<10					<10	ug/l	TM16/PM30
Benzo(ghi)perylene	<10					<10	ug/l	TM16/PM30
Phthalates							Ŭ	
Bis(2-ethylhexyl) phthalate	<10					<10	ug/l	TM16/PM30
Butylbenzyl phthalate	<10					<10	ug/l	TM16/PM30
Di-n-butyl phthalate	<10					<10	ug/l	TM16/PM30
Di-n-Octyl phthalate	<10					<10	ug/l	TM16/PM30
Diethyl phthalate	<10					<10	ug/l	TM16/PM30
Dimethyl phthalate	<10					<10	ug/l	TM16/PM30
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								ĺ

Client Name: SVOC Report : Liquid

Reference: E0937

Location:

Contact: Eleanor Burke

JE Job No.:	12/9855						_		
J E Sample No.	1-6								
Sample ID	MW6								
Depth								e attached n	
COC No / misc							abbrevi	ations and a	cronyms
Containers									
Sample Date									
Sample Type									T 1
Batch Number							LOD	Units	Method No.
Date of Receipt	14/12/2012								NO.
SVOC MS									
Other SVOCs 1,2-Dichlorobenzene	<10						<10	ug/l	TM16/PM30
1,2,4-Trichlorobenzene	<10						<10	ug/l	TM16/PM30
1,3-Dichlorobenzene	<10						<10	ug/l	TM16/PM30
1,4-Dichlorobenzene	<10						<10	ug/l	TM16/PM30
2-Nitroaniline	<10						<10	ug/l	TM16/PM30
2,4-Dinitrotoluene	<10						<10	ug/l	TM16/PM30
2,6-Dinitrotoluene	<10						<10	ug/l	TM16/PM30
3-Nitroaniline	<10						<10	ug/l	TM16/PM30
4-Bromophenylphenylether	<10						<10	ug/l	TM16/PM30
4-Chloroaniline	<10						<10	ug/l	TM16/PM30
4-Chlorophenylphenylether	<10						<10	ug/l	TM16/PM30
4-Nitroaniline	<10						<10	ug/l	TM16/PM30
Azobenzene	<10						<10	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane	<10						<10	ug/l	TM16/PM30
Bis(2-chloroethyl)ether	<10						<10	ug/l	TM16/PM30
Carbazole	<10						<10	ug/l	TM16/PM30
Dibenzofuran	<10						<10	ug/l	TM16/PM30
Hexachlorobenzene	<10						<10	ug/l	TM16/PM30
Hexachlorobutadiene	<10						<10	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<10						<10	ug/l	TM16/PM30
Hexachloroethane	<10						<10	ug/l	TM16/PM30
Isophorone	<10						<10	ug/l	TM16/PM30 TM16/PM30
N-nitrosodi-n-propylamine	<10 <10						<10 <10	ug/l	TM16/PM30
Nitrobenzene	<10						<10	ug/l	TIVITO/PIVISO
				_	_	_		_	

Client Name: VOC Report : Liquid

Reference: E0937

Location:

Contact: Eleanor Burke

JE Job No.:	12/9855								
J E Sample No.	1-6								
Sample ID	MW6								
Depth							Please se	e attached r	notes for all
COC No / misc								ations and a	
Containers	VHNPG								
Sample Date									
Sample Type									
									1
Batch Number	1						LOD	Units	Method No.
Date of Receipt	14/12/2012								NO.
VOC MS	_		ļ	ļ			_	_	
Dichlorodifluoromethane #	<2		ļ	ļ			<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether #	<1		Į.	Į.			<1	ug/l	TM15/PM10
Chloromethane #	<3		Į.	Į.			<3	ug/l	TM15/PM10
Vinyl Chloride	<2		Į.	Į.			<2	ug/l	TM15/PM10
Bromomethane	<1						<1	ug/l	TM15/PM10
Chloroethane #	<3		ļ l	ļ l			<3	ug/l	TM15/PM10
Trichlorofluoromethane #	<3						<3	ug/l	TM15/PM10
1,1-Dichloroethene #	<3		ı	ı			<3	ug/l	TM15/PM10
Dichloromethane #	<3		Į.	Į.			<3	ug/l	TM15/PM10
trans-1-2-Dichloroethene #	<3						<3	ug/l	TM15/PM10
1.1-Dichloroethane #	<3						<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene #	<3						<3	ug/l	TM15/PM10
	<3 <1								TM15/PM10
2,2-Dichloropropane Bromochloromethane #							<1	ug/l	
	<2						<2	ug/l	TM15/PM10
Chloroform #	<2						<2	ug/l	TM15/PM10
1,1,1-Trichloroethane #	<2						<2	ug/l	TM15/PM10
1,1-Dichloropropene #	<3						<3	ug/l	TM15/PM10
Carbon tetrachloride #	<2		Į.	Į.			<2	ug/l	TM15/PM10
1,2-Dichloroethane #	<2						<2	ug/l	TM15/PM10
Benzene #	<1						<1	ug/l	TM15/PM10
Trichloroethene #	<3						<3	ug/l	TM15/PM10
1,2-Dichloropropane #	<2						<2	ug/l	TM15/PM10
Dibromomethane #	<3						<3	ug/l	TM15/PM10
Bromodichloromethane #	<2						<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2						<2	ug/l	TM15/PM10
Toluene #	<2						<2	_	TM15/PM10
			Į.	Į.				ug/l	
trans-1-3-Dichloropropene	<2						<2	ug/l	TM15/PM10
1,1,2-Trichloroethane #	<2		Į.	Į.			<2	ug/l	TM15/PM10
Tetrachloroethene #	<3						<3	ug/l	TM15/PM10
1,3-Dichloropropane #	<2		,	,			<2	ug/l	TM15/PM10
Dibromochloromethane #	<2						<2	ug/l	TM15/PM10
1,2-Dibromoethane #	<2						<2	ug/l	TM15/PM10
Chlorobenzene #	<2						<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane #	<2						<2	ug/l	TM15/PM10
Ethylbenzene #	<2						<2	ug/l	TM15/PM10
p/m-Xylene #	<3						<3	ug/l	TM15/PM10
o-Xylene #	<2						<2	ug/l	TM15/PM10
	<2						<2	_	TM15/PM10
Styrene Bromoform #								ug/l	TM15/PM10
	<2						<2	ug/l	Į.
Isopropylbenzene #	<3						<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4						<4	ug/l	TM15/PM10
Bromobenzene #	<2						<2	ug/l	TM15/PM10
1,2,3-Trichloropropane #	<3						<3	ug/l	TM15/PM10
Propylbenzene #	<3						<3	ug/l	TM15/PM10
2-Chlorotoluene #	<3						<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene #	<3						<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3						<3	ug/l	TM15/PM10
tert-Butylbenzene #	<3						<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene #	<3						<3	ug/l	TM15/PM10
sec-Butylbenzene #	<3						<3	ug/l	TM15/PM10
4-Isopropyltoluene #	<3						<3	ug/l	TM15/PM10
1,3-Dichlorobenzene #								_	TM15/PM10
	<3						<3	ug/l	
1,4-Dichlorobenzene #	<3						<3	ug/l	TM15/PM10
n-Butylbenzene #	<3		 				<3	ug/l	TM15/PM10
1,2-Dichlorobenzene #	<3						<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2						<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3						<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3						<3	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3						<3	ug/l	TM15/PM10
		1			l			_	1
Surrogate Recovery Toluene D8	82		1				<0	%	TM15/PM10

#### NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

**JE Job No.:** 12/9855

#### SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

#### **WATERS**

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory . It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

#### **DEVIATING SAMPLES**

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

#### **SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

#### NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in an interim report but will remove the accreditation, in this instance results should be considered indicative only. Where possible samples will be re-extracted and a final report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

#### **ABBREVIATIONS and ACRONYMS USED**

12/9855

#	UKAS accredited.
В	Indicates analyte found in associated method blank.
DR	Dilution required.
М	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
СО	Suspected carry over
NFD	No Fibres Detected

**JE Job No** 12/9855

JE Job No	12/9000	<b>.</b>	T	ı	MOEDTO	A - 1 - 2 - 1 A -	0.510
Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Solid Results expressed on Dry/Wet basis
TM15	VOC - Target by GC-MS, modified USEPA 8260	PM10	VOC GC-MS				
TM15	VOC - Target by GC-MS, modified USEPA 8260	PM10	VOC GC-MS	Yes			
TM16	SVOC - Target by GC-MS, modified USEPA 8270	PM30	Magnetic stirrer extraction				
TM20	TDS, TSS and TS - gravimetric	PM0	No Preparation				
TM27	SO4,CI,NO3,NO2,F,PO4 by Dionex	РМ0	No Preparation				
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)				
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)	Yes			
TM38	SO4,CI,NO3,NO2,F,PO4, Amm N2,ThioCN, Hex Cr by Aquakem	PM0	No Preparation	Yes			
TM39	Atrazine & Simazine by GC-MS	PM30	Magnetic stirrer extraction				
TM42	OC and OP Pesticides by GC-MS	PM30	Magnetic stirrer extraction				
TM60	TOC/DOC by NDIR	PM0	No Preparation				
TM75	Alkalinity by Metrohm	PM0	No Preparation	Yes			
TM89	Cyanide by FIA	PM0	No Preparation	Yes			



Unit 3 Deeside Point

Zone 3

Deeside Industrial Park

Deeside CH5 2UA

Malone O'Regan 2b Richview Office Park Clonskeagh Dublin 14 Ireland

Tel: +44 (0) 1244 833780 Fax: +44 (0) 1244 833781





Attention : Eleanor Burke

Date: 2nd January, 2013

Your reference : EO937

Our reference: Test Report 12/9860 Batch 1

Location :

Date samples received: 14th December, 2012

Status: Final report

Issue:

Three samples were received for analysis on 14th December, 2012. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Bruce Leslie

**Project Co-ordinator** 

Bob Millward B.Sc Principal Chemist

Rjuiellward

Client Name: Malone O'Regan Report : Liquid

Reference: EO937

Location:

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.:	12/9860				H=H <sub>2</sub> SO <sub>4</sub> , 2	Z=ZnAc, N=	NaOH, HN=	:HN0 <sub>3</sub>			
J E Sample No.	1-6	7-12	13-18								
Sample ID	BH2	MW5	MW4								
Depth									Diagon	e attached n	otoo for all
COC No / misc										e attached hations and a	
		VHNPG									
Sample Date	13/12/2012	13/12/2012	13/12/2012								
Sample Type	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1						LOD	Units	Method
Date of Receipt	14/12/2012	14/12/2012	14/12/2012						LOD	Units	No.
Dissolved Arsenic #	22.4	10.3	2.6						<2.5	ug/l	TM30/PM14
Dissolved Boron	740	545	31						<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Calcium #	383.9	268.4	122.2						<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	3.1	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7						<7	ug/l	TM30/PM14
Total Dissolved Iron #	1392	<20	<20						<20	ug/l	TM30/PM14
Dissolved Lead #	15	10	6						<5	ug/l	TM30/PM14
Dissolved Magnesium #	59.8	32.0	18.0						<0.1	mg/l	TM30/PM14
Dissolved Manganese #	3392	1644	464						<2	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1						<1	ug/l	TM30/PM14
Dissolved Nickel #	14	30	3						<2	ug/l	TM30/PM14
Dissolved Potassium #	54.2	15.9	2.7						<0.1	mg/l	TM30/PM14
Dissolved Sodium #	279.9	94.5	22.7						<0.1	mg/l	TM30/PM14
Dissolved Zinc #	10	49	15						<3	ug/l	TM30/PM14
MRP as Total Phosphorus	161	84	38						<5	ug/l	TM30/PM14
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Client Name: Malone O'Regan Report : Liquid

EO937 Reference:

Location:

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

<b>JE Job No.:</b> 12/9860	H=H <sub>2</sub> SO <sub>4</sub> , Z=ZnAc, N=NaOH, HN=HNO <sub>3</sub>
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Alpha BHC         < 0.01	JE Job No.:	12/9860				H=H <sub>2</sub> SO <sub>4</sub> , 2	Z=ZnAc, N=	NaOH, HN=	:HN0 <sub>3</sub>						
COC NO / mise	J E Sample No.	1-6	7-12	13-18											
COC No / mise   Containers   V + N P G	Sample ID	BH2	MW5	MW4											
COC No / mise   Containers   V + N P G	Depth									Division					
Container   Cont															
Sample Type															
Sample Type															
Batch Number   1	Sample Date	13/12/2012	13/12/2012	13/12/2012											
Date of Receipt   14/12/2012	Sample Type	Ground Water	Ground Water	Ground Water											
Date of Receips   14/12/2012	Batch Number	1	1	1								Method			
Organochlorine Pesticides         Companion of Addrin         40.01	Date of Receipt	14/12/2012	14/12/2012	14/12/2012						LOD	Units	No.			
Organochlorine Pesticides         Companion of Addrin         40.01	Pesticides MS														
Alpha-BHC         < 0.01															
Sels-BHC	Aldrin	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30			
Chlorothaloni	Alpha-BHC	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30			
dis-Chlordane   4.0.01   4.0	Beta-BHC	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30			
Country   Coun	Chlorothalonil	<0.01	<0.01	<0.01						<0.01	ug/l				
Endosulphan I	cis-Chlordane														
Endosulphan II	Dieldrin														
Endosulphan sulphate	Endosulphan I														
Endrin	Endosulphan II														
Gamma-BHC         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Heptachlor         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Heptachlor Epoxide         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Hexachlorobenzene         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Jop'-DDE         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Op'-DDT         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Op'-DDE         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Op'-DDE         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Op'-DDE         < 0.01         < 0.01         < 0.01         < 0.01         < 0.01         ug/l         TM42/PM30           Op'-DDT         < 0.01         < 0.01         < 0.01															
Heptachlor															
Heptachlor Epoxide															
Hexachlorobenzene															
Sodrin   Co.01   Co.															
o.p.*DDE         <0.01         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30         TM42/PM30         <0.01         ug/l         TM42/PM30         TM42/PM30         <0.01         ug/l         TM42/P															
Op-DDT   Co.01   Co.															
Country   Coun	o,p'-DDT	<0.01	<0.01	<0.01						<0.01		TM42/PM30			
p.p'-DDE	o,p'-Methoxychlor	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30			
p.p'-DDT	o,p'-TDE	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30			
p.p'-Methoxychlor	p,p'-DDE	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30			
P.p'-TDE	p,p'-DDT	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30			
Pendimethalin         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Permethrin I         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Permethrin II         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Quintozene         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Tecnazene         <0.01         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Telodrin         <0.01         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           trans-Chlordane         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01<	p,p'-Methoxychlor	<0.01	<0.01							<0.01	ug/l				
Permethrin I	p,p'-TDE											1			
Permethrin II	Pendimethalin														
Quintozene         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Tecnazene         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Telodrin         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           trans-Chlordane         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Triadimefon         <0.01         <0.01         <0.01         <0.01         <0.01         ug/l         TM42/PM30           Triallate         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01         <0.01	Permethrin I														
Tecnazene	Permethrin II														
Telodrin															
trans-Chlordane         < 0.01															
Triadimefon         < 0.01															
Triallate <0.01 <0.01 <0.01 <0.01 <0.01 Ug/l TM42/PM30	Triadimefon														
	Triallate														
	Trifluralin	<0.01	<0.01	<0.01						<0.01		TM42/PM30			

Client Name: Malone O'Regan Report : Liquid

Reference: EO937

Location:

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.:	12/9860				H=H <sub>2</sub> SO <sub>4</sub> , 2	Z=ZnAc, N=	NaOH, HN=	:HN0₃			
J E Sample No.	1-6	7-12	13-18								
Sample ID	BH2	MW5	MW4								
Depth									Please se	e attached r	notes for all
COC No / misc										ations and a	
	VHNDG	VHNPG	VHNPG								
Sample Date											
Sample Type	Ground Water	Ground Water	Ground Water							1	
Batch Number	1	1	1						LOD	Units	Method
Date of Receipt	14/12/2012	14/12/2012	14/12/2012						202	<b>5</b>	No.
Pesticides MS											
Organophosphorus Pesticides											
Azinphos ethyl	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Azinphos methyl	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Carbophenothion	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Chlorfenvinphos	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Chlorpyrifos	<0.01	<0.01 <0.01	<0.01 <0.01						<0.01	ug/l	TM42/PM30 TM42/PM30
Chlorpyrifos-methyl	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Diazinon	<0.01	<0.01	<0.01						<0.01	ug/l ug/l	TM42/PM30
Dichlorvos Dimethoate	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Ethion	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Ethyl Parathion (Parathion)	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Etrimphos	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Fenitrothion	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Fenthion	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Malathion	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Methyl Parathion	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Mevinphos	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Phosalone	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Pirimiphos Methyl	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Propetamphos	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Triazophos	<0.01	<0.01	<0.01						<0.01	ug/l	TM42/PM30
Benazolin	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Bentazone	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Bromoxynil	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1						<0.1 <0.1	ug/l	TM16/PM30 TM16/PM30
Clopyralid	<0.1	<0.1	<0.1						<0.1	ug/l ug/l	TM16/PM30
4- CPA 2,4 – D	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
2,4 – D 2,4 –DB	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Dicamba	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Dichloroprop	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Diclofop	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Fenoprop	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Flamprop	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Flamprop – isopropyl	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
loxynil	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
MCPA	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
МСРВ	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Mecoprop	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Picloram	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Pentachlorophenol	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
2,4,5 – T	<0.1	<0.1	<0.1			<u> </u>	<u> </u>		<0.1	ug/l	TM16/PM30

Client Name: Malone O'Regan Report : Liquid

EO937 Reference:

Location:

Contact: Eleanor Burke Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle

JE Job No.:	12/9860				H=H <sub>2</sub> SO <sub>4</sub> , 2	Z=ZnAc, N=	NaOH, HN=	:HN0 <sub>3</sub>			
J E Sample No.	1-6	7-12	13-18								
Sample ID	BH2	MW5	MW4								
Depth									Please se	e attached n	otes for all
COC No / misc										ations and a	
Containers	VHNPG	VHNPG	VHNPG								
Sample Date											
Sample Type											
Batch Number		1	1						LOD	Units	Method No.
Date of Receipt											
2,3,6 – TBA	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Triclopyr	<0.1	<0.1	<0.1						<0.1	ug/l	TM16/PM30
Atrazine	<1	<1	<1						<1	ug/l	TM39/PM30
Simazine	<1	<1	<1						<1	ug/l	TM39/PM30
Fluoride	<0.3	<0.3	<0.3						<0.3	mg/l	TM27/PM0
- · · · #	40.01	00.01	04.00						0.05		Thank (D) is
Sulphate # Chloride #	16.24 135.3	20.61 78.3	94.69 30.0						<0.05 <0.3	mg/l mg/l	TM38/PM0 TM38/PM0
Total Oxidised Nitrogen as N #	<0.2	1.2	<0.2						<0.2	mg/l	TM38/PM0
										Ü	
Total Cyanide #	<0.01	<0.01	<0.01						<0.01	mg/l	TM89/PM0
Ammoniacal Nitrogen as N #	45.46**	9.66**	0.15						<0.03	mg/l	TM38/PM0
T-1-1-1-11-11-11-1-1-1-1-1-1-1-1-1-1-1-	-	404	188						-4	ma/l	TM75/DMO
Total Alkalinity as CaCO3 #	-	404	188						<1	mg/l	TM75/PM0
COD (Settled)	328	-	-						<7	mg/l	TM57/PM0
Total Organic Carbon	-	14	9						<2	mg/l	TM60/PM0
Total Dissolved Solids	-	928	488						<35	mg/l	TM20/PM0

Client Name: Malone O'Regan SVOC Report: Liquid

Reference: EO937

Location:

Contact: Eleanor Burke

JE Job No.: 12/9860 J E Sample No 7-12 13-18 ВН2 MW5 MW4 Depth Please see attached notes for all abbreviations and acronyms COC No / misc Containers VHNPG VHNPG VHNPG Sample Date 13/12/2012 13/12/2012 13/12/2012 Sample Type Ground Wate Ground Wate Ground Wate Batch Numbe Method LOD Units Date of Receipt 14/12/2012 14/12/2012 14/12/2012 No. SVOC MS 2-Chlorophenol <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM3 <10 <10 <10 <10 ua/l 2-Methylphenol TM16/PM30 2-Nitrophenol <10 <10 <10 <10 ug/l 2,4-Dichlorophenol <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM30 <10 <10 <10 <10 ug/l 2.4-Dimethylphenol TM16/PM30 <10 <10 2,4,5-Trichlorophenol <10 <10 ug/l 2,4,6-Trichlorophenol -10 <10 -10 <10 ug/l TM16/PM30 <10 <10 <10 <10 TM16/PM30 4-Chloro-3-methylphenol ug/l TM16/PM30 <10 <10 41 <10 4-Methylphenol ug/l TM16/PM30 4-Nitrophenol <10 <10 <10 <10 ug/l Pentachlorophenol <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM30 24 <10 <10 Phenol <10 ug/l PΔHs 2-Chloronaphthalene <10 <10 <10 <10 ug/l TM16/PM30 2-Methylnaphthalene <10 <10 <10 ug/l TM16/PM30 TM16/PM30 <10 <10 <10 <10 ug/l Naphthalene Acenaphthylene <10 <10 <10 <10 ug/l TM16/PM30 Acenaphthene <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM30 <10 <10 <10 <10 ug/l Fluorene TM16/PM30 Phenanthrene <10 <10 <10 <10 ug/l Anthracene <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM30 <10 <10 <10 <10 ug/l Fluoranthene TM16/PM30 Pyrene <10 <10 <10 <10 ug/l TM16/PM30 Benzo(a)anthracene <10 <10 <10 <10 ug/l <10 <10 <10 <10 TM16/PM30 Chrysene ug/l TM16/PM30 <10 Benzo(bk)fluoranthene <10 <10 <10 ug/l TM16/PM30 Benzo(a)pyrene <10 <10 <10 <10 ug/l <10 <10 <10 <10 ug/l TM16/PM30 Indeno(123cd)pyrene TM16/PM30 <10 <10 <10 <10 Dibenzo(ah)anthracene ug/l TM16/PM30 Benzo(ghi)perylene <10 <10 <10 <10 ug/l Phthalates Bis(2-ethylhexyl) phthalate <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM30 <10 <10 <10 <10 ug/l Butylbenzyl phthalate Di-n-butyl phthalate <10 <10 <10 <10 ug/l TM16/PM30 <10 <10 <10 <10 ug/l TM16/PM30 Di-n-Octyl phthalate TM16/PM30 <10 <10 <10 Diethyl phthalate <10 ug/l TM16/PM30 Dimethyl phthalate <10 <10 <10 <10 ug/l

#### Jones Environmental Laboratory

Client Name: Malone O'Regan SVOC Report: Liquid

Reference: EO937

Location:

Contact: Eleanor Burke

JE Job No.: 12/9860 J E Sample No 7-12 13-18 ВН2 MW5 MW4 Depth Please see attached notes for all abbreviations and acronyms COC No / misc Containers VHNPG VHNPG VHNPG 13/12/2012 13/12/2012 13/12/2012 Sample Date Sample Type Ground Wate Ground Wate Ground Wate Batch Numbe Method LOD Units Date of Receipt 14/12/2012 14/12/2012 14/12/2012 No. SVOC MS Other SVOCs 1,2-Dichlorobenzene <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM3 <10 <10 <10 <10 ua/l 1 2 4-Trichlorobenzene TM16/PM30 1,3-Dichlorobenzene <10 <10 <10 <10 ug/l 1,4-Dichlorobenzene <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM30 2-Nitroaniline <10 <10 <10 <10 ug/l TM16/PM30 <10 <10 2,4-Dinitrotoluene <10 <10 ug/l TM16/PM30 2,6-Dinitrotoluene <10 <10 <10 <10 ug/l <10 <10 <10 <10 TM16/PM30 3-Nitroaniline ug/l TM16/PM30 <10 <10 <10 <10 4-Bromophenylphenylether ug/l TM16/PM30 4-Chloroaniline <10 <10 <10 <10 ug/l <10 <10 <10 <10 ug/l TM16/PM30 4-Chlorophenylphenylether TM16/PM30 <10 <10 <10 <10 4-Nitroaniline ug/l TM16/PM30 <10 <10 <10 <10 Azobenzene ug/l Bis(2-chloroethoxy)methane <10 <10 <10 <10 ug/l TM16/PM30 Bis(2-chloroethyl)ether <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM30 <10 <10 <10 <10 ug/l Carbazole Dibenzofuran <10 <10 <10 <10 ug/l TM16/PM30 Hexachlorobenzene <10 <10 <10 <10 ug/l TM16/PM30 TM16/PM30 <10 <10 <10 <10 ug/l Hexachlorobutadiene TM16/PM30 Hexachlorocyclopentadiene <10 <10 <10 <10 ug/l <10 <10 <10 <10 ug/l TM16/PM30 <10 <10 <10 TM16/PM30 <10 ug/l Isophorone TM16/PM30 N-nitrosodi-n-propylamine <10 <10 <10 <10 ug/l Nitrobenzene <10 <10 <10 <10 ug/l TM16/PM30

#### Jones Environmental Laboratory

Client Name: Malone O'Regan VOC Report : Liquid

Reference: EO937

Location:

Contact: Eleanor Burke
JE Job No.: 12/9860

J E Sample No 7-12 13-18 ВН2 MW5 MW4 Depti Please see attached notes for all abbreviations and acronyms COC No / misc Containers VHNPG VHNPG VHNPG Sample Date 13/12/2012 13/12/2012 13/12/2012 Sample Type Ground Wate Ground Wate Ground Wate Batch Numbe Method LOD Units Date of Receipt 14/12/2012 14/12/2012 14/12/2012 No. VOC MS Dichlorodifluoromethane <2 <2 <2 <2 ug/l TM15/PM1 Methyl Tertiary Butyl Ether # <1 <1 <1 TM15/PM1 <1 ug/l TM15/PM10 Chloromethane # <3 <3 <3 <3 ua/l TM15/PM10 <2 Vinyl Chloride <2 <2 <2 ug/l Bromomethane <1 <1 <1 <1 ug/l TM15/PM10 TM15/PM10 Chloroethane <3 <3 <3 <3 ug/l TM15/PM10 Trichlorofluoromethane <3 <3 <3 <3 ug/l 1,1-Dichloroethene <3 <3 <3 <3 ug/l TM15/PM10 Dichloromethane <3 <3 <3 <3 TM15/PM10 ug/l trans-1-2-Dichloroethene # <3 TM15/PM10 <3 <3 <3 uq/l 1.1-Dichloroethane <3 TM15/PM10 <3 <3 <3 ug/l cis-1-2-Dichloroethene <3 <3 <3 <3 TM15/PM10 ug/l TM15/PM10 <1 <1 <1 2.2-Dichloropropane <1 ug/l Bromochloromethane # TM15/PM10 <2 <2 <2 <2 uq/l Chloroform <sup>1</sup> <2 <2 <2 <2 ug/l TM15/PM10 1,1,1-Trichloroethane <2 <2 <2 <2 ug/l TM15/PM10 TM15/PM10 1,1-Dichloropropene # <3 <3 <3 <3 ug/l Carbon tetrachloride # <2 <2 <2 <2 ug/l TM15/PM10 1,2-Dichloroethane <2 <2 <2 <2 ug/l TM15/PM10 TM15/PM10 Benzene \* 5 <1 <1 <1 uq/l TM15/PM10 Trichloroethene <3 <3 <3 <3 ug/l 1,2-Dichloropropane # <2 <2 <2 <2 ug/l TM15/PM10 TM15/PM10 Dibromomethane i <3 <3 <3 <3 ug/l Bromodichloromethane # TM15/PM10 <2 <2 <2 <2 ug/l TM15/PM10 cis-1-3-Dichloropropene <2 <2 <2 <2 ug/l <2 <2 <2 <2 TM15/PM10 ug/l <2 <2 TM15/PM10 trans-1-3-Dichloropropene <2 <2 ug/l TM15/PM10 <2° <2 <2° 1.1.2-Trichloroethane <2 ug/l Tetrachloroethene <3 <3 <3 <3 TM15/PM10 ug/l <2 TM15/PM10 1,3-Dichloropropane \* <2 <2 <2 ug/l TM15/PM10 Dibromochloromethane # <2 <2 <2 <2 ug/l 1,2-Dibromoethane <2 <2 <2 <2 ug/l TM15/PM10 Chlorobenzene \* <2 <2 <2 <2 ug/l TM15/PM10 1,1,1,2-Tetrachloroethane # <2 <2 <2 TM15/PM10 <2 ua/l Ethylbenzene 3 <2 <2 <2 ug/l TM15/PM10 p/m-Xylene <3 <3 <3 ug/l TM15/PM10 TM15/PM10 o-Xylene <2 <2 <2 <2 ug/l <2 <2 TM15/PM10 Styrene <2 <2 ug/l Bromoform # <2 <2 <2 <2 ug/l TM15/PM10 3 TM15/PM10 lsopropylbenzene <sup>‡</sup> <3 <3 <3 ug/l TM15/PM10 1,1,2,2-Tetrachloroethane <4 <4 <4 <4 uq/l <2 TM15/PM10 Bromobenzene <2 <2 <2 ug/l 1,2,3-Trichloropropane <3 <3 <3 <3 TM15/PM10 ug/l Propylbenzene <3 <3 <3 TM15/PM10 <3 uq/l 2-Chlorotoluene # TM15/PM10 <3 <3 <3 <3 ug/l 1,3,5-Trimethylbenzene # <3 <3 <3 <3 TM15/PM10 ug/l <3 <3 <3 TM15/PM10 1-Chlorotoluene <3 ug/l tert-Butylbenzene # TM15/PM10 <3 <3 <3 <3 uq/l 1,2,4-Trimethylbenzene 26 <3 <3 <3 ug/l TM15/PM10 ec-Butylbenzene <3 <3 <3 <3 TM15/PM10 ug/l 4-Isopropyltoluene # TM15/PM10 <3 <3 <3 <3 ug/l 1,3-Dichlorobenzene # <3 <3 <3 <3 ug/l TM15/PM10 1,4-Dichlorobenzene <sup>i</sup> <3 <3 <3 <3 TM15/PM10 ug/l TM15/PM10 n-Butylbenzene # <3 <3 <3 <3 ug/l 1,2-Dichlorobenzene # TM15/PM10 <3 <3 <3 <3 ug/l <2 <2 <2 <2 ug/l TM15/PM10 <3 <3 <3 <3 ug/l TM15/PM10 1,2,4-Trichlorobenzene TM15/PM10 <3 <3 <3 <3 Hexachlorobutadiene ug/l 1,2,3-Trichlorobenzene <3 <3 <3 <3 ug/l TM15/PM10 105 102 <0 TM15/PM10 Surrogate Recovery Toluene D8 TM15/PM1 rogate Recovery 4-Bromofluoroben;

#### NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

**JE Job No.:** 12/9860

#### SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

#### **WATERS**

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory . It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

#### **DEVIATING SAMPLES**

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

#### **SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

### NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in an interim report but will remove the accreditation, in this instance results should be considered indicative only. Where possible samples will be re-extracted and a final report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

### **ABBREVIATIONS and ACRONYMS USED**

#	UKAS accredited.
В	Indicates analyte found in associated method blank.
DR	Dilution required.
М	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
СО	Suspected carry over
NFD	No Fibres Detected

**JE Job No** 12/9860

	12/9860						
Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Solid Results expressed on Dry/Wet basis
TM15	VOC - Target by GC-MS, modified USEPA 8260	PM10	VOC GC-MS				
TM15	VOC - Target by GC-MS, modified USEPA 8260	PM10	VOC GC-MS	Yes			
TM16	SVOC - Target by GC-MS, modified USEPA 8270	PM30	Magnetic stirrer extraction				
TM20	TDS, TSS and TS - gravimetric	PM0	No Preparation				
TM27	SO4,CI,NO3,NO2,F,PO4 by Dionex	PM0	No Preparation				
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)				
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)	Yes			
TM38	SO4,CI,NO3,NO2,F,PO4, Amm N2,ThioCN, Hex Cr by Aquakem	PM0	No Preparation	Yes			
TM39	Atrazine & Simazine by GC-MS	PM30	Magnetic stirrer extraction				
TM42	OC and OP Pesticides by GC-MS	PM30	Magnetic stirrer extraction				
TM57	COD by Colourimetric measurement	PM0	No Preparation				
TM60	TOC/DOC by NDIR	PM0	No Preparation				
TM75	Alkalinity by Metrohm	PM0	No Preparation	Yes			
TM89	Cyanide by FIA	PM0	No Preparation	Yes			



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www.cityanalysts.ie

Customer Contact: Patrick Walsh

Customer: Malone O'Regan Environmental Services

Customer Address: 28, Richview Office Park

Clonskeagh

Dublin 14



Report Reference: 12-06740-MOR

Report Version:

Reason for report re-issue: Customer contact updated.

**Report Date:** 08/01/2013

Customer PO No.: Main Contract Page 1 of 2

Chain of Custody No.:

## **Certificate Of Analysis**

Analysis of 1 sample(s) submitted on 14/12/2012 is now complete. We have the pleasure of enclosing your certificate of analysis.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our web site at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

Authorised By: Maria Nevin

Maria Nevin

**Date:** 08/01/2013

**Authorised Signatories:** 

Dublin: Miriam Byrne, Melissa Brady, Maria Nevin, Leann Hession,

Slawek Gryczewski, Ewa Krol Limerick: Hugh O'Donnell, Maurice Daffy

Note: Information on methods of analysis and performance characteristics is available on request.

Note: Results relate only to the items tested.

Test report shall not be reproduced except in full or with written approval of City Analysts Ltd .

Template 1146 Revision 014



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## **Certificate of Analysis**

Customer Contact: Patrick Walsh

Customer: Malone O'Regan Environmental Services

Customer Address: 28, Richview Office Park

Clonskeagh Dublin 14 Report Reference: 12-06740-MOR

Report Version: 2

**Date Received:** 14/12/2012



Page 2 of 2

Sample Description: BH 2

Sample Type: Leachate
Date Sampled: 13/12/2012
Lab Reference Number: 142144

Site/Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value	Accreditation Status
D/1003	14/12/2012	CBOD5	199	mg/l	-	INAB

Note:

NAC & ATC - No abnormal change and acceptable to customers.

TVC - Total Viable Count

PV Value is the parametric value, taken from European Communities, (Drinking Water) (No. 2) Regulations, 2007. S.I. No. 278 of 2007, and relates only to drinking water samples.



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Customer Contact: Conor McGrath

Customer: Malone O'Regan Environmental Services

Customer Address: 28, Richview Office Park

Clonskeagh

Dublin 14



Report Reference: 12-06847-MOR

Report Version:

**Report Date:** 27/12/2012

Customer PO No.: E.Burke Page 1 of 4

Chain of Custody No.:

## **Certificate Of Analysis**

Analysis of 3 sample(s) submitted on 20/12/2012 is now complete. We have the pleasure of enclosing your certificate of analysis.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our web site at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

Authorised By: Melissa Brady

Authorised Signatories:

**Dublin :** Miriam Byrne, Melissa Brady, Maria Nevin, Leann Hession,

Slawek Gryczewski, Ewa Krol Limerick: Hugh O'Donnell, Maurice Daffy

Note: Information on methods of analysis and performance characteristics is available on request.

Note: Results relate only to the items tested.

Test report shall not be reproduced except in full or with written approval of City Analysts Ltd.

Melssa Brady

Template 1146 Revision 014

Date:

27/12/2012



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# **Certificate of Analysis**

Customer Contact: Conor McGrath

Customer: Malone O'Regan Environmental Services

Customer Address: 28, Richview Office Park

Clonskeagh Dublin 14 Report Reference:

12-06847-MOR

Report Version: Date Received:

20/12/2012



Page 2 of 4

Sample Description: MW 6

Sample Type:Ground WaterDate Sampled:20/12/2012Lab Reference Number:142509

Site/Metho Ref.	d Analysis Start Date	Parameter	Result	Units	PV Value	Accreditation Status
D/3221	20/12/2012	Faecal Coliforms	<1	cfu/100ml	-	INAB
D/1201	20/12/2012	Coliforms	<1	MPN/100ml	-	INAB



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# **Certificate of Analysis**

Customer Contact: Conor McGrath

Customer: Malone O'Regan Environmental Services

Customer Address: 28, Richview Office Park

Clonskeagh Dublin 14 Report Reference: 12-06847-MOR

Report Version: 1

**Date Received:** 20/12/2012



Page 3 of 4

Sample Description: MW 5

Sample Type:Ground WaterDate Sampled:20/12/2012Lab Reference Number:142510

Site/Metho Ref.	d Analysis Start Date	Parameter	Result	Units	PV Value	Accreditation Status
D/3221	20/12/2012	Faecal Coliforms	1	cfu/100ml	-	INAB
D/1201	20/12/2012	Coliforms	28.5	MPN/100ml	-	INAB



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# **Certificate of Analysis**

Customer Contact: Conor McGrath

Customer: Malone O'Regan Environmental Services

Customer Address: 28, Richview Office Park

Clonskeagh Dublin 14 Report Reference: 12-06847-MOR

Report Version: 1

**Date Received:** 20/12/2012



Page 4 of 4

Sample Description: MW 4

Sample Type:Ground WaterDate Sampled:20/12/2012Lab Reference Number:142511

Site/Metho Ref.	od Analysis Start Date	Parameter	Result	Units	PV Value	Accreditation Status
D/3221	21/12/2012	Faecal Coliforms	<1	cfu/100ml	-	INAB
D/1201	20/12/2012	Coliforms	43.5	MPN/100ml	-	INAB

Date	31-Dec-12			
Client	CW		Sample Height mm	100
Test	Constant Head		Sample Diameter mm	105
	Permeability			
Site	Waterstown Lan	dfill	Sample Volume cm3	865
Soil Type	Black silty CLAY	con gravel	Initial Wet Mass g	1623
Area		NA	Final Wet Mass g	1650
S.no		1	Dry Mass g	1329
Sampling Me	ethod	U4	Bulk Density Mg/m3	1875
Depth m		0.2	Dry Density Mg/m3	1536
Borehole		BH3	Initial Water Content %	22.1
			Final Water Content %	24.2

## Saturation Stage

Initail B Value	<0.8
Back Pore Water Pressure During Saturation kPa	450
Cell Pressure kPa	420
Final B Value	0.95
Duration h	72

## Consolidation Stage

Cell pressure kPa	500
Back Pore Water Pressure kPa	450
Duration of Consolidation h	48

### Permeability Stage

Temperature C°	20
Cell Pressure kPa	500
Pore Water Pressure (Top) kPa	450
Pore Water Pressure (Bottom) kPa	470
Average Effective Stress kPa	40
Head Difference kPa	20
Head Loss kPa	2
Net Head difference m	1.83
Sample Height m	0.1
Hydraulic Gradient i	18.35
Flow Rate cm3/min	0.24
Area of the Sample cm2	80.4
Permeability m/s	2.7E-08

Checked by V Sivakumar (Reader in Geotechnical Engineering) (BSc, MSc, DIC, PhD, PGCHET, FICE, CEng, DSC)

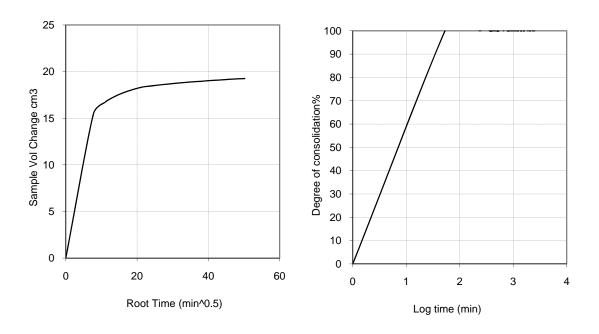


Figure 1 Volume Change Vs Root Time and degree of consolidation vs log time (Consolidation Stage)

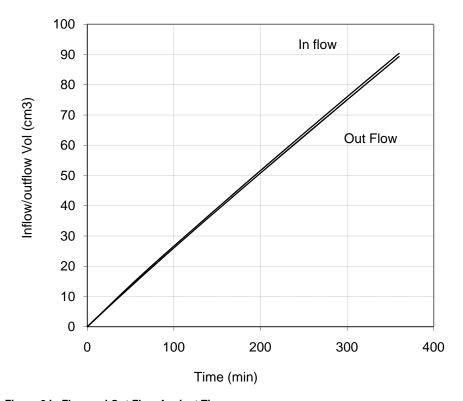


Figure 2 In Flow and Out Flow Against Time

Date	31-Dec-12			
Client	CW		Sample Height mm	100
Test	Constant Head		Sample Diameter mm	105
	Permeability			
Site	Waterstown Lan	dfill	Sample Volume cm3	865
Soil Type	Black silty CLAY	con gravel	Initial Wet Mass g	1915
Area		NA	Final Wet Mass g	1920
S.no		1	Dry Mass g	1680
Sampling Mo	ethod	U4	Bulk Density Mg/m3	2213
Depth m		0.2	Dry Density Mg/m3	1941
Borehole		BH2	Initial Water Content %	14.0
			Final Water Content %	14.3

## Saturation Stage

Initail B Value	<0.8
Back Pore Water Pressure During Saturation kPa	450
Cell Pressure kPa	420
Final B Value	0.95
Duration h	72

## Consolidation Stage

Cell pressure kPa	500
Back Pore Water Pressure kPa	450
Duration of Consolidation h	48

### Permeability Stage

Temperature C°	20
Cell Pressure kPa	500
Pore Water Pressure (Top) kPa	450
Pore Water Pressure (Bottom) kPa	470
Average Effective Stress kPa	40
Head Difference kPa	20
Head Loss kPa	2
Net Head difference m	1.83
Sample Height m	0.1
Hydraulic Gradient i	18.35
Flow Rate cm3/min	0.0068
Area of the Sample cm2	80.4
Permeability m/s	7.7E-10

Checked by V Sivakumar (Reader in Geotechnical Engineering) (BSc, MSc, DIC, PhD, PGCHET, FICE, CEng, DSC)

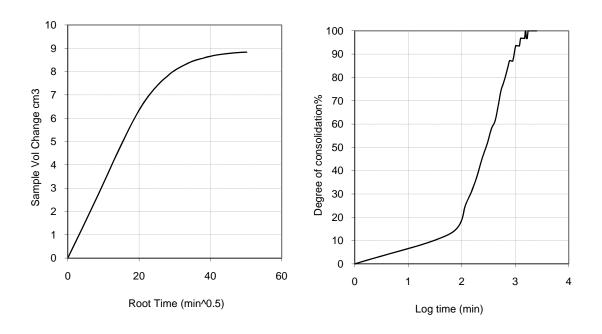


Figure 1 Volume Change Vs Root Time and degree of consolidation vs log time (Consolidation Stage)

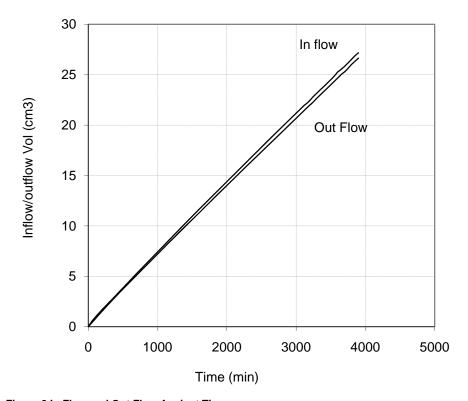


Figure 2 In Flow and Out Flow Against Time

Particle size	%		sedimen	tation	sieve sizes (mm)									
(mm)	passing			0.063	0.150	0.212	0.425	1.18	2. 3.35 5. 6.3	O # 6	28 37.5 50	w 10 0		
125	100	100		0		· · ·	<u> </u>	<del></del>	3.35	10 41 8	28 28 37.	63 75 90		
90	76													
75	76													
63	76	90												
50	76													
37.5	72	80										+		
28	64											+		
20	60	70												
14	59													
10	57													
6.3	53	60												
5	52	, ba												
3.35	50	50 – sasing %												
2	46	bas												
1.18	43													
0.6	39	40												
0.425	37													
0.3	34	30												
0.212	31													
0.15	29	20												
0.063	24													
0.0343	19.8	-												
0.0177	16.2	10												
0.0094	12.5													
0.0053	9.5 7.3	0 1												
0.0031	5.9	0.001	0.01		0.1	particle s	ize (mm)	1		10		100		
0.0015	5.9													
					fine	med	ium	coarse	fine	medium	coarse	Cobbles		
		Clay 6%	Silt 18%		Title		Gravel 31%							
		Sand 22% Gravel 31%										24%		
							Samp	ole						
		Project: Watersto	wn Landfill	Explorator	BH02	Туре	No.		(m) Sample					
		Job No.: 0		Hole No.:		В			description:					
	1				1		1 1			L				

## **Particle Size Distribution**

## BS1377:1990 Part 2 Clause 9.2 and 9.5

Particle size						se	diment															
(mm)	passing								0.063	0.150	0.212	0.300	0.600	1.18		3.35	5	0	4 ~	28	50 63 75	
125	100	100							o.	· · ·		0 0	; • • •	<del>-</del>	2	<u>κ</u> ;	ις 9 9	10	14 20	, 12 to	10 21	: 8 T
90	100																				+	
75	100		-																			
63	92	90																				
50	90																					
37.5	87	80																				+
28	82																					
20	78	70	-																			
14	76																					
10	72																					
6.3	68	60 -														•						+
5	66		වූග																			
3.35	63	50	% passing																			
2	59		o ba																			
1.18	56	40	6																			
0.6	51	40																				
0.425	49																					
0.3	47	30 -																				
0.212	45																					
0.15	43	20																				
0.063	37																					
0.0338	32.9																					
0.0175	27.2	10																				
0.0093	18.2																					
0.0032	13.6	0 -								-	•		•	<u> </u>		•			•		<b></b>	$\sqcup \hspace{-0.1cm} \sqcup$
0.0031	10.2	0.0	001			0.01				0.1	partio	cle siz	e (mm)	) 1				10				100
0.0013	10.2																					
										fine		mediu	ım	COarse		fine		med:	ium	coarse		obbles
		Clay 12% Silt 25%							Tille				coarse		fine medium coarse  Gravel 33%						8%	
									Sand 22%									Jiuve	. 33/0			
				_						San	Sample											
		Projec	t: Watersto	own Landfi	ll			Exploratory	ratory	BH03	Тур					Sample						
		Job No.: 0						Hole No.:	5.103	В			0.20	0.80	— aescribtion:							
L											<u> </u>			_1	<u> </u>	ı		1				