FASSAROE PHASE 1 SHD APPLICATION ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Volume 3 – Landfill Remediation Documentation

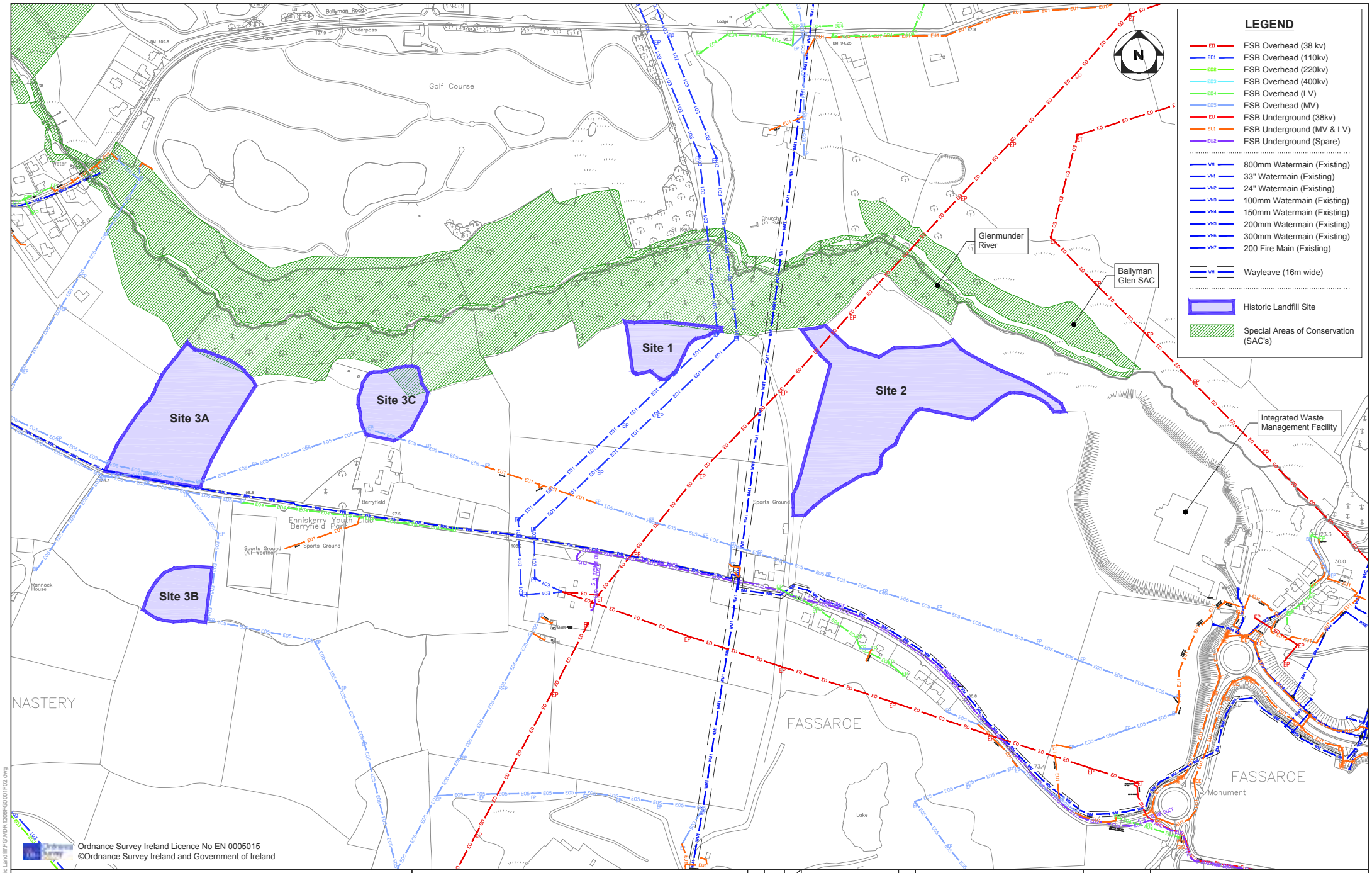
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	Part 4: Addendum to Environmental Risk Assessment, RPS, 2022

PART 1

Map of Historic Landfill Sites



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Client

Comhairle Contae Chill Mhantáin

General Notes

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(iii) DO NOT SCALE, use figured dimensions only, if in doubt ask.

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No.	Date		Amendment / Issue	App
F02	03.05.18	KD	COA APPLICATION	
F01	May '16	KD	FINAL ISSUE	

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Drawn	RH
Checked	LD
Approved	CC
Date	May 2016
Scale	1:2500 @ A1 1:5000 @ A3
Job No.	MDR1206

Project
FASSAROE HISTORIC LANDFILL

Title
PLAN SHOWING HISTORIC LANDFILL LOCATIONS, EXISTING SERVICES, WAYLEAVES & SAC's

File Ref. MDR1206FG0001F02.dwg | Drg. No. Figure 1 | Rev. F02

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PART 2

Copies of Certificates of Authorisation from EPA for Historic Landfill Sites 2, 3a, 3b and 3c

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

Closed Landfill

Certificate of Authorisation

Certificate of Authorisation Number:	**H0475-01**
Certification of Authorisation Holder:	**Wicklow County Council**
Location of Facility:	**Fassaroe 2** **Bray** **County Wicklow**

HEADQUARTERS
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WASTE MANAGEMENT (CERTIFICATION OF HISTORIC UNLICENSED WASTE DISPOSAL AND RECOVERY ACTIVITY) REGULATIONS 2008

HISTORIC LANDFILL

CERTIFICATE OF AUTHORISATION

Decision of Agency, under Regulation 7(6) of the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008

Reference Number: H0475-01

In pursuance of the powers conferred on it by the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008, the Environmental Protection Agency (the Agency) grants, under Regulation 7(6) of the said Regulations, this Certificate of Authorisation to Wicklow County Council, County Buildings, Whitegates, Wicklow Town, in respect of the closed landfill at Fassaroe 2, Bray, County Wicklow, subject to conditions set out in the Certificate of Authorisation.

A copy of the Decision is attached.

Sealed by the Seal of the Agency on this the 22nd day of November 2019

PRESENT when the seal of the Agency was affixed hereto:

Tara Gillen

Tara Gillen, Authorised Person

Glossary of Terms

All terms in this Certificate of Authorisation should be interpreted in accordance with the definitions in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008) unless otherwise defined in the Certificate of Authorisation.

Agency	Environmental Protection Agency.
Agreement	Agreement in writing.
Annually	At approximately twelve-monthly intervals.
Application	The application by the local authority for this Certificate of Authorisation including the risk assessment, any amendments to the risk assessment, additional information received from the local authority and other documents provided by the local authority.
Certificate of Authorisation	Includes this document and the application.
Closed landfill	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Code of Practice	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Biannually	All or part of a period of six consecutive months.
Documentation	Any report, record, results, data, drawing, proposal, interpretation or other document in written or electronic form which is required by this Certificate of Authorisation.
Drawing	Any reference to a drawing or drawing number means a drawing or drawing number contained in the application, unless otherwise specified in this Certificate of Authorisation.
Environmental pollution	As defined in the Waste Management Act 1996 as amended.
Incident	The following shall constitute an incident for the purposes of this Certificate of Authorisation: (i) an emergency; (ii) any emission which does not comply with the requirements of this Certificate of Authorisation; (iii) any trigger level specified in this Certificate of Authorisation which is attained or exceeded; and (iv) any indication that environmental pollution has, or may have, taken place.

Inert Waste	Waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater.
Maintain	Keep in a fit state, including such regular inspection, servicing, calibration and repair as may be necessary to perform its function adequately.
Necessary Measures	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Quarterly	All or part of a period of three consecutive months.
Risk Assessment	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Sample	Unless the context of this document indicates to the contrary, the term sample or samples shall include measurements taken by electronic instruments.
Status	As defined in the Water Framework Directive, in relation to surface water and groundwater.
The Local Authority	Wicklow County Council, County Buildings, Whitegates, Wicklow Town.
Trigger Level	A parameter value the achievement or exceedance of which requires certain actions to be taken by the local authority.

Part I Authorisation of a closed landfill

The Environmental Protection Agency (the Agency) grants, under Regulation 7(6) of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (the Regulations), this Certificate of Authorisation to Wicklow County Council, County Buildings, Whitegates, Wicklow Town, in respect of the closed landfill at Fassaroe 2, Bray, County Wicklow, subject to conditions set out in Part II and the Reasons for the Decision in Part III.

Part II Conditions

Condition 1. Scope

1.1 For the purposes of this Certificate of Authorisation, the closed landfill authorised by this Certificate of Authorisation is the area of land outlined in red on Drawing Number MDR1206FG0001F02-Figure 2 submitted with the application. Any reference in this Certificate of Authorisation to "closed landfill" shall mean the area thus outlined in red. Activities associated with the closed landfill shall be carried on only within the area outlined.

1.2 No waste shall be accepted at the closed landfill.

1.3 No waste shall be burned at the closed landfill.

1.4 The facility shall be controlled, operated and maintained, and emissions shall take place as authorised by this Certificate of Authorisation. No material change that will result in an increase in the actual or potential nature or quantity of any emission shall be carried out or commenced without the agreement of the Agency.

1.5 Nothing in this Certificate of Authorisation shall prohibit authorised beneficial uses of the site of the closed landfill that do not interfere with the integrity of the remediation measures adopted.

Reason:	*To clarify the scope of this Certificate of Authorisation.*

Condition 2. Notifications, Records and Reports

2.1 The local authority shall notify the Agency as soon as practicable after the occurrence of any incident. The incident notification shall be provided in a format as may be specified in relevant guidance issued by the Agency.

2.2 The local authority shall keep the following documents available for inspection by the Agency at all reasonable times and to members of the public by request:

2.2.1 records of all sampling, analyses, measurements, examinations, calibrations and maintenance;

2.2.2 records of incidents;

2.2.3 records of all complaints of an environmental nature;

2.2.4 the validation report prepared on completion of the remediation; and

2.2.5 other documentation required by this Certificate of Authorisation or as may be otherwise directed by the Agency.

2.3 Environmental Liabilities

The local authority shall put in place and maintain a financial provision for costs of likely events or accidents/incidents related to the closed landfill and associated works.

2.4 The local authority shall annually pay to the Agency €1,083 or such sum as the Agency from time to time determines in accordance with charges policy, for the performance of its functions under the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 in relation to the closed landfill regulated by this Certificate of Authorisation.

Reason:	*To provide for the collection and reporting of adequate information on the activity. To provide for adequate financing for monitoring and financial provisions for measures to protect the environment.*

Condition 3. Management and Monitoring

3.1 The local authority shall implement the following measures within 18 months of the date of grant of this Certificate of Authorisation, or as otherwise agreed by the Agency:

a) Prepare and implement a programme of 24-hour pumping trials for seven days, at a minimum of 3 gas yielding monitoring locations (12% v/v or above) to determine the quantity and characteristics of the landfill gas. This programme shall be submitted to the Agency and approval obtained in advance of implementation. The monitoring programme shall be completed within 4 months of the date of this Certificate of Authorisation.

b) In the event that methane values consistently exceed 12% v/v, install measures for extracting and treating landfill gas by flaring or another suitable technique that is satisfactory to the Agency.

c) Install a low permeability landfill cap, minimum 1m, with 1mm thick low permeability geomembrane having a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s.

d) Unless otherwise agreed by the Agency, install gas protection measures including:

(i) the installation of a virtual gas curtain along the boundary of the capped landfill;

(ii) Geo-composite nodes inserted at 1m intervals along the curtain length;

(iii) 3m high vent stacks located at every 20 – 25 m intervals;

(iv) collection duct constructed over the nodes which dilutes any gas and vents it to the atmosphere via vent bollards.

e) Unless otherwise approved by the Agency, install gas vents in the landfill body at appropriate locations such that the increased back-pressure caused by the cap does not result in increased lateral movement of gas.

f) Install appropriate surface water collection measures to ensure that the water is drained towards the perimeter of the waste body through a subsurface drain.

g) Carry out slope stabilisation measures where slope failures have occurred, and where potentially unstable slopes have been identified, along the northern boundary.

h) Minimise the disturbance of deposited waste to the extent possible.

i) Take appropriate remedial actions to identify and eradicate invasive species (including, but not limited to, Japanese knotweed) growing at the site.

3.2 The local authority shall manage the closed landfill to ensure that discharges and emissions from the closed landfill do not cause environmental pollution or deterioration in the status of the receiving surface water body or groundwater body.

3.3 The local authority shall compile a validation report in accordance with the requirements of the Code of Practice. Unless otherwise agreed, the validation report shall be submitted to the Agency within 30 months of the date of grant of this Certificate of Authorisation.

3.4 The local authority shall assess the results of all monitoring carried out to confirm whether the closed landfill continues to achieve the objectives set for it in the risk assessment or this Certificate of Authorisation.

3.5 The local authority shall biannually conduct and record:

a) a visual inspection of the landfill to ensure that the condition of the site has not deteriorated;

b) monitoring for leachate (sample, analyse, characterise, and measure the level of leachate) in all leachate monitoring boreholes;

c) quarterly monitoring to detect the presence and concentration of landfill gas in all monitoring boreholes;

d) monitoring (sample, analyse and characterise) of relevant surface waters both upstream and downstream of the closed landfill;

e) monitoring (sample, analyse and characterise) of groundwater from at least three available groundwater monitoring boreholes, two of which shall be downgradient of the closed landfill; and

f) the assessment of monitoring results against trigger levels and/or standard reference values for relevant pollutants including environmental quality standards in the European Communities Environmental Objectives (Surface Waters) Regulations 2009 and European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended.

3.6 The following are the trigger levels for landfill gas emissions from the facility measured in any service duct or manhole on, at or immediately adjacent to the facility and/or at any other point located outside the body of the waste:-

a) Methane, greater than or equal to 1.0% v/v; or

b) Carbon dioxide, greater than or equal to 1.5% v/v.

3.7 In relation to surface emissions measured over the waste body and identified features, the following shall constitute a trigger level: -

a) VOC greater than or equal to 50ppmv as methane average over capped area; or

b) VOC greater than or equal to 100ppmv as methane instantaneous reading on open surfaces within the landfill footprint; or

c) VOC greater than or equal to 500ppmv as methane around all identified features.

3.8 The location, frequency, methods and scope of monitoring, sampling and analyses, as set out in this Certificate of Authorisation, may be amended with the agreement of the Agency.

3.9 Soil and stone imported for use in remedial, corrective or other engineering works at the closed landfill shall be greenfield soil and stone or soil and stone of equivalent nature and character in terms of chemical and physical contamination.

Documented acceptance, storage/stockpiling and utilisation procedures shall be operational in advance of receipt of such materials. Records shall be maintained showing the site of origin of the soil and stone and its nature.

3.10 No emissions, including odours and noise, from works carried on at the site shall result in an impairment of, or an interference with amenities or the environment beyond the facility boundary or any other legitimate uses of the environment beyond the facility boundary.

3.11 The local authority shall ensure that the closed landfill does not result in an impairment of, or an interference with, amenities or the environment at the facility or beyond the facility boundary (including those arising from emissions (including odours, noise, dust, litter and mud), vermin and birds).

3.12 Wells and boreholes

3.12.1 Groundwater monitoring wells shall be constructed having regard to the guidance given in the Agency's landfill manual "Landfill Monitoring".

3.12.2 All wellheads shall be adequately protected to prevent contamination or physical damage.

3.12.3 All wells & boreholes shall be adequately sealed to prevent surface contamination and, as may be appropriate, decommissioned in accordance with the UK Environment Agency guidelines

"Decommissioning Redundant Boreholes and Wells", unless otherwise agreed by the Agency.

3.13 The local authority shall clearly label and provide safe and permanent access to all on-site sampling and monitoring points and to off-site points as required by the risk assessment or this Certificate of Authorisation. The requirement with regard to off-site points is subject to the prior agreement of the landowners concerned.

3.14 Incidents

In the event of an incident the local authority shall immediately:

(i) if necessary, contact the emergency services;

(ii) carry out an investigation to identify the nature, source and cause of the incident and any emission arising therefrom;

(iii) isolate the source of any such emission;

(iv) evaluate the environmental pollution, if any, caused by the incident;

(v) identify and execute measures to minimise the emissions/malfunction and the effects thereof;

(vi) identify the date, time and place of the incident; and

(vii) notify the Agency (in accordance with Condition 2.1) and all other relevant authorities including, where relevant, the Water Services Authority and Inland Fisheries Ireland.

3.15 Communications

a) The local authority shall establish, maintain and implement a communications programme to inform the occupiers and owners of land and buildings adjacent to the closed landfill of the risks posed by landfill gas and its migration.

b) The communications programme shall inform future occupiers and owners of properties what they can and should do to protect their property and health and members of the public.

c) The local authority shall communicate directly, either in writing or in person, at least once each year with said occupiers and owners of properties.

d) The local authority shall, as part of the communications programme, publish gas monitoring data quarterly and water monitoring data bi-annually in a manner accessible by the public.

Reason: *To make provision for the proper closure of the activity ensuring protection of the environment.*

Part III: Schedules

Schedule 1: Reasons for the Decision

In granting this Certificate of Authorisation, the Agency determines that the risk assessment submitted by the local authority as part of the application for a Certificate of Authorisation is adequate. To ensure appropriate protection for human health and the environment and to ensure conformity with the provisions of Council Directive 2006/12/EC and Council Directive 80/68/EC, the conditions set out in Part II of this Certificate of Authorisation are specified as further necessary measures in addition to those identified by the risk assessment.

A screening for Appropriate Assessment was undertaken to assess, in view of best scientific knowledge and the conservation objectives of the site, if the activity, individually or in combination with other plans or projects is likely to have a significant effect on any European Site. In this context, particular attention was paid to the European Site at the Ballyman Glen SAC [Site Code: 000713].

The activity is not directly connected with or necessary to the management of any European Site and the Agency considered, for the reasons set out below, that it cannot be excluded, on the basis of objective information, that the activity, individually or in combination with other plans or projects, will have a significant effect on any European Site and accordingly determined that an Appropriate Assessment of the activity was required. The reasons for this determination are as follows:

- the northern boundary of the landfill site is adjacent to, and within the Ballyman Glen SAC [Site Code: 000713].
- slope failures and potentially unstable slopes have been recorded along the northern boundary of the landfill site adjacent to, and within the Ballyman Glen SAC [Site Code: 000713].

The Agency has completed the Appropriate Assessment of potential impacts on these sites and has made certain, based on best scientific knowledge in the field and in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, pursuant to Article 6(3) of the Habitats Directive, that the activity, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site, in particular the Ballyman Glen SAC [Site Code: 000713], having regard to their conservation objectives and will not affect the preservation of these sites at favourable conservation status if carried out in accordance with the application and risk assessment, this Certificate of Authorisation and the conditions attached hereto for the following reasons:

- Specifically, the remedial works will be undertaken to avoid the potential for water pollution and will ensure that there will be no significant impact on Ballyman Glen SAC [Site Code: 000713], and with a further objective to result in positive impacts to current water quality conditions.
- the project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Ballyman Glen SAC [Site Code: 000713].
- Condition 3.5 requires ongoing environmental assessment and monitoring.

The Agency is satisfied that no reasonable scientific doubt remains as to the absence of adverse effects on the integrity of the European Site: Ballyman Glen SAC [Site Code: 000713].

Part IV: SIGNATURE

Sealed by the Seal of the Agency on this the 22nd day of November 2019

PRESENT when the Seal of the Agency was affixed hereto:

Tara Gillen

Tara Gillen, Authorised Person

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

Closed Landfill

Certificate of Authorisation

Certificate of Authorisation Number:	**H0477-02**
Certification of Authorisation Holder:	**Wicklow County Council**
Location of Facility:	**Fassaroe 3A** **Bray** **County Wicklow**

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

HEADQUARTERS
JOHNSTOWN CASTLE ESTATE
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WASTE MANAGEMENT (CERTIFICATION OF HISTORIC UNLICENSED WASTE DISPOSAL AND RECOVERY ACTIVITY) REGULATIONS 2008

HISTORIC LANDFILL

CERTIFICATE OF AUTHORISATION

Decision of Agency, under Regulation 7(6) of the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008

Reference Number: H0477-02

In pursuance of the powers conferred on it by the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008, the Environmental Protection Agency (the Agency) grants, under Regulation 7(6) of the said Regulations, this Certificate of Authorisation to Wicklow County Council, County Buildings, Whitegates, Wicklow Town, in respect of the closed landfill at Fassaroe 3A, Bray, County Wicklow, subject to conditions set out in the Certificate of Authorisation.

A copy of the Decision is attached.

Sealed by the Seal of the Agency on this the 22nd day of November 2019

PRESENT when the seal of the Agency was affixed hereto:

Tara Gillen

Tara Gillen, Authorised Person

Glossary of Terms

All terms in this Certificate of Authorisation should be interpreted in accordance with the definitions in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008) unless otherwise defined in the Certificate of Authorisation.

Agency	Environmental Protection Agency.
Agreement	Agreement in writing.
Annually	At approximately twelve-monthly intervals.
Application	The application by the local authority for this Certificate of Authorisation including the risk assessment, any amendments to the risk assessment, additional information received from the local authority and other documents provided by the local authority.
Certificate of Authorisation	Includes this document and the application.
Closed landfill	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Code of Practice	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Biannually	All or part of a period of six consecutive months.
Documentation	Any report, record, results, data, drawing, proposal, interpretation or other document in written or electronic form which is required by this Certificate of Authorisation.
Drawing	Any reference to a drawing or drawing number means a drawing or drawing number contained in the application, unless otherwise specified in this Certificate of Authorisation.
Environmental pollution	As defined in the Waste Management Act 1996 as amended.
Incident	The following shall constitute an incident for the purposes of this Certificate of Authorisation: (i) an emergency; (ii) any emission which does not comply with the requirements of this Certificate of Authorisation; (iii) any trigger level specified in this Certificate of Authorisation which is attained or exceeded; and (iv) any indication that environmental pollution has, or may have, taken place.

Inert Waste	Waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater.
Maintain	Keep in a fit state, including such regular inspection, servicing, calibration and repair as may be necessary to perform its function adequately.
Necessary Measures	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Quarterly	All or part of a period of three consecutive months.
Risk Assessment	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Sample	Unless the context of this document indicates to the contrary, the term sample or samples shall include measurements taken by electronic instruments.
Status	As defined in the Water Framework Directive, in relation to surface water and groundwater.
The Local Authority	Wicklow County Council, County Buildings, Whitegates, Wicklow Town.
Trigger Level	A parameter value the achievement or exceedance of which requires certain actions to be taken by the local authority.

Part I Authorisation of a closed landfill

The Environmental Protection Agency (the Agency) grants, under Regulation 7(6) of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (the Regulations), this Certificate of Authorisation to Wicklow County Council, County Buildings, Whitegates, Wicklow Town, in respect of the closed landfill at Fassaroe 3A, Bray, County Wicklow, subject to conditions set out in Part II and the Reasons for the Decision in Part III.

Part II Conditions

Condition 1. Scope

1.1 For the purposes of this Certificate of Authorisation, the closed landfill authorised by this Certificate of Authorisation is the area of land outlined in red on Drawing Number MDR1206FG0001F02-Figure 3 submitted with the application. Any reference in this Certificate of Authorisation to "closed landfill" shall mean the area thus outlined in red. Activities associated with the closed landfill shall be carried on only within the area outlined.

1.2 No waste shall be accepted at the closed landfill.

1.3 No waste shall be burned at the closed landfill.

1.4 The facility shall be controlled, operated and maintained, and emissions shall take place as authorised by this Certificate of Authorisation. No material change that will result in an increase in the actual or potential nature or quantity of any emission shall be carried out or commenced without the agreement of the Agency.

1.5 Nothing in this Certificate of Authorisation shall prohibit authorised beneficial uses of the site of the closed landfill that do not interfere with the integrity of the remediation measures adopted.

Reason: *To clarify the scope of this Certificate of Authorisation.*

Condition 2. Notifications, Records and Reports

2.1 The local authority shall notify the Agency as soon as practicable after the occurrence of any incident. The incident notification shall be provided in a format as may be specified in relevant guidance issued by the Agency.

2.2 The local authority shall keep the following documents available for inspection by the Agency at all reasonable times and to members of the public by request:

2.2.1 records of all sampling, analyses, measurements, examinations, calibrations and maintenance;

2.2.2 records of incidents;

2.2.3 records of all complaints of an environmental nature;

2.2.4 the validation report prepared on completion of the remediation; and

2.2.5 other documentation required by this Certificate of Authorisation or as may be otherwise directed by the Agency.

2.3 Environmental Liabilities

The local authority shall put in place and maintain a financial provision for costs of likely events or accidents/incidents related to the closed landfill and associated works.

2.4 The local authority shall annually pay to the Agency €1,083, or such sum as the Agency from time to time determines in accordance with charges policy, for the performance of its functions under the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 in relation to the closed landfill regulated by this Certificate of Authorisation.

Reason:	*To provide for the collection and reporting of adequate information on the activity. To provide for adequate financing for monitoring and financial provisions for measures to protect the environment.*

Condition 3. Management and Monitoring

3.1 The local authority shall implement the following measures within 18 months of the date of grant of this Certificate of Authorisation, or as otherwise agreed by the Agency.

a) Prepare and implement a programme of 24-hour pumping trials for seven days, at a minimum of 2 gas yielding monitoring locations (12% v/v or above) to determine the quantity and characteristics of the landfill gas. This programme shall be submitted to the Agency and approval obtained in advance of implementation. The monitoring programme shall be completed within 4 months of the date of this Certificate of Authorisation.

b) In the event that methane values consistently exceed 12% v/v, install measures for extracting and treating landfill gas by flaring or another suitable technique that is satisfactory to the Agency.

c) Install a low permeability landfill cap, minimum 1m, with 1mm thick low permeability geomembrane having a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s.

d) Unless otherwise agreed by the Agency, install gas protection measures including:

(i) the installation of a virtual gas curtain along the boundary of the capped landfill;

(ii) Geo-composite nodes inserted at 1m intervals along the curtain length;

(iii) 3m high vent stacks located at every 20 – 25 m intervals;

(iv) collection duct constructed over the nodes which dilutes any gas and vents it to the atmosphere via vent bollards.

e) Unless otherwise approved by the Agency, install gas vents in the landfill body at appropriate locations such that the increased back-pressure caused by the cap does not result in increased lateral movement of gas.

f) Install appropriate surface water collection measures to ensure that the water is drained towards the perimeter of the waste body through a subsurface drain.

g) Carry out slope stabilisation measures where slope failures have occurred, and where potentially unstable slopes have been identified, along the northern boundary.

h) Minimise the disturbance of deposited waste to the extent possible.

3.2 The local authority shall manage the closed landfill to ensure that discharges and emissions from the closed landfill do not cause environmental pollution or deterioration in the status of the receiving surface water body or groundwater body.

3.3 The local authority shall compile a validation report in accordance with the requirements of the Code of Practice. Unless otherwise agreed, the validation report shall be submitted to the Agency within 30 months of the date of grant of this Certificate of Authorisation.

3.4 The local authority shall assess the results of all monitoring carried out to confirm whether the closed landfill continues to achieve the objectives set for it in the risk assessment or this Certificate of Authorisation.

3.5 The local authority shall biannually conduct and record:

a) a visual inspection of the landfill to ensure that the condition of the site has not deteriorated;

b) monitoring for leachate (sample, analyse, characterise, and measure the level of leachate) in all leachate monitoring boreholes;

c) quarterly monitoring to detect the presence and concentration of landfill gas in all monitoring boreholes;

d) monitoring (sample, analyse and characterise) of relevant surface waters both upstream and downstream of the closed landfill;

e) monitoring (sample, analyse and characterise) of groundwater from at least three available groundwater monitoring boreholes, two of which shall be downgradient of the closed landfill; and

f) the assessment of monitoring results against trigger levels and/or standard reference values for relevant pollutants including environmental quality standards in the European Communities Environmental Objectives (Surface Waters) Regulations 2009 and European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended.

3.6 The following are the trigger levels for landfill gas emissions from the facility measured in any service duct or manhole on, at or immediately adjacent to the facility and/or at any other point located outside the body of the waste:-

a) Methane, greater than or equal to 1.0% v/v; or

b) Carbon dioxide, greater than or equal to 1.5% v/v

3.7 In relation to surface emissions measured over the waste body and identified features, the following shall constitute a trigger level:-

a) VOC greater than or equal to 50ppmv as methane average over capped area; or

b) VOC greater than or equal to 100ppmv as methane instantaneous reading on open surfaces within the landfill footprint; or

c) VOC greater than or equal to 500ppmv as methane around all identified features.

3.8 The location, frequency, methods and scope of monitoring, sampling and analyses, as set out in this Certificate of Authorisation, may be amended with the agreement of the Agency.

3.9 Soil and stone imported for use in remedial, corrective or other engineering works at the closed landfill shall be greenfield soil and stone or soil and stone of equivalent nature and character in terms of chemical and physical contamination.

Documented acceptance, storage/stockpiling and utilisation procedures shall be operational in advance of receipt of such materials. Records shall be maintained showing the site of origin of the soil and stone and its nature.

3.10 No emissions, including odours and noise, from works carried on at the site shall result in an impairment of, or an interference with amenities or the environment beyond the facility boundary or any other legitimate uses of the environment beyond the facility boundary.

3.11 The local authority shall ensure that the closed landfill does not result in an impairment of, or an interference with, amenities or the environment at the facility or beyond the facility boundary (including those arising from emissions (including odours, noise, dust, litter and mud), vermin and birds).

3.12 Wells and boreholes

3.12.1 Groundwater monitoring wells shall be constructed having regard to the guidance given in the Agency's landfill manual "Landfill Monitoring".

3.12.2 All wellheads shall be adequately protected to prevent contamination or physical damage.

3.12.3 All wells & boreholes shall be adequately sealed to prevent surface contamination and, as may be appropriate, decommissioned in accordance with the UK Environment Agency guidelines "Decommissioning Redundant Boreholes and Wells", unless otherwise agreed by the Agency.

3.13 The local authority shall clearly label and provide safe and permanent access to all on-site sampling and monitoring points and to off-site points as required by the risk assessment or this Certificate of Authorisation. The requirement with regard to off-site points is subject to the prior agreement of the landowners concerned.

3.14 Incidents

In the event of an incident the local authority shall immediately:

(i) if necessary, contact the emergency services;

(ii) carry out an investigation to identify the nature, source and cause of the incident and any emission arising therefrom;

(iii) isolate the source of any such emission;

(iv) evaluate the environmental pollution, if any, caused by the incident;

(v) identify and execute measures to minimise the emissions/malfunction and the effects thereof;

(vi) identify the date, time and place of the incident; and

(vii) notify the Agency (in accordance with Condition 2.1) and all other relevant authorities including, where relevant, the Water Services Authority and Inland Fisheries Ireland.

3.15 Communications

a) The local authority shall establish, maintain and implement a communications programme to inform the occupiers and owners of land and buildings adjacent to the closed landfill of the risks posed by landfill gas and its migration.

b) The communications programme shall inform future occupiers and owners of properties what they can and should do to protect their property and health and members of the public.

c) The local authority shall communicate directly, either in writing or in person, at least once each year with said occupiers and owners of properties.

d) The local authority shall, as part of the communications programme, publish gas monitoring data quarterly and water monitoring data bi-annually in a manner accessible by the public.

Reason: *To make provision for the proper closure of the activity ensuring protection of the environment.*

Part III: Schedules

Schedule 1: Reasons for the Decision

In granting this Certificate of Authorisation, the Agency determines that the risk assessment submitted by the local authority as part of the application for a Certificate of Authorisation is adequate. To ensure appropriate protection for human health and the environment and to ensure conformity with the provisions of Council Directive 2006/12/EC and Council Directive 80/68/EC, the conditions set out in Part II of this Certificate of Authorisation are specified as further necessary measures in addition to those identified by the risk assessment.

A screening for Appropriate Assessment was undertaken to assess, in view of best scientific knowledge and the conservation objectives of the site, if the activity, individually or in combination with other plans or projects is likely to have a significant effect on any European Site. In this context, particular attention was paid to the European Site at the Ballyman Glen SAC [Site Code: 000713].

The activity is not directly connected with or necessary to the management of any European Site and the Agency considered, for the reasons set out below, that it cannot be excluded, on the basis of objective information, that the activity, individually or in combination with other plans or projects, will have a significant effect on any European Site and accordingly determined that an Appropriate Assessment of the activity was required. The reasons for this determination are as follows:

- the northern boundary of the landfill site is adjacent to, and within the Ballyman Glen SAC [Site Code: 000713].
- slope failures and potentially unstable slopes have been recorded along the northern boundary of the landfill site adjacent to, and within the Ballyman Glen SAC [Site Code: 000713].

The Agency has completed the Appropriate Assessment of potential impacts on these sites and has made certain, based on best scientific knowledge in the field and in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, pursuant to Article 6(3) of the Habitats Directive, that the activity, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site, in particular the Ballyman Glen SAC [Site Code: 000713], having regard to their conservation objectives and will not affect the preservation of these sites at favourable conservation status if carried out in accordance with the application and risk assessment, this Certificate of Authorisation and the conditions attached hereto for the following reasons:

- Specifically, the remedial works will be undertaken to avoid the potential for water pollution and will ensure that there will be no significant impact on Ballyman Glen SAC [Site Code: 000713], and with a further objective to result in positive impacts to current water quality conditions.
- the project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Ballyman Glen SAC [Site Code: 000713].

- Condition 3.5 requires ongoing environmental assessment and monitoring.

The Agency is satisfied that no reasonable scientific doubt remains as to the absence of adverse effects on the integrity of the European Sites: Ballyman Glen SAC [Site Code: 000713].

Part IV: SIGNATURE

Sealed by the Seal of the Agency on this the 22nd day of November 2019

PRESENT when the Seal of the Agency was affixed hereto:

Tara Gillen

Tara Gillen, Authorised Person

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

Closed Landfill

Certificate of Authorisation

Certificate of Authorisation Number:	**H0476-01**
Certification of Authorisation Holder:	**Wicklow County Council**
Location of Facility:	**Fassaroe 3B** **Bray** **County Wicklow**

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

HEADQUARTERS
JOHNSTOWN CASTLE ESTATE
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WASTE MANAGEMENT (CERTIFICATION OF HISTORIC UNLICENSED WASTE DISPOSAL AND RECOVERY ACTIVITY) REGULATIONS 2008

HISTORIC LANDFILL

CERTIFICATE OF AUTHORISATION

Decision of Agency, under Regulation 7(6) of the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008

Reference Number: H0476-01

In pursuance of the powers conferred on it by the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008, the Environmental Protection Agency (the Agency) grants, under Regulation 7(6) of the said Regulations, this Certificate of Authorisation to Wicklow County Council, County Buildings, Whitegates, Wicklow Town, in respect of the closed landfill at Fassaroe 3B, Bray, County Wicklow, subject to conditions set out in the Certificate of Authorisation.

A copy of the Decision is attached.

Sealed by the Seal of the Agency on this the 22nd day of November 2019

PRESENT when the seal of the Agency was affixed hereto:

Tara Gillen

Tara Gillen, Authorised Person

Glossary of Terms

All terms in this Certificate of Authorisation should be interpreted in accordance with the definitions in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008) unless otherwise defined in the Certificate of Authorisation.

Agency	Environmental Protection Agency.
Agreement	Agreement in writing.
Annually	At approximately twelve-monthly intervals.
Application	The application by the local authority for this Certificate of Authorisation including the risk assessment, any amendments to the risk assessment, additional information received from the local authority and other documents provided by the local authority.
Certificate of Authorisation	Includes this document and the application.
Closed landfill	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Code of Practice	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Biannually	All or part of a period of six consecutive months.
Documentation	Any report, record, results, data, drawing, proposal, interpretation or other document in written or electronic form which is required by this Certificate of Authorisation.
Drawing	Any reference to a drawing or drawing number means a drawing or drawing number contained in the application, unless otherwise specified in this Certificate of Authorisation.
Environmental pollution	As defined in the Waste Management Act 1996 as amended.
Incident	The following shall constitute an incident for the purposes of this Certificate of Authorisation: (i) an emergency; (ii) any emission which does not comply with the requirements of this Certificate of Authorisation; (iii) any trigger level specified in this Certificate of Authorisation which is attained or exceeded; and (iv) any indication that environmental pollution has, or may have, taken place.

Inert Waste	Waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater.
Maintain	Keep in a fit state, including such regular inspection, servicing, calibration and repair as may be necessary to perform its function adequately.
Necessary Measures	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Quarterly	All or part of a period of three consecutive months.
Risk Assessment	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Sample	Unless the context of this document indicates to the contrary, the term sample or samples shall include measurements taken by electronic instruments.
Status	As defined in the Water Framework Directive, in relation to surface water and groundwater.
The Local Authority	Wicklow County Council, County Buildings, Whitegates, Wicklow Town.
Trigger Level	A parameter value the achievement or exceedance of which requires certain actions to be taken by the local authority.

Part I Authorisation of a closed landfill

The Environmental Protection Agency (the Agency) grants, under Regulation 7(6) of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (the Regulations), this Certificate of Authorisation to Wicklow County Council, County Buildings, Whitegates, Wicklow Town, in respect of the closed landfill at Fassaroe 3B, Bray, County Wicklow, subject to conditions set out in Part II and the Reasons for the Decision in Part III.

Part II Conditions

Condition 1. Scope

1.1 For the purposes of this Certificate of Authorisation, the closed landfill authorised by this Certificate of Authorisation is the area of land outlined in red on Drawing Number MDR1206FG0001F02-Figure 4 submitted with the application. Any reference in this Certificate of Authorisation to "closed landfill" shall mean the area thus outlined in red. Activities associated with the closed landfill shall be carried on only within the area outlined.

1.2 No waste shall be accepted at the closed landfill.

1.3 No waste shall be burned at the closed landfill.

1.4 The facility shall be controlled, operated and maintained, and emissions shall take place as authorised by this Certificate of Authorisation. No material change that will result in an increase in the actual or potential nature or quantity of any emission shall be carried out or commenced without the agreement of the Agency.

1.5 Nothing in this Certificate of Authorisation shall prohibit authorised beneficial uses of the site of the closed landfill that do not interfere with the integrity of the remediation measures adopted.

Reason: *To clarify the scope of this Certificate of Authorisation.*

Condition 2. Notifications, Records and Reports

2.1 The local authority shall notify the Agency as soon as practicable after the occurrence of any incident. The incident notification shall be provided in a format as may be specified in relevant guidance issued by the Agency.

2.2 The local authority shall keep the following documents available for inspection by the Agency at all reasonable times and to members of the public by request:

2.2.1 records of all sampling, analyses, measurements, examinations, calibrations and maintenance;

2.2.2 records of incidents;

2.2.3 records of all complaints of an environmental nature;

2.2.4 the validation report prepared on completion of the remediation; and

2.2.5 other documentation required by this Certificate of Authorisation or as may be otherwise directed by the Agency.

2.3 Environmental Liabilities

The local authority shall put in place and maintain a financial provision for costs of likely events or accidents/incidents related to the closed landfill and associated works.

2.4 The local authority shall annually pay to the Agency €1,083, or such sum as the Agency from time to time determines in accordance with charges policy, for the performance of its functions under the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 in relation to the closed landfill regulated by this Certificate of Authorisation.

Reason:	*To provide for the collection and reporting of adequate information on the activity. To provide for adequate financing for monitoring and financial provisions for measures to protect the environment.*

Condition 3. Management and Monitoring

3.1 The local authority shall implement the following measures within 18 months of the date of grant of this Certificate of Authorisation, or as otherwise agreed by the Agency.

a) Prepare and implement a programme of 24-hour pumping trials for seven days, at a minimum of one gas yielding monitoring locations (12% v/v or above) to determine the quantity and characteristics of the landfill gas. This programme shall be submitted to the Agency and approval obtained in advance of implementation. The monitoring programme shall be completed within 4 months of the date of this Certificate of Authorisation.

b) In the event that methane values consistently exceed 12% v/v, install measures for extracting and treating landfill gas by flaring or another suitable technique that is satisfactory to the Agency.

c) Install a low permeability landfill cap, minimum 1m, with 1mm thick low permeability geomembrane having a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s.

d) Unless otherwise agreed by the Agency, install gas protection measures including:

(i) the installation of a virtual gas curtain along the boundary of the capped landfill;

(ii) Geo-composite nodes inserted at 1m intervals along the curtain length;

(iii) 3m high vent stacks located at every 20 – 25 m intervals;

(iv) collection duct constructed over the nodes which dilutes any gas and vents it to the atmosphere via vent bollards.

e) Unless otherwise approved by the Agency, install gas vents in the landfill body at appropriate locations such that the increased back-pressure caused by the cap does not result in increased lateral movement of gas.

f) Install appropriate surface water collection measures to ensure that the water is drained towards the perimeter of the waste body through a subsurface drain.

g) Minimise the disturbance of deposited waste to the extent possible.

3.2 The local authority shall manage the closed landfill to ensure that discharges and emissions from the closed landfill do not cause environmental pollution or deterioration in the status of the receiving surface water body or groundwater body.

3.3 The local authority shall compile a validation report in accordance with the requirements of the Code of Practice. Unless otherwise agreed, the validation report shall be submitted to the Agency within 30 months of the date of grant of this Certificate of Authorisation.

3.4 The local authority shall assess the results of all monitoring carried out to confirm whether the closed landfill continues to achieve the objectives set for it in the risk assessment or this Certificate of Authorisation.

3.5 The local authority shall biannually conduct and record:

a) a visual inspection of the landfill to ensure that the condition of the site has not deteriorated;

b) monitoring for leachate (sample, analyse, characterise, and measure the level of leachate) in all leachate monitoring boreholes;

c) quarterly monitoring to detect the presence and concentration of landfill gas in all monitoring boreholes;

d) monitoring (sample, analyse and characterise) of relevant surface waters both upstream and downstream of the closed landfill;

e) monitoring (sample, analyse and characterise) of groundwater from at least three available groundwater monitoring boreholes, two of which shall be downgradient of the closed landfill; and

f) the assessment of monitoring results against trigger levels and/or standard reference values for relevant pollutants including environmental quality standards in the European Communities Environmental Objectives (Surface Waters) Regulations 2009 and European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended.

3.6 The following are the trigger levels for landfill gas emissions from the facility measured in any service duct or manhole on, at or immediately adjacent to the facility and/or at any other point located outside the body of the waste: -

a) Methane, greater than or equal to 1.0% v/v; or

b) Carbon dioxide, greater than or equal to 1.5% v/v.

3.7 In relation to surface emissions measured over the waste body and identified features, the following shall constitute a trigger level:-

a) VOC greater than or equal to 50ppmv as methane average over capped area; or

b) VOC greater than or equal to 100ppmv as methane instantaneous reading on open surfaces within the landfill footprint; or

c) VOC greater than or equal to 500ppmv as methane around all identified features.

3.8 The location, frequency, methods and scope of monitoring, sampling and analyses, as set out in this Certificate of Authorisation, may be amended with the agreement of the Agency.

3.9 Soil and stone imported for use in remedial, corrective or other engineering works at the closed landfill shall be greenfield soil and stone or soil and stone of equivalent nature and character in terms of chemical and physical contamination.

Documented acceptance, storage/stockpiling and utilisation procedures shall be operational in advance of receipt of such materials. Records shall be maintained showing the site of origin of the soil and stone and its nature.

3.10 No emissions, including odours and noise, from works carried on at the site shall result in an impairment of, or an interference with amenities or the environment beyond the facility boundary or any other legitimate uses of the environment beyond the facility boundary.

3.11 The local authority shall ensure that the closed landfill does not result in an impairment of, or an interference with, amenities or the environment at the facility or beyond the facility boundary (including those arising from emissions (including odours, noise, dust, litter and mud), vermin and birds).

3.12 Wells and boreholes

3.12.1 Groundwater monitoring wells shall be constructed having regard to the guidance given in the Agency's landfill manual "Landfill Monitoring".

3.12.2 All wellheads shall be adequately protected to prevent contamination or physical damage.

3.12.3 All wells & boreholes shall be adequately sealed to prevent surface contamination and, as may be appropriate, decommissioned in accordance with the UK Environment Agency guidelines "Decommissioning Redundant Boreholes and Wells", unless otherwise agreed by the Agency.

3.13 The local authority shall clearly label and provide safe and permanent access to all on-site sampling and monitoring points and to off-site points as required by the risk assessment or this Certificate of Authorisation. The requirement with regard to off-site points is subject to the prior agreement of the landowners concerned.

3.14 Incidents

In the event of an incident the local authority shall immediately:

(i) if necessary, contact the emergency services;

(ii) carry out an investigation to identify the nature, source and cause of the incident and any emission arising therefrom;

(iii) isolate the source of any such emission;

(iv) evaluate the environmental pollution, if any, caused by the incident;

(v) identify and execute measures to minimise the emissions/malfunction and the effects thereof;

(vi) identify the date, time and place of the incident; and

(vii) notify the Agency (in accordance with Condition 2.1) and all other relevant authorities including, where relevant, the Water Services Authority and Inland Fisheries Ireland.

3.15 Communications

a) The local authority shall establish, maintain and implement a communications programme to inform the occupiers and owners of land and buildings adjacent to the closed landfill of the risks posed by landfill gas and its migration.

b) The communications programme shall inform future occupiers and owners of properties what they can and should do to protect their property and health and members of the public.

c) The local authority shall communicate directly, either in writing or in person, at least once each year with said occupiers and owners of properties.

d) The local authority shall, as part of the communications programme, publish gas monitoring data quarterly and water monitoring data bi-annually in a manner accessible by the public.

Reason: *To make provision for the proper closure of the activity ensuring protection of the environment.*

Part III: Schedules

Schedule 1: Reasons for the Decision

In granting this Certificate of Authorisation, the Agency determines that the risk assessment submitted by the local authority as part of the application for a Certificate of Authorisation is adequate. To ensure appropriate protection for human health and the environment and to ensure conformity with the provisions of Council Directive 2006/12/EC and Council Directive 80/68/EC, the conditions set out in Part II of this Certificate of Authorisation are specified as further necessary measures in addition to those identified by the risk assessment.

A screening for Appropriate Assessment was undertaken to assess, in view of best scientific knowledge and the conservation objectives of the site, if the activity, individually or in combination with other plans or projects is likely to have a significant effect on any European Site. In this context, particular attention was paid to the European Site at the Ballyman Glen SAC [Site Code: 000713].

The activity is not directly connected with or necessary to the management of any European Site and the Agency considered, for the reasons set out below, that it cannot be excluded, on the basis of objective information, that the activity, individually or in combination with other plans or projects, will have a significant effect on any European Site and accordingly determined that an Appropriate Assessment of the activity was required. The reasons for this determination are as follows:

- though this landfill site is situated approximately 70 m south of the Ballyman Glen SAC [Site Code: 000713], there is groundwater connectivity between the landfill site and the SAC.

The Agency has completed the Appropriate Assessment of potential impacts on these sites and has made certain, based on best scientific knowledge in the field and in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, pursuant to Article 6(3) of the Habitats Directive, that the activity, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site, in particular the Ballyman Glen SAC [Site Code: 000713], having regard to their conservation objectives and will not affect the preservation of these sites at favourable conservation status if carried out in accordance with the application and risk assessment, this Certificate of Authorisation and the conditions attached hereto for the following reasons:

- Specifically, the remedial works will be undertaken to avoid the potential for water pollution and will ensure that there will be no significant impact on Ballyman Glen SAC [Site Code: 000713], and with a further objective to result in positive impacts to current water quality conditions.
- the project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Ballyman Glen SAC [Site Code: 000713].
- Condition 3.5 requires ongoing environmental assessment and monitoring.

The Agency is satisfied that no reasonable scientific doubt remains as to the absence of adverse effects on the integrity of the European Site: Ballyman Glen SAC [Site Code: 000713].

Part IV: SIGNATURE

Sealed by the Seal of the Agency on this the 22nd day of November 2019

PRESENT when the Seal of the Agency was affixed hereto:

Tara Gillen

Tara Gillen, Authorised Person

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

Closed Landfill

Certificate of Authorisation

Certificate of Authorisation Number:	**H0474-02**
Certification of Authorisation Holder:	**Wicklow County Council**
Location of Facility:	**Fassaroe 3C** **Bray** **County Wicklow**

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

HEADQUARTERS
JOHNSTOWN CASTLE ESTATE
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WASTE MANAGEMENT (CERTIFICATION OF HISTORIC UNLICENSED WASTE DISPOSAL AND RECOVERY ACTIVITY) REGULATIONS 2008

HISTORIC LANDFILL

CERTIFICATE OF AUTHORISATION

Decision of Agency, under Regulation 7(6) of the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008

Reference Number: H0474-02

In pursuance of the powers conferred on it by the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008, the Environmental Protection Agency (the Agency) grants, under Regulation 7(6) of the said Regulations, this Certificate of Authorisation to Wicklow County Council, County Buildings, Whitegates, Wicklow Town, in respect of the closed landfill at Fassaroe 3C, Bray, County Wicklow, subject to conditions set out in the Certificate of Authorisation.

A copy of the Decision is attached.

Sealed by the Seal of the Agency on this the 22nd day of November 2019

PRESENT when the seal of the Agency was affixed hereto:

Tara Gillen

Tara Gillen, Authorised Person

Glossary of Terms

All terms in this Certificate of Authorisation should be interpreted in accordance with the definitions in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008) unless otherwise defined in the Certificate of Authorisation.

Agency	Environmental Protection Agency.
Agreement	Agreement in writing.
Annually	At approximately twelve-monthly intervals.
Application	The application by the local authority for this Certificate of Authorisation including the risk assessment, any amendments to the risk assessment, additional information received from the local authority and other documents provided by the local authority.
Certificate of Authorisation	Includes this document and the application.
Closed landfill	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Code of Practice	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Biannually	All or part of a period of six consecutive months.
Documentation	Any report, record, results, data, drawing, proposal, interpretation or other document in written or electronic form which is required by this Certificate of Authorisation.
Drawing	Any reference to a drawing or drawing number means a drawing or drawing number contained in the application, unless otherwise specified in this Certificate of Authorisation.
Environmental pollution	As defined in the Waste Management Act 1996 as amended.
Incident	The following shall constitute an incident for the purposes of this Certificate of Authorisation: (i) an emergency; (ii) any emission which does not comply with the requirements of this Certificate of Authorisation; (iii) any trigger level specified in this Certificate of Authorisation which is attained or exceeded; and (iv) any indication that environmental pollution has, or may have, taken place.

Inert Waste	Waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater.
Maintain	Keep in a fit state, including such regular inspection, servicing, calibration and repair as may be necessary to perform its function adequately.
Necessary Measures	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Quarterly	All or part of a period of three consecutive months.
Risk Assessment	As defined in the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008.
Sample	Unless the context of this document indicates to the contrary, the term sample or samples shall include measurements taken by electronic instruments.
Status	As defined in the Water Framework Directive, in relation to surface water and groundwater.
The Local Authority	Wicklow County Council, County Buildings, Whitegates, Wicklow Town.
Trigger Level	A parameter value the achievement or exceedance of which requires certain actions to be taken by the local authority.

Part I Authorisation of a closed landfill

The Environmental Protection Agency (the Agency) grants, under Regulation 7(6) of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (the Regulations), this Certificate of Authorisation to Wicklow County Council, County Buildings, Whitegates, Wicklow Town, in respect of the closed landfill at Fassaroe 3C, Bray, County Wicklow, subject to conditions set out in Part II and the Reasons for the Decision in Part III.

Part II Conditions

Condition 1. Scope

1.1 For the purposes of this Certificate of Authorisation, the closed landfill authorised by this Certificate of Authorisation is the area of land outlined in red on Drawing Number MDR1206FG0001F02-Figure 5 submitted with the application. Any reference in this Certificate of Authorisation to "closed landfill" shall mean the area thus outlined in red. Activities associated with the closed landfill shall be carried on only within the area outlined.

1.2 No waste shall be accepted at the closed landfill.

1.3 No waste shall be burned at the closed landfill.

1.4 The facility shall be controlled, operated and maintained, and emissions shall take place as authorised by this Certificate of Authorisation. No material change that will result in an increase in the actual or potential nature or quantity of any emission shall be carried out or commenced without the agreement of the Agency.

1.5 Nothing in this Certificate of Authorisation shall prohibit authorised beneficial uses of the site of the closed landfill that do not interfere with the integrity of the remediation measures adopted.

Reason: *To clarify the scope of this Certificate of Authorisation.*

Condition 2. Notifications, Records and Reports

2.1 The local authority shall notify the Agency as soon as practicable after the occurrence of any incident. The incident notification shall be provided in a format as may be specified in relevant guidance issued by the Agency.

2.2 The local authority shall keep the following documents available for inspection by the Agency at all reasonable times and to members of the public by request:

2.2.1 records of all sampling, analyses, measurements, examinations, calibrations and maintenance;

2.2.2 records of incidents;

2.2.3 records of all complaints of an environmental nature;

2.2.4 the validation report prepared on completion of the remediation; and

2.2.5 other documentation required by this Certificate of Authorisation or as may be otherwise directed by the Agency.

2.3 Environmental Liabilities

The local authority shall put in place and maintain a financial provision for costs of likely events or accidents/incidents related to the closed landfill and associated works.

2.4 The local authority shall annually pay to the Agency €1,083, or such sum as the Agency from time to time determines in accordance with charges policy, for the performance of its functions under the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 in relation to the closed landfill regulated by this Certificate of Authorisation.

Reason: *To provide for the collection and reporting of adequate information on the activity. To provide for adequate financing for monitoring and financial provisions for measures to protect the environment.*

Condition 3. Management and Monitoring

3.1 The local authority shall implement the following measures within 18 months of the date of grant of this Certificate of Authorisation, or as otherwise agreed by the Agency:

a) Prepare and implement a programme of 24-hour pumping trials for seven days, at a minimum of 2 gas yielding monitoring locations (12% v/v or above) to determine the quantity and characteristics of the landfill gas. This programme shall be submitted to the Agency and approval obtained in advance of implementation. The monitoring programme shall be completed within 4 months of the date of this Certificate of Authorisation.

b) In the event that methane values consistently exceed 12% v/v, install measures for extracting and treating landfill gas by flaring or another suitable technique that is satisfactory to the Agency.

c) Install a low permeability landfill cap, minimum 1m, with 1mm thick low permeability geomembrane having a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s.

d) Unless otherwise agreed by the Agency, install gas protection measures including:

(i) the installation of a virtual gas curtain along the boundary of the capped landfill;

(ii) Geo-composite nodes inserted at 1m intervals along the curtain length;

(iii) 3m high vent stacks located at every 20 – 25 m intervals;

(iv) collection duct constructed over the nodes which dilutes any gas and vents it to the atmosphere via vent bollards.

e) Unless otherwise approved by the Agency, install gas vents in the landfill body at appropriate locations such that the increased back-pressure caused by the cap does not result in increased lateral movement of gas.

f) Install appropriate surface water collection measures to ensure that the water is drained towards the perimeter of the waste body through a subsurface drain.

g) Carry out slope stabilisation measures where slope failures have occurred, and where potentially unstable slopes have been identified, along the northern boundary.

h) Minimise the disturbance of deposited waste to the extent possible.

3.2 The local authority shall manage the closed landfill to ensure that discharges and emissions from the closed landfill do not cause environmental pollution or deterioration in the status of the receiving surface water body or groundwater body.

3.3 The local authority shall compile a validation report in accordance with the requirements of the Code of Practice. Unless otherwise agreed, the validation report shall be submitted to the Agency within 30 months of the date of grant of this Certificate of Authorisation.

3.4 The local authority shall assess the results of all monitoring carried out to confirm whether the closed landfill continues to achieve the objectives set for it in the risk assessment or this Certificate of Authorisation.

3.5 The local authority shall biannually conduct and record:

a) a visual inspection of the landfill to ensure that the condition of the site has not deteriorated;

b) monitoring for leachate (sample, analyse, characterise, and measure the level of leachate) in all leachate monitoring boreholes;

c) quarterly monitoring to detect the presence and concentration of landfill gas in all monitoring boreholes;

d) monitoring (sample, analyse and characterise) of relevant surface waters both upstream and downstream of the closed landfill;

e) monitoring (sample, analyse and characterise) of groundwater from at least three available groundwater monitoring boreholes, two of which shall be downgradient of the closed landfill; and

f) the assessment of monitoring results against trigger levels and/or standard reference values for relevant pollutants including environmental quality standards in the European Communities Environmental Objectives (Surface Waters) Regulations 2009 and European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended.

3.6 The following are the trigger levels for landfill gas emissions from the facility measured in any service duct or manhole on, at or immediately adjacent to the facility and/or at any other point located outside the body of the waste:-

a) Methane, greater than or equal to 1.0% v/v; or

b) Carbon dioxide, greater than or equal to 1.5% v/v.

3.7 In relation to surface emissions measured over the waste body and identified features, the following shall constitute a trigger level:-

a) VOC greater than or equal to 50ppmv as methane average over capped area; or

b) VOC greater than or equal to 100ppmv as methane instantaneous reading on open surfaces within the landfill footprint; or

c) VOC greater than or equal to 500ppmv as methane around all identified features.

3.8 The location, frequency, methods and scope of monitoring, sampling and analyses, as set out in this Certificate of Authorisation, may be amended with the agreement of the Agency.

3.9 Soil and stone imported for use in remedial, corrective or other engineering works at the closed landfill shall be greenfield soil and stone or soil and stone of equivalent nature and character in terms of chemical and physical contamination.

Documented acceptance, storage/stockpiling and utilisation procedures shall be operational in advance of receipt of such materials. Records shall be maintained showing the site of origin of the soil and stone and its nature.

3.10 No emissions, including odours and noise, from works carried on at the site shall result in an impairment of, or an interference with amenities or the environment beyond the facility boundary or any other legitimate uses of the environment beyond the facility boundary.

3.11 The local authority shall ensure that the closed landfill does not result in an impairment of, or an interference with, amenities or the environment at the facility or beyond the facility boundary (including those arising from emissions (including odours, noise, dust, litter and mud), vermin and birds).

3.12 Wells and boreholes

3.12.1 Groundwater monitoring wells shall be constructed having regard to the guidance given in the Agency's landfill manual "Landfill Monitoring".

3.12.2 All wellheads shall be adequately protected to prevent contamination or physical damage.

3.12.3 All wells & boreholes shall be adequately sealed to prevent surface contamination and, as may be appropriate, decommissioned in accordance with the UK Environment Agency guidelines

"Decommissioning Redundant Boreholes and Wells", unless otherwise agreed by the Agency.

3.13 The local authority shall clearly label and provide safe and permanent access to all on-site sampling and monitoring points and to off-site points as required by the risk assessment or this Certificate of Authorisation. The requirement with regard to off-site points is subject to the prior agreement of the landowners concerned.

3.14 Incidents

In the event of an incident the local authority shall immediately:

(i) if necessary, contact the emergency services;

(ii) carry out an investigation to identify the nature, source and cause of the incident and any emission arising therefrom;

(iii) isolate the source of any such emission;

(iv) evaluate the environmental pollution, if any, caused by the incident;

(v) identify and execute measures to minimise the emissions/malfunction and the effects thereof;

(vi) identify the date, time and place of the incident; and

(vii) notify the Agency (in accordance with Condition 2.1) and all other relevant authorities including, where relevant, the Water Services Authority and Inland Fisheries Ireland.

3.15 Communications

a) The local authority shall establish, maintain and implement a communications programme to inform the occupiers and owners of land and buildings adjacent to the closed landfill of the risks posed by landfill gas and its migration.

b) The communications programme shall inform future occupiers and owners of properties what they can and should do to protect their property and health and members of the public.

c) The local authority shall communicate directly, either in writing or in person, at least once each year with said occupiers and owners of properties.

d) The local authority shall, as part of the communications programme, publish gas monitoring data quarterly and water monitoring data bi-annually in a manner accessible by the public.

Reason: *To make provision for the proper closure of the activity ensuring protection of the environment.*

Part III: Schedules

Schedule 1: Reasons for the Decision

In granting this Certificate of Authorisation, the Agency determines that the risk assessment submitted by the local authority as part of the application for a Certificate of Authorisation is adequate. To ensure appropriate protection for human health and the environment and to ensure conformity with the provisions of Council Directive 2006/12/EC and Council Directive 80/68/EC, the conditions set out in Part II of this Certificate of Authorisation are specified as further necessary measures in addition to those identified by the risk assessment.

A screening for Appropriate Assessment was undertaken to assess, in view of best scientific knowledge and the conservation objectives of the site, if the activity, individually or in combination with other plans or projects is likely to have a significant effect on any European Site. In this context, particular attention was paid to the European Site at the Ballyman Glen SAC [Site Code: 000713].

The activity is not directly connected with or necessary to the management of any European Site and the Agency considered, for the reasons set out below, that it cannot be excluded, on the basis of objective information, that the activity, individually or in combination with other plans or projects, will have a significant effect on any European Site and accordingly determined that an Appropriate Assessment of the activity was required. The reasons for this determination are as follows:

- the northern boundary of the landfill site is adjacent to, and within the Ballyman Glen SAC [Site Code: 000713].
- slope failures and potentially unstable slopes have been recorded along the northern boundary of the landfill site adjacent to, and within the Ballyman Glen SAC [Site Code: 000713].

The Agency has completed the Appropriate Assessment of potential impacts on these sites and has made certain, based on best scientific knowledge in the field and in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, pursuant to Article 6(3) of the Habitats Directive, that the activity, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site, in particular the Ballyman Glen SAC [Site Code: 000713], having regard to their conservation objectives and will not affect the preservation of these sites at favourable conservation status if carried out in accordance with the application and risk assessment, this Certificate of Authorisation and the conditions attached hereto for the following reasons:

- Specifically, the remedial works will be undertaken to avoid the potential for water pollution and will ensure that there will be no significant impact on Ballyman Glen SAC [Site Code: 000713], and with a further objective to result in positive impacts to current water quality conditions.
- the project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Ballyman Glen SAC [Site Code: 000713].
- Condition 3.5 requires ongoing environmental assessment and monitoring.

The Agency is satisfied that no reasonable scientific doubt remains as to the absence of adverse effects on the integrity of the European Sites: Ballyman Glen SAC [Site Code: 000713].

Part IV: SIGNATURE

Sealed by the Seal of the Agency on this the 22nd day of November 2019

PRESENT when the Seal of the Agency was affixed hereto:

Tara Gillen

Tara Gillen, Authorised Person

PART 3

Fassaroe Historic Landfills Environmental Risk Assessment, RPS, 2018

RPS

Comhairle Contae Chill Mhantáin

Fassaroe Historic Landfills

Environmental Risk Assessment

May 2018







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Fassaroe Historic Landfills

Environmental Risk Assessment

Document Control Sheet

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1 INTRODUCTION

In 2017, RPS was appointed by Wicklow County Council to carry out an Environmental Risk Assessment (ERA) for the historic landfills located at Fassaroe, Co. Wicklow. The site, hereinafter referred to as the Fassaroe Site is show in **Figure 1**. An ERA is required in support of the application for a Certificate of Authorisation from the Environment Protection Agency (EPA) in relation to the historic landfill sites, as descried in the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008). The ERA and this report has been completed in accordance with the EPA Code of Practice for Unregulated Waste Disposal Sites, 2007, hereinafter referred to as the EPA Code of Practice. A detailed site investigation and associated programme of environmental monitoring was undertaken on the Site between November 2015 and March 2018, following the completion of desk based risk assessment as outlined in the EPA Code of Practice.

1.1 BACKGROUND

Five historic unregulated landfills (Site 1, Site 2, Site 3B, Site 3A and Site 3C) are located on the Fassaroe Site, which is currently allocated for future development as a mixed development area. Before the Fassaroe site can be developed a Certificate of Authorisation is required from the EPA that addresses the legacy contamination issues associated with the five historical landfill sites. The landfill sites on the Fassaroe site are currently in the ownership of Cosgrave Developments at Fassaroe, Co. Wicklow.

From a review of the register compiled in accordance with Section 22 of the Waste Management Act 1996 as amended (the Act) and presented in the Eastern Midlands Region Waste Management Plan 2015 – 2021, Wicklow County Council (WCC) have registered four Historic Unregulated Local Authority Landfills located within lands on the Fassaroe Site as shown in **Table 1.1**.

Table 1.1 - Section 22 Register

Site ID	Local Authority	Site Name	Risk Rating
S22-02639	Wicklow County Council	Fassaroe No.2	B (Moderate Risk)
S22-02633	Wicklow County Council	Fassaroe No. 3A	A (High Risk)
S22-02635	Wicklow County Council	Fassaroe No. 3B	C (Low Risk)
S22-02637	Wicklow County Council	Fassaroe No. 3C	A (High Risk)

Source: Eastern Midlands Region Waste Management Plan 2015-2021

An additional historic landfill (Site 1) is also located within Cosgrave Development's ownership (see **Figure 1** below) with reference made to such in WCC's report entitled 'Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013)' which states:

Between the early-1970s and the mid-1990s, Wicklow County Council operated a number of municipal landfills in the Fassaroe area, to the west of Bray, in north County Wicklow. Four landfills were sited on the northern side of Berrysfield Lane with a fifth small landfill located to the south of the road.

Tier 1 Risk Assessments have been completed by WCC for four Local Authority sites in accordance with the requirements as set out under S.I. No. 524/2008 Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations, 2008 (the Regulations) with the following risk rankings being applied:

- Site 2 – Moderate Risk (B)
- Site 3A – High Risk (A)
- Site 3B – Low Risk (C)
- Site3C – High Risk (A)

Sites 3A and 3C have been investigated further (to Tier 2-3) by WCC and applications for Certification of Authorisation (COA) have been submitted to the EPA in accordance with the requirements as set out in the Regulations.

At the time of compiling this report, RPS is unaware of any investigations of Site 1 by WCC.

The following risk assessment has been carried out to examine the extent of the waste bodies and also to determine if they are causing a likely significant risk to the environment and human health.

The aim of the risk assessment is to provide an understanding of the potential risks associated with the waste detected at the sites and also provide recommendations and options for any remediation if required, having consideration of the proposed development.

LEGEND

- ESB Overhead (38 kv)
- ESB Overhead (110kv)
- ESB Overhead (220kv)
- ESB Overhead (400kv)
- ESB Overhead (LV)
- ESB Overhead (MV)
- ESB Underground (38kv)
- ESB Underground (MV & LV)
- ESB Underground (Spare)
- 800mm Watermain (Existing)
- 33" Watermain (Existing)
- 24" Watermain (Existing)
- 100mm Watermain (Existing)
- 150mm Watermain (Existing)
- 200mm Watermain (Existing)
- 300mm Watermain (Existing)
- 200 Fire Main (Existing)
- Wayleave (16m wide)
- Historic Landfill Site
- Special Areas of Conservation (SAC's)

Site 1
Site 2
Site 3A
Site 3B
Site 3C
Glenmunder River
Ballyman Glen SAC
Integrated Waste Management Facility
Ballyman Road
Golf Course
Underpass
Lodge
Church (in Ruins)
St Kevin's Well
Water
Berryfield
Enniskerry Youth Club
Berryfield Park
Sports Ground
Sports Ground (All-weather)
Rannock House
Sports Ground
NASTERY
FASSAROE
FASSAROE
Monument
Lake
N

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Title: PLAN SHOWING HISTORIC LANDFILL LOCATIONS, EXISTING SERVICES, WAYLEAVES & SAC's

File Ref. MDR1206FG0001F02.dwg | Drg. No. Figure 1 | Rev. F02

1.2 OBJECTIVES

The principal objective of the ERA is to assess the potential risk that waste deposited at the five landfill sites currently poses to human or environmental receptors. On the basis of this assessment a Remediation Options Appraisal (ROA) that conforms to the EPA Code of Practice shall be provided. The document provides a Generic and Detailed Quantitative Risk Assessment (GQRA & DQRA) which integrates relevant data obtained from the recent site investigations and associated programme of environmental. The objectives ERA include the following:

- Determination of the nature and extent of the waste mass at each landfill site;
- Provision of information to assess the significance of active pollutant (Source-Pathway-Receptor) linkages present at each landfill site;
- Provision of an initial GQRA, followed by a DQRA using best practice modelling techniques in respect to contaminant transport and human health if required;
- Provision of a final, detailed Conceptual Site Model (CSM) for each landfill site;
- An evaluation of the contamination status of the site and immediate environs that can be used to inform the requirements of Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 (Statutory Instrument No. 524 of 2008) and the EPA Code of Practice; and
- Provide an outline assessment of Remediation Options for managing risks identified with respect to the five landfill sites in advance of any future development.

1.3 OVERALL METHODOLOGY

In order to achieve the above objectives the following scope of work was undertaken:

- Desk based survey and site walkover including collation of information from Wicklow County Council (WCC), Atkins and Muir Associates;
- Development and subsequent refinement of a CSM based on available information;
- Design and implementation of an exploratory soil and water site investigation in accordance with BS 10175:2011+A1:2013 and BS 5930:2015;
- Design and delivery of programme of environmental monitoring between November 2015 and March 2018 to provide a time series dataset to inform the CSM and baseline characterisation of the hydrogeological system;
- Assessment of risks to human and environmental receptors in accordance with the EPA Code of Practice;
- Production of a Remediation Options Appraisal (ROA); and
- Preparation of a report in accordance with Chapter 8 “Reporting Requirements” in the EPA Code of Practice.

1.4 RISK ASSESSMENT APPROACH

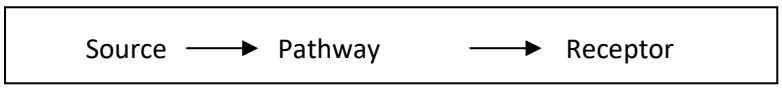
This assessment has been carried out in accordance with the EPA Code of Practice (EPA, 2007). The consideration of the impact of the historical landfill sites may have on the environment and human health is based on a risk assessment of active pollutant 'Source–Pathway–Receptor (SPR)' linkages defined from the CSM for each landfill site, where the probability of impact by the landfill sites is considered in the context of the severity of consequence of that event actually happening. The pollutant (SPR) linkage approach underpins the EPA Code of Practice.

The assessment looks at the relationship of possible contamination of the environment (*i.e.* the surroundings and habitats) and of a range of receptors (such as humans, flora, fauna, groundwater and ecological systems) to develop a conceptual understanding of what is occurring. Aspects of the source material and impacts on the receptors are identified and measured as part of a characterisation process. This in turn facilitates the development of environmental engineering design controls to manage, mitigate, protect, and/or remediate the site.

The principal sources of contamination from landfilled waste are liquid leachate and landfill gas generated through the decomposition of the waste mass. The type of waste is characterised in order to determine the potential magnitude of risk posed to surface water and groundwater receptors.

An assessment of the potential for landfill gas generation as a contaminant source is also a requirement and its rate of gas generation and potential for migration needs to be considered. This assessment is undertaken in accordance with the Code of Practice.

The relationship between the discrete **source** of the contamination (*i.e.* waste material) and the receiving environment known as the **receptor** (*e.g.* surface water or groundwater) is considered. The connecting route, known as the **pathway** (groundwater flow, drainage systems and soil systems) and the driving force in the form of a fluid (*i.e.* liquid in the form of rainfall and leachate) can induce contamination to move through the system. Thus the system can be summarised by the following:



Source: Substance or material that has the potential to cause harm to the environment or human health by virtue of its physical or chemical characteristics.

Pathway: Historical, current or possible future mechanism by which the receptor can be exposed to the source.

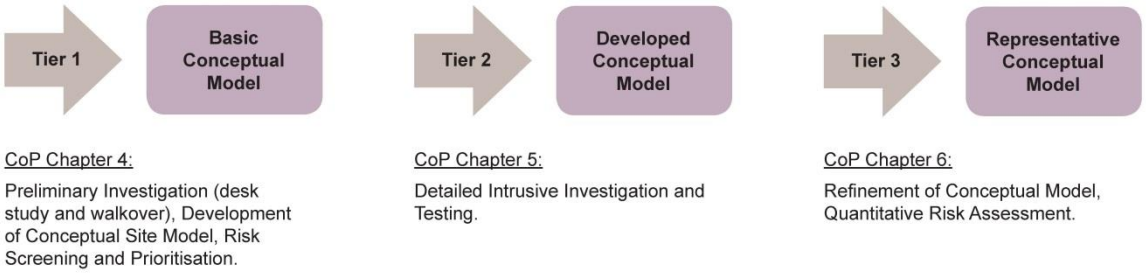
Receptor: A human or environmental entity which has the potential to be harmed through direct or indirect exposure to the source.

In the EPA Code of Practice pollutant (SPR) linkage approach to risk assessment, all three elements have to be present and linked in order for a risk to be present. If any of these components is absent there is, by definition, no risk.

The EPA Code of Practice utilises a structured phased approach to identify the SPR components and conduct a risk assessment of the linkages between the elements. The process involves preliminary

site investigations and initial screening to indicate the range of high to low risk factors. Areas requiring further investigation are identified, and finally the model is refined. At each stage the information and risks are reviewed and assessed before progressing to the next phase.

The Code of Practice tiered methodology is as follows:



CoP Chapter 4:
Preliminary Investigation (desk study and walkover), Development of Conceptual Site Model, Risk Screening and Prioritisation.

CoP Chapter 5:
Detailed Intrusive Investigation and Testing.

CoP Chapter 6:
Refinement of Conceptual Model, Quantitative Risk Assessment.

Assumptions and uncertainties in the development of a conceptual model must be identified and clearly expressed to ensure that the degree of representation is understood before evaluation can meaningfully take place. The tiered technique of risk assessment within the Code of Practice seeks to minimise gaps in characterising each of the components within the SPR framework, so that at each stage the conceptual model is refined and uncertainties are reduced. Accordingly, the extent of information and data available at each stage of the model development is incorporated within each individual section of the assessment for individual tiers.

1.5 REPORT LIMITATIONS AND CONDITIONS

The findings and opinions provided in this document are given in good faith and are subject to the limitations and constraints imposed by the information sources described in this report.

Where comments and opinions have been provided based on ground investigation works and reports carried out by a third party, RPS can accept no liability for the accuracy or reliability of such information.

Any figure or opinion on the possible configuration of strata, contamination or other spatially variable features between or beyond investigation positions is conjectural and given for guidance only.

Evaluation of groundwater is based on observations made at the time of the investigation, or subsequently. It should be noted that groundwater levels and quality may however vary because of seasonal and other effects.

All new monitoring borehole locations were installed on lands within the ownership of Cosgrave Developments which combined with access/slope stability constraints restricted the siting and availability of down gradient groundwater monitoring locations. The constraints on the installation of down gradient monitoring boreholes, have however been mitigated through the monitoring of springs within the river valley.

Historic boreholes are in existence across Sites 1 and 2 however borehole logs were not available therefore the integrity of existing monitoring infrastructure could not be established and were not utilised during the monitoring regime.

It is understood that specialist ecological surveys and associated assessments are to be collated under separate contract and are excluded from the scope of this report.

The duration of gas monitoring was limited due to restrictions in contract timeline.

1.6 REPORT FORMAT

The environmental risk assessment report is presented in accordance with the following format:

- Section 2: Previous Site Investigations
- Section 3: Tier 1 - Preliminary Investigation and Risk Screening
- Section 4: Tier 2 - Site Investigation and Testing
- Section 5: Tier 3 - Refinement of CSM and Quantitative Risk Assessment
  - Section 5.1 - Refinement of CSM
  - Section 5.3 - Refinement of Risk Screening & Prioritisation
- Section 6: Tier 3 Quantitative Risk Assessment
  - Section 6.1 - Generic Quantified Risk Assessment (Landfill Gas, Human Health and Water Environment)
  - Section 6.2 - Detailed Quantified Water Environment Risk Assessment
- Section 7 - Remediation Options Appraisal
- Section 8 - Conclusions

2 PREVIOUS SITE INVESTIGATION

The following historic investigative reports were provided by the current land owner of the Fassaroe Site (Cosgrave Developments) and were reviewed as part of the Tier 1 desk study and associated risk screening and prioritisation. Relevant summary information has been provided on a site by site basis.

- Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013);
- Disused Wicklow County Council Landfill Sites 3A, 3B and 3C at Fassaroe, County Wicklow Appropriate Assessment Screening Report – Altemar in association with Environmental Management Services, April 2013;
- Fassaroe Business Park Geotechnical Interpretative Report – Atkins McCarthy, July 2001;
- Fassaroe Historic Landfill Environmental Risk Assessment – Atkins, June 2010;
- Fassaroe AGS and Excel ground investigation data (IGSL and Glovers logs) received from Atkins on the 19th of October 2015;
- Environmental Ground and Geotechnical Site Evaluation Report for Site at Fassaroe, Bray – Muir Associates, January 1998;

2.1 SITE 1

The following information was provided by Atkins with respect to ground investigations within the vicinity of Site 1;

- Fassaroe Business Park Geotechnical Interpretative Report – Atkins McCarthy, July 2001;
- Fassaroe Historic Landfill Environmental Risk Assessment – Atkins, June 2010;
- Fassaroe AGS and Excel ground investigation data (IGSL and Glovers logs) received from Atkins on the 19th of October 2015.

A total of 5 No. trial pits were excavated within Site 1, ranging in depth from 1.80 metres below ground level (mbgl) to 4.00mbgl with base of waste encountered (1.20mbgl) in TP094 only. The general description of the waste encountered appears to correspond with anecdotal evidence that this was a construction and demolition (C&D) waste disposal facility, however it should be noted that TPB36 documented the presence of domestic waste. The European Commission defines C&D waste as consisting of numerous materials, including concrete, bricks, gypsum, wood, glass, metals, plastic, solvents, asbestos and excavated soil.
(http://ec.europa.eu/environment/waste/construction_demolition.htm).

Table 2.1 - Site 1: Historic Site Investigation Data

ID	Depth (m)	Base of waste (m)	Waste Type
TPB36	1.80	>1.80	**Domestic** waste in clay matrix
TP092	4.00	>4.00	Plastic, glass, metal, concrete blocks, tyres, brick, wood
TP093	2.90	>2.90	Metal, plastic piping, concrete blocks, reinforced concrete, glass
TP094	3.60	1.20	Plastic, glass, ceramics, metal,

Source: Atkins, 2010

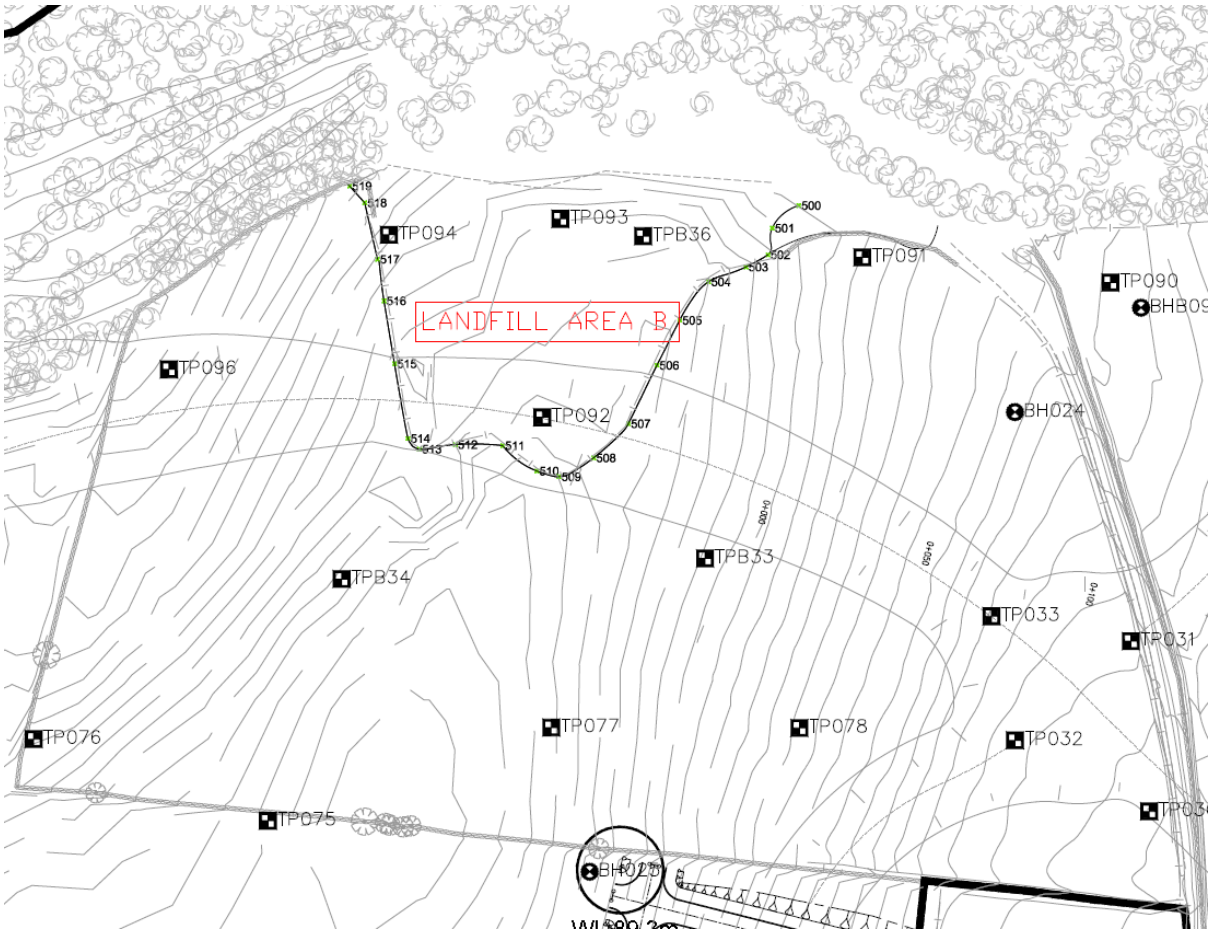
Paragraph 6 of the Atkins Report '*Fassaroe Historic Landfill Environmental Risk Assessment, June 2010*' confirms that no sampling was conducted on Site 1.

Available intrusive data suggests the site comprises C&D waste however reference to the presence of domestic waste in TPB36 and the lack of available data to confirm the vertical and lateral extent of the waste body would raise some uncertainty on the overall classification/characterisation of the waste body.

It should also be noted that to RPS's knowledge no environmental monitoring (i.e. gas, leachate, groundwater or surface water) has been completed within Site 1, which leads to uncertainty in determining the intrinsic risk posed to receptors (i.e. human health or environmental).

Site 1 is located adjacent to the Ballyman Glen Special Area of Conservation (SAC) (Site Code: 000713). Due to the lack of environmental monitoring data and the fact that an Appropriate Assessment Screening (Stage 1) has not been completed, the potential risk posed to the SAC cannot be adequately determined at this time.

Figure 2 Site 1: Historic SI Locations (Atkins)



Source: Extract from Atkins Drawing 1739GE001 Site Investigation Borehole and Trial Pit Locations.
Note Site 1 equates to 'Landfill Area B'

2.2 SITE 2

The following information was compiled by Muir Associates and provided by Cosgrave Developments:

- Environmental Ground and Geotechnical Site Evaluation Report for Site at Fassaroe, Bray – Muir Associates, January 1998.

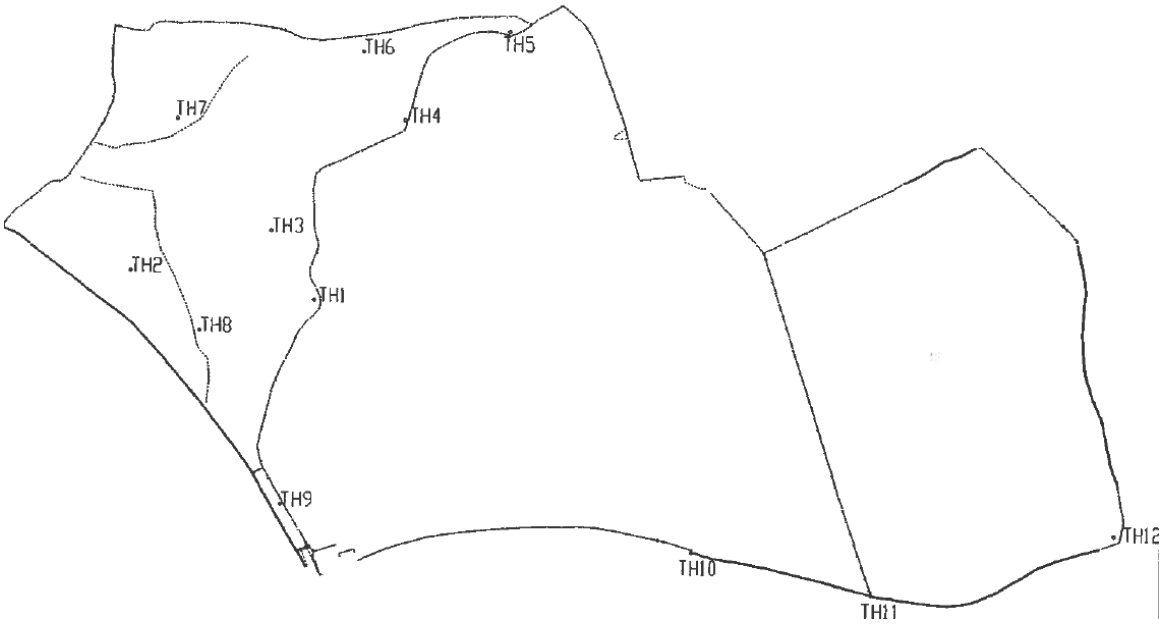
As part of the environmental evaluation of Site 2, Muir Associates supervised the excavation of 9 No. trial pits within the vicinity of Site 2 and 3 no. within the surrounding environs. The trial pits varied in depth from 2.70mbgl to 4.80mbgl.

Table 2.2 - Site 2: Historic Site Investigation Data

ID	Depth (m)	Base of waste (m)	Waste Type
TH1	2.90	1.30	Domestic waste including plastic bags and bottles
TH2*	2.70	-	No waste encountered
TH3	3.60	>3.60	Domestic waste including plastic bags, bottles, concrete, fabric, timber, waving piping and newspaper
TH4	4.30	1.50	Domestic waste including plastic bags
TH5	4.80	1.30	Domestic waste including plastic bags, bottles, concrete
TH6	3.10	>3.10	Domestic waste including plastic bags and bottles
TH7*	3.40	-	No waste encountered
TH8	3.40	>3.40	Domestic waste including plastic bags, bottles and tins
TH9	3.30	-	No waste encountered (MADEGROUND hardcore fill noted)
TH10*	3.30	-	No waste encountered (MADEGROUND hardcore fill noted)
TH11*	3.50	-	No waste encountered
TH12*	3.60	-	No waste encountered

Source: Environmental Ground and Geotechnical Site Evaluation Report for Site at Fassaroe, Bray – Muir Associates, January 1998; * Outside landfill boundary

Figure 3 Site 2: Historic SI Locations (Muir Associates, 1998)



Source: Environmental Ground and Geotechnical Site Evaluation Report for Site at Fassaroe, Bray – Muir Associates, January 1998

The report also noted the presence of waste outside the area delineated as landfill which raised some doubt regarding the lateral extent of the waste body.

A total of 8 No samples were taken from the trial pits (Samples were taken from trial pits 2, 3, 4, 6, 7, 9, 10 and 12) and analysed for the Interdepartmental Committee of the Redevelopment of Contaminated Land (ICRCL Guidance Note 59/83, Second Edition, 1987) suite. Elevated levels (above threshold vales) of copper, nickel, lead, arsenic, cadmium, zinc and phenols were recorded in samples taken from within waste. Elevated levels of arsenic (above target value for action) were noted outside the waste body (TH10).

Gas monitoring (for methane only) was completed at trial pits 1-8 inclusive and recorded elevated methane concentrations across the site however it should be noted that no gas pressure or flow analysis was conducted. These results are indicative of the presence of methane only and should not be interrogated further as they were atmospheric concentrations recorded at open pits and are therefore not considered to be representative of the potential gas characteristics of the site.

Two surface water samples were also taken (at “upstream” and “downstream” locations) which indicated that there was no discernible impact associated with the waste body at the time of monitoring.

The report recommended further investigations to determine the depth of waste, type of subsoil, depth to groundwater, groundwater quality, groundwater flow and gas levels (flow and migration).

The following information was provided by Atkins with respect to ground investigations within the vicinity of Site 2:

- Fassaroe Business Park Geotechnical Interpretative Report – Atkins McCarthy, July 2001;
- Fassaroe Historic Landfill Environmental Risk Assessment – Atkins, June 2010; and
- Fassaroe AGS and Excel ground investigation data (IGSL and Glovers logs) received from Atkins on the 19th of October 2015.

A total of 16 No. trial pits and 8 No. boreholes were completed within Site 2. The trial pits varied in depth from 2.90mbgl to 5.00mbgl with base of waste encountered within five of the trial pits for which records are available. Base of waste, at a depth which averaged c.1.3m, was determined in those trial pits located along the lateral extent of the waste body.

Available records suggest the waste type is municipal, which corresponds with information provided by WCC.

It should be noted that no waste characterisation has been conducted therefore the presence/absence of hazardous material has not been determined.

A total of 20 No. samples were recovered from the Atkins McCarthy ground investigation and analysed for the suite as set out in the ICRCL guidance. The principal contaminants noted were heavy metals, sulphides and phenols.

It should be noted that no analysis for Asbestos Containing Material (ACM) was completed at the site.

Atkins and City Analysts also completed environmental monitoring at the site in May 2010. It should be noted that no groundwater monitoring was completed during this monitoring event. The presence of leachate was confirmed within three boreholes (located to the south of the site) however the results should be considered with caution as the integrity of the boreholes cannot be determined due to the lack of information regarding installation details. The leachate samples were analysed for a range of contaminants based on the EPA Leachate Characterisation Suite 2003 however it should be noted that no analysis for trace organic substances was completed.

Results indicated that the leachate is of moderate strength. Parameters of typical note are ammonia, iron, boron, manganese and lead.

Table 2.3 - Site 2: Historic Site Investigation Data (Atkins, 2001)

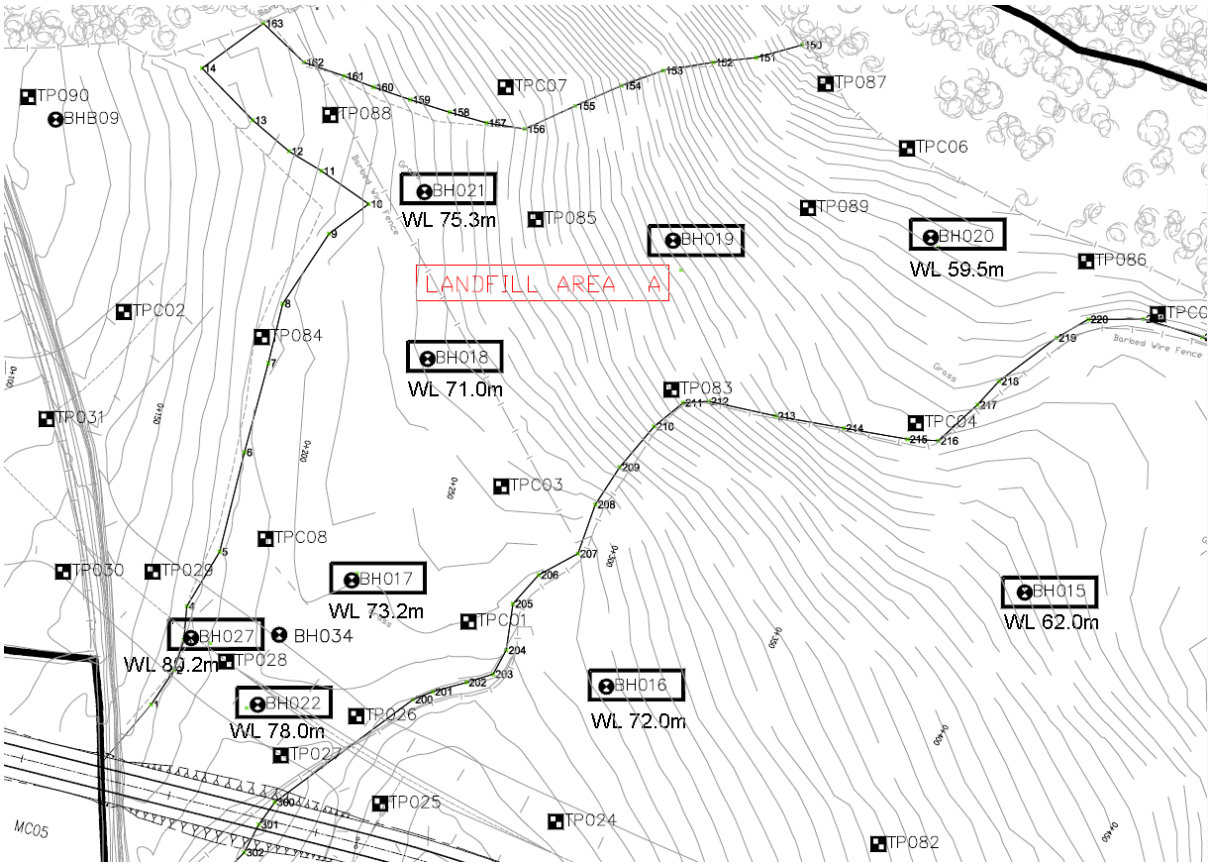
ID	Depth (m)	Base of waste (m)	Waste Type
TPC01	2.90	1.10	Domestic waste
TPC03	3.60	>3.60	Plastic, wood, concrete, domestic waste
TPC04	4.30	1.50	MADE GROUND – some plastic found at 1.50m
TPC05	5.00	1.30	Concrete, paper
TPC06	3.10	>3.10	Domestic waste
TPC08	3.40	1.20	Plastic, domestic waste
TP026	No Data Available		
TP027	No Data Available		
TP028	3.30	>3.30	Plastic, material, glass, paper, concrete
TP083	3.30	>3.30	Plastic, glass, paper, wood
TP084	3.50	-	CLAY – no waste encountered
TP085	3.60	>3.60	Plastic, wood, newspaper, metal, glass, brick, concrete blocks
TP086	3.20	>3.20	Plastic, metal, wood, concrete blocks, textiles, glass
TP087	3.60	-	MADE GROUND – no waste encountered
TP088	3.60	>3.60	Plastic, metal, glass, rubble
TP089	3.20	>3.20	Plastic, material, paper, glass, wood, metal
BH017	Gas Monitoring Borehole (323878.6 : 218469.2) – No Data Available		
BH018	Gas Monitoring Borehole (323819.8 : 218476.9) – No Data Available		
BH019	Gas Monitoring Borehole (323656.1 : 218386.3)– No Data Available		
BH020	Gas Monitoring Borehole (323529.7 : 218249.6)– No Data Available		
BH021	Gas Monitoring Borehole (323541.9 : 217759.7) – No Data Available		
BH022	Gas Monitoring Borehole – No Data Available		
BH027	Gas Monitoring Borehole – No Data Available		
BH034	No Data Available		

Source: Atkins

Gas monitoring was also completed by Atkins and City Analysts in May 2010 with elevated concentrations of methane (max. 74% v/v) and carbon dioxide (max. 27% v/v) being recorded across the site. Vegetation die back was also noted across the site which is suggestive of the presence of vertical fugitive gas emissions.

The gas monitoring results should also be interpreted with caution due to the lack of information regarding the integrity of the monitoring boreholes, coupled with the lack of gas valves at monitoring locations (with boreholes passively venting prior to monitoring).

Figure 4 Site 2: Historic SI Locations



Source: Extract from Atkins Drawing 1739GE001 Site Investigation Borehole and Trial Pit Locations.
Note Landfill Area A equates to Site 2

2.3 SITE 3A

The following information was provided by WCC with respect to ground investigations and environmental monitoring within the vicinity of Site 3A:

- Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013); and
- Disused Wicklow County Council Landfill Sites 3A, 3B and 3C at Fassaroe, County Wicklow Appropriate Assessment Screening Report – Altemar in association with Environmental Management Services, April 2013.

WCC completed a Tier 2 investigation of Site 3A in 2012 which comprised 12 No. trial pits and 2 No. boreholes (MW3 and MW4). Municipal waste was encountered in all trial pits excavated at Site 3A and base of waste was not encountered.

Table 2.4 - Site 3A: Historic Site Investigation Data – Trial Pits (WCC, 2013)

Trial Pit	Topsoil Depth (m)	Clay/Capping Depth (m)	Waste Depth (m)	Waste Thickness (m)	Waste Type	% by volume waste (visual)
A1	0.70	0.70-3.10	3.10-6.00	>2.90	Domestic	30-40
A2	0.30	0.30-0.60	0.60-6.00	>5.40	Domestic	65-85
A3	0.20	0.20-0.80	0.80-3.00	>2.20	Domestic	70-80
A4	0.30	0.30-2.50	2.50-6.00	>3.50	Domestic	40
A5	0.30	0.30-0.70	0.70-6.00	>5.30	Domestic	50
A6	0.25	0.25-0.55	0.55-5.00	>4.45	Domestic	30
A7	0.30	0.30-1.50	1.50-6.00	>4.50	Domestic	60-70
A8	0.30	0.30-3.00	3.00-6.00	>3.00	Domestic	30-40
A9	0.30	0.30-1.30	1.30-5.50	>4.20	Domestic	70-80
A10	0.20	0.20-0.45	0.45-5.50	>5.05	Domestic	70-80
A11	0.40	0.40-2.50	2.50-5.00	>2.50	Domestic	60-70
A12	0.35	0.35-3.80	3.80-6.00	>2.20	Domestic	30-40

Source: Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013)

Boreholes MW3 and MW4 included the installation of gas monitoring standpipes within the waste body. MW3 also included a groundwater monitoring standpipe installed within the gravels beneath the waste body.

No up-gradient or down-gradient groundwater monitoring boreholes are known to have been installed at the site.

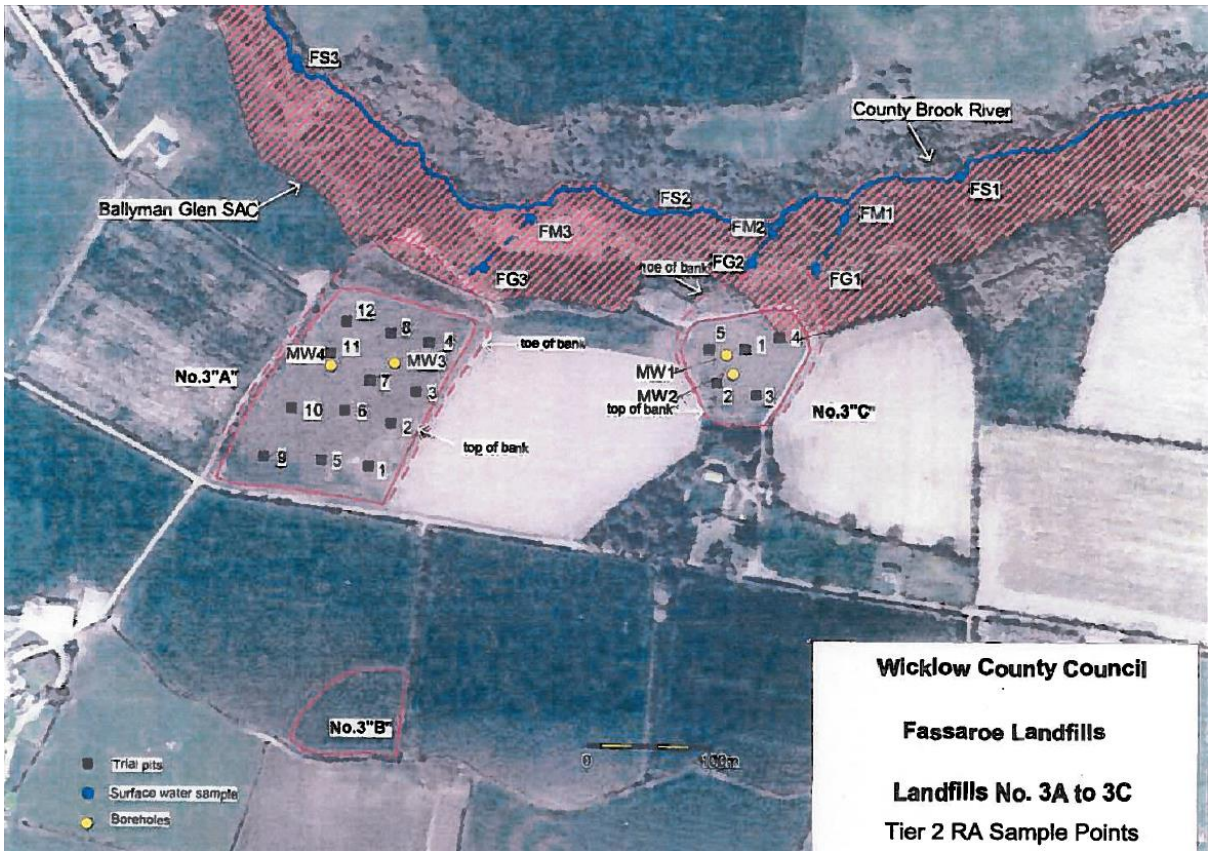
Table 2.5 - Site 3A: Historic Site Investigation Data – Boreholes (WCC, 2013)

Borehole	Topsoil Depth (m)	Clay/Capping Depth (m)	Waste Depth (m)	Borehole Total Depth (m)	Waste Thickness (m)	Waste Type
MW3	0.10	0.10-2.50	2.50-11.90	17.70	9.40	MSW
MW4	0.10	0.10-1.85	1.85-10.50	13.30	8.65	MSW

Source: Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013)

A number of springs and drains were identified within the vicinity of Site 3A. The springs/drains were sampled by WCC along with upstream and downstream monitoring locations on the County Brook River. The WCC report concluded that Site 3A was contributing elevated levels of ammonia and manganese to the surface water drainage network, however due to the assimilative capacity of the County Brook River it was considered that there is no adverse impact on the water quality within the river.

Figure 5 Site 3A & 3C: Historic SI locations



Source: extract from Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013)

Gas monitoring was completed at the 2 No. boreholes installed on the site in September and November 2012. Elevated concentrations of methane, ranging from 46.7%v/v to 67.4%v/v, and carbon dioxide, ranging from 17.2%v/v to 35.3% v/v were recorded. Vegetation die back was noted across the site which is suggestive of vertical fugitive gas emissions.

No perimeter and/or off site gas monitoring boreholes have been installed at the site therefore the potential for lateral gas migration has not been assessed.

2.4 SITE 3B

The following information was provided by WCC with respect to ground investigations and environmental monitoring within the vicinity of Site 3B:

- Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013); and
- Disused Wicklow County Council Landfill Sites 3A, 3B and 3C at Fassaroe, County Wicklow Appropriate Assessment Screening Report – Altemar in association with Environmental Management Services, April 2013.

As part of the Tier 2 investigation of Sites 3A and 3C, WCC excavated 2 No. trial pits within Site 3B which confirmed the presence of municipal waste in excess of 4.00m.

Table 2.6 - Site 3B: Historic Site Investigation Data (WCC, 2013)

Trial Pit	Topsoil Depth (m)	Clay/Capping Depth (m)	Waste Depth (m)	Waste Thickness (m)	Waste Type	% by volume waste (visual)
B1	0.40	0.40-1.00	1.00-5.00	>4.00	Domestic	50-60
B2	0.35	0.35-0.75	0.75-5.00	>4.25	Domestic	70-80

Source: Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013)

2.5 SITE 3C

The following information was provided by WCC with respect to ground investigations and environmental monitoring within the vicinity of Site 3C:

- Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013); and
- Disused Wicklow County Council Landfill Sites 3A, 3B and 3C at Fassaroe, County Wicklow Appropriate Assessment Screening Report – Altemar in association with Environmental Management Services, April 2013.

WCC completed a Tier 2 investigation of Site 3C in 2012 which comprised 5 No. trial pits and 2 No. boreholes (MW1 and MW2). Municipal waste was encountered in all trial pits excavated at Site 3C and base of waste was not encountered.

Table 2.7 - Site 3C: Historic Site Investigation Data – Trial Pits (WCC, 2013)

Trial Pit	Topsoil Depth (m)	Clay/Capping Depth (m)	Waste Depth (m)	Waste Thickness (m)	Waste Type	% by volume waste (visual)
C1	0.20	0.20-1.50	1.50-5.50	>4.00	Domestic	50
C2	0.40	0.40-1.20	1.20-5.50	>4.30	Domestic	70
C3	0.30	0.30-0.80	0.80-5.50	>4.70	Domestic	70-80
C4	0.40	0.40-1.50	1.50-5.50	>4.00	Domestic	60-70
C5	0.35	0.35-2.00	2.00-5.50	>3.50	Domestic	40

Source: Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013)

Boreholes MW1 and MW2 included the installation of gas/leachate monitoring standpipes within the waste body. No up-gradient or down-gradient groundwater monitoring boreholes have been installed at the site.

Table 2.8 - Site 3C: Historic Site Investigation Data – Boreholes (WCC, 2013)

Borehole	Topsoil Depth (m)	Clay/Capping Depth (m)	Waste Depth (m)	Borehole Total Depth (m)	Waste Thickness (m)	Waste Type
MW1	0.20	0.20-1.00	1.00-4.00	4.00	>4.00	MSW
MW2	0.10	0.10-1.25	1.25-5.40	8.10	4.15	MSW

Source: Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013)

Gas monitoring was completed at the 2 No. boreholes installed on the site in September and November 2012. Elevated concentrations of methane, ranging from 32.4%v/v to 67.7%v/v, and carbon dioxide, ranging from 17.8%v/v to 33.3% v/v were recorded. RPS is unaware of the availability of any flow data for Site 3C.

No perimeter and/or off site gas monitoring boreholes have been installed at the site therefore the potential for lateral gas migration has not been assessed.

3 TIER 1 – PRELIMINARY INVESTIGATION & RISK SCREENING

3.1 INFORMATION SOURCES

In accordance with the EPA Code of Practice a comprehensive desk study of existing data available for the sites and the surrounding area was conducted in completion of the Tier 1 Assessment. The Tier 1 Assessment also benefitted from previous site investigation data supplied by Atkins, Muir Associates and WCC. A comprehensive review of this information was completed as part of the Tier 1 Assessment.

The following sources of information were consulted as part of the desk study:

- Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council, December 2012 (amended April 2013);
- Disused Wicklow County Council Landfill Sites 3A, 3B and 3C at Fassaroe, County Wicklow Appropriate Assessment Screening Report – Altemar in association with Environmental Management Services, April 2013;
- Fassaroe Business Park Geotechnical Interpretative Report – Atkins McCarthy, July 2001;
- Fassaroe Historic Landfill Environmental Risk Assessment – Atkins, June 2010;
- Fassaroe AGS and Excel ground investigation data (IGSL and Glovers logs) received from Atkins on the 19th of October 2015;
- Environmental Ground and Geotechnical Site Evaluation Report for Site at Fassaroe, Bray – Muir Associates, January 1998;
- Eastern Midlands Region Waste Management Plan 2015-2021;
- EPA Code of Practice – Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007);
- Geological Survey of Ireland online datasets;
- OSI Aerial Photography;
- National Parks and Wildlife Service (NPWS) online maps and data. Database of Special Areas of Conservation, National Heritage Areas, National Parks, Special Protection Areas including site synopsis reports;
- Ordnance Survey of Ireland (OSI) Discovery Series, Sheet 32:20/ 32:22; and
- Geology of Wicklow, Geological Survey of Ireland (GSI) datasets.

3.2 SITE DESCRIPTION

3.2.1 Site Location & Land-use

The five historical landfill sites are located in Fassaroe, Bray, Co. Wicklow immediately to the south of the Dublin/Wicklow county boundary. The sites are located to the west of the M11 motorway and are accessed from Berryfield Lane. A summary of the site location is provided in **Figure 1**.

The landfill sites are situated between Berryfield Lane and the County Brook River (Fassaroe Stream). The valley which is known as Ballyman Glen is designated a SAC (Site Code: 000713) designated on the basis of the following habitats and/or species listed on Annex I/II of the EU Habitats Directive: petrifying springs with tufa formation; and alkaline fens.

Berryfield Lane is characterised by one off housing developments in a predominantly agricultural setting. As shown in **Figure 1** a sports ground and associated facilities are located in lands immediately to the east of Site 3B.

An integrated waste management facility (EPA Ref. W0053-03) is located immediately to the east of Site 2. The licence is for the following operations: bulking of municipal solid waste prior to transfer off site for disposal, composting, wood shredding, processing/storage of dry recyclables, recovery of construction and demolition waste, acceptance of waste at a civic waste facility including acceptance of hazardous waste such as bonded asbestos waste, WEEE and chlorofluorocarbons.

A sand and gravel quarry is located to the south of Berryfield Lane which is operated by Roadstone Limited. The site also holds an EPA licence (W0269-01) for operation as a soil recovery facility comprising the following activities:

(i) the restoration of the sand and gravel quarry using soil and stones; and
(ii) the operation of a construction and demolition waste recycling operation.

A number of utilities/services are located within the vicinity of the existing landfills:

- An ESB 38kV overhead traverses the north west margin of Site 1;
- A twin 110kV overhead ESB pylon traverses the western margin of Site 1;
- A water main runs in a north south direction between Sites 1 and 2;
- A MV ESB overhead traverses the southern margins of Sites 3A and 3C; and
- A MV ESB overhead traverses the western margin of Site 3B.

3.2.2 Site Inspection

RPS carried out an initial site inspection on the on the 12th of October 2015. An understanding of the delineation of and the location of imported material was obtained and an opinion on the composition of the surface material was established.

Olfactory evidence of landfill gas was noted at Sites 3A and 3C. Vegetative die back was notable in Sites 2 and 3B with Sites 1, 3A and 3C showing notable signs of ground disturbance

Visible evidence of waste was noted in the northern margins of Site 2 where erosion has taken place on the slopes leading to the river valley.

In total 9 discrete springs were noted along the southern river bank of the County Brook River (Fassaroe Stream) between Site 1 and Site 3a. Spring 1 (see Plate 1) is located at the base of a steep embankment adjacent the river. The ground was soft underfoot, with clear signs of ochre staining and hydrocarbon sheening at surface. Plate 2 shows Spring 3, which is more typical of the springs within the SAC that emerge as diffuse flow from the wet embankments and coalesce into a small channel with distance downstream.

Emerging groundwater spring flows feed the tufa deposits and alkaline fen and therefore constitute a Groundwater Dependant Terrestrial Ecosystems (GWDTE) receptor as identified in the EPA Code of Practice and protected through the Water Framework Directive (WFD). An example of tufa deposits observed on the southern bank of the river is shown below in Plate 3.

Plate 1. Photograph of Spring 1 in October 2015 (SP1)



Plate 2.Photograph of Spring 3



Plate 3. Photograph of Tufa Deposit near river bank (off-white deposit in the centre of the picture)



3.2.3 Aerial Photographs

Aerial photography indicates that the Site 2 and 3A – 3C are grassed with evidence of vegetation die back. Site 1 consists of scrub and Gorse with some surface debris.

Figure 6 Aerial Photography



Source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/ Airbus DS, USDA, USGS, AEX, Geomapping, Aerogrid, IGN, IGP, swisstopo and the GIS User Community

3.2.4 Historical Land Use

It is understood that Sites 1, 3A and 3C were previously operated as sand and gravel pits. Wicklow County Council's report entitled 'Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council', December 2012 (amended April 2013) states:

Between the early-1970s and the mid-1990s, Wicklow County Council operated a number of municipal landfills in the Fassaroe area, to the west of Bray, in north County Wicklow. Four landfills were sited on the northern side of Berrysfield Lane with a fifth small landfill located to the south of the road.

Available information regarding the volumes and types of waste deposited as well as the duration of filling have been taken from the EPA's Section 22 register and presented in **Table 3.1** below. Information has been provided for Sites 2, 3B and 3C only.

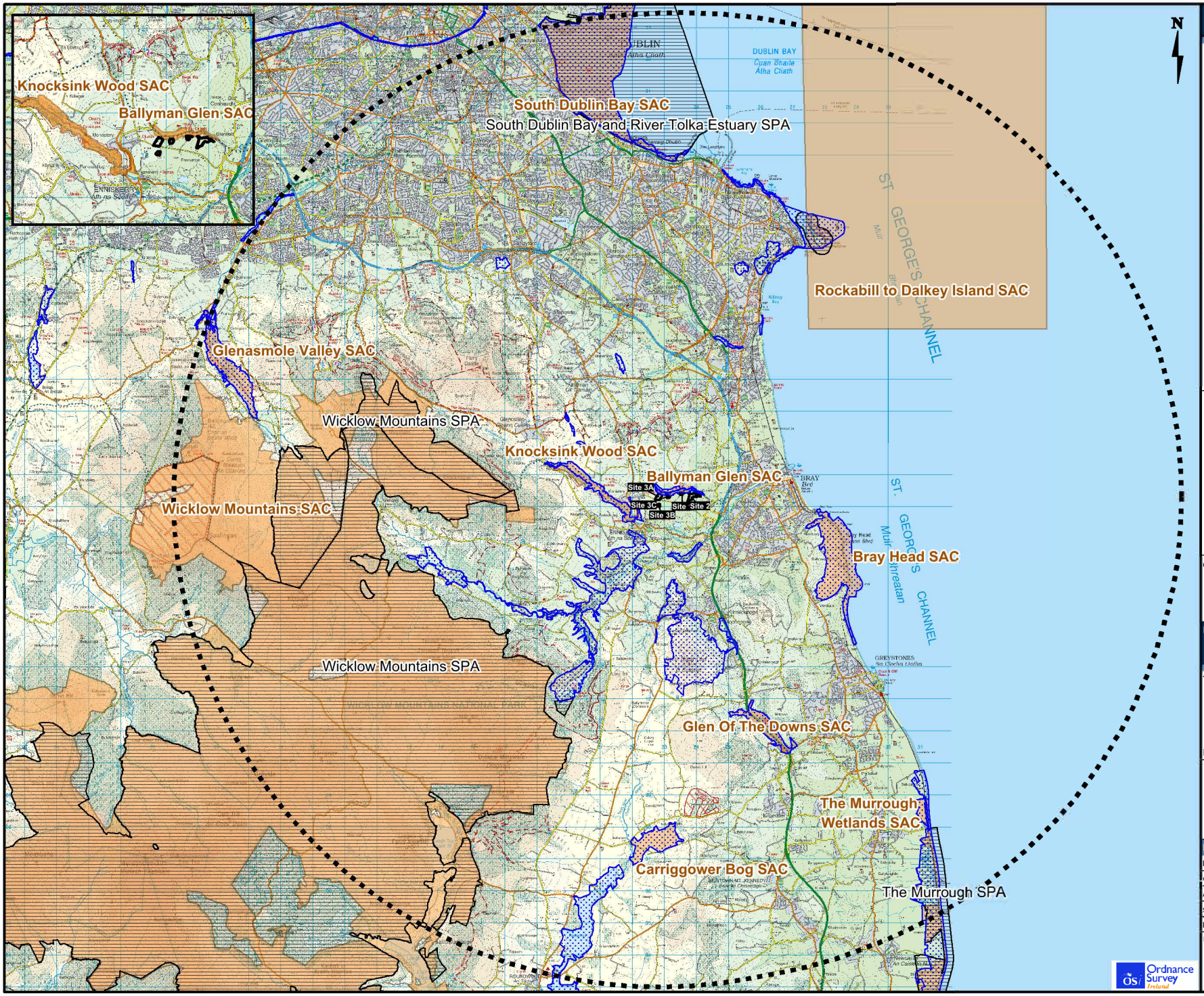
3.2.5 Local Sensitive Sites

Sites 1, 2, 3A and C are located adjacent to the Ballyman Glen SAC (Site Code: 000713) designated on the basis of petrifying springs with tufa formation and alkaline fens (see Appendix A for the site synopsis and **Figure 1** for site locations). The tufa deposits are not explicitly mapped within the SAC area, however numerous isolated instances of tufa deposits were noted along the southern banks of the County Brook River (Fassaroe Stream), typically associated with seepages from the bank.

Table 3.1 - Data from EPA Section 22 Register

Site Name	Waste Type	Hazardous Waste	Waste Quantity	Verification	Start Date	End Date	Holder of Waste	Site Owner
Fassaroe 2	Municipal	-	150,000	Local Knowledge	01/01/1979	31/12/1991	Wicklow Co Co	Cosgrave Bros
Fassaroe 3B	Municipal	-	9,000	Local Knowledge	01/01/1994	31/12/1995	Wicklow Co Co	Borg Developments
Fassaroe 3C	Municipal	-	30,000	Walk Over Survey	01/01/1992	31/12/1995	Wicklow Co Co	Borg Developments

Source: EPA



Legend

- Sites
- 15km Buffer
- Natural Heritage Areas (NHA/pNHA)
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)

DATA SOURCE:
National Parks and Wildlife Service (NPWS).



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Designations within 15 km

Figure 7

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3.3 HYDROLOGY

3.3.1 Regional Hydrology

The northern site boundary is bordered along the County Brook River (Fassaroe Stream) (EPA Name: County Brook). County Brook River (Fassaroe Stream) flows eastwards into the Dargle River and flows into St. Georges Channel and into the Irish Sea. The Dargle River is a registered salmonid river under the Salmonid Regulations (S.I. 293). The Dargle River catchment forms part of the Eastern River Basin District.

Outside of the river valley, the Fassaroe site is underlain by thick permeable subsoil and as a result the surface water drainage density is low, with very few field drains in the area and no ponds or tributaries to the County Brook River (Fassaroe Stream). As such there is no formal drainage system connecting the land around the historical landfill sites and the County Brook River (Fassaroe Stream) or its associated drainage system within the valley.

Groundwater fed springs and seepages are evident in the riparian zone along the County Brook River. These springs feed the alkaline fen and tufa deposits. The spring flows are relatively small coalesce downstream to form a more defined channel.

3.3.2 Surface Water Quality

The Water Framework Directive (WFD) status of the County Brook River has been assigned as 'Good' in periods between 2007-2009 and 2010-2012. The EPA has previously completed river water quality monitoring both upstream and downstream of the site on the County Brook River (Fassaroe Stream) at Ballyman Road Bridge (Site No. RS10C060200) and Thornhill Road Bridge (No. RS10C060300) respectively.

3.4 GEOLOGY

3.4.1 Regional Bedrock Geology

The geology of the site is presented in **Figure 8** Bedrock Geology.

The site is underlain by bedrock of the Ordovician Maulin Formation which consists of dark blue-grey slate, phyllite & schist (Deep marine). The Glencullen River formation, consisting of namely tuff & greywacke bedrock is found to the south site of the site. These units are predominantly striking NE-SW with minor deviations in strike.

The metasediments of the Maulin and Glencullen River bedrock formations are thrust faulted against Cambrian metasediments (consisting of dominantly greywacke & quartzite rock) to the east and southeast of the site towards Bray. The rocks are highly folded and faulted as a result of several phases of deformation. The predominant structures in the region are primarily NE / SW trending normal faults with minor thrust faults and associated folding. These structures influence the overall hydrology and topography of the region in the area with river valleys following the structural features.

3.4.2 Regional Superficial Geology

The Fassaroe site is underlain by shallow, well drained mineral (mainly basic) soils (BminSW, (Teagasc, 2004).

The subsoils (Quaternary Geology units above the rock) at the site consist of glaciofluvial sands and gravels. According to the GSI, these sand and gravel deposits derived dominantly from Limestones make up the Fassaroe Delta. The site forms part of the Enniskerry delta, listed as an Irish Geological Heritage Site (WW020).

Depth to bedrock has not been proven at the site to date, albeit occurrences of shale/ schist outcrops were observed along the adjacent river at a small number of locations. In particular outcrop was noted directly north of Site 1 at approximately 55m above Ordnance Datum (aOD), see Plate 4 below.

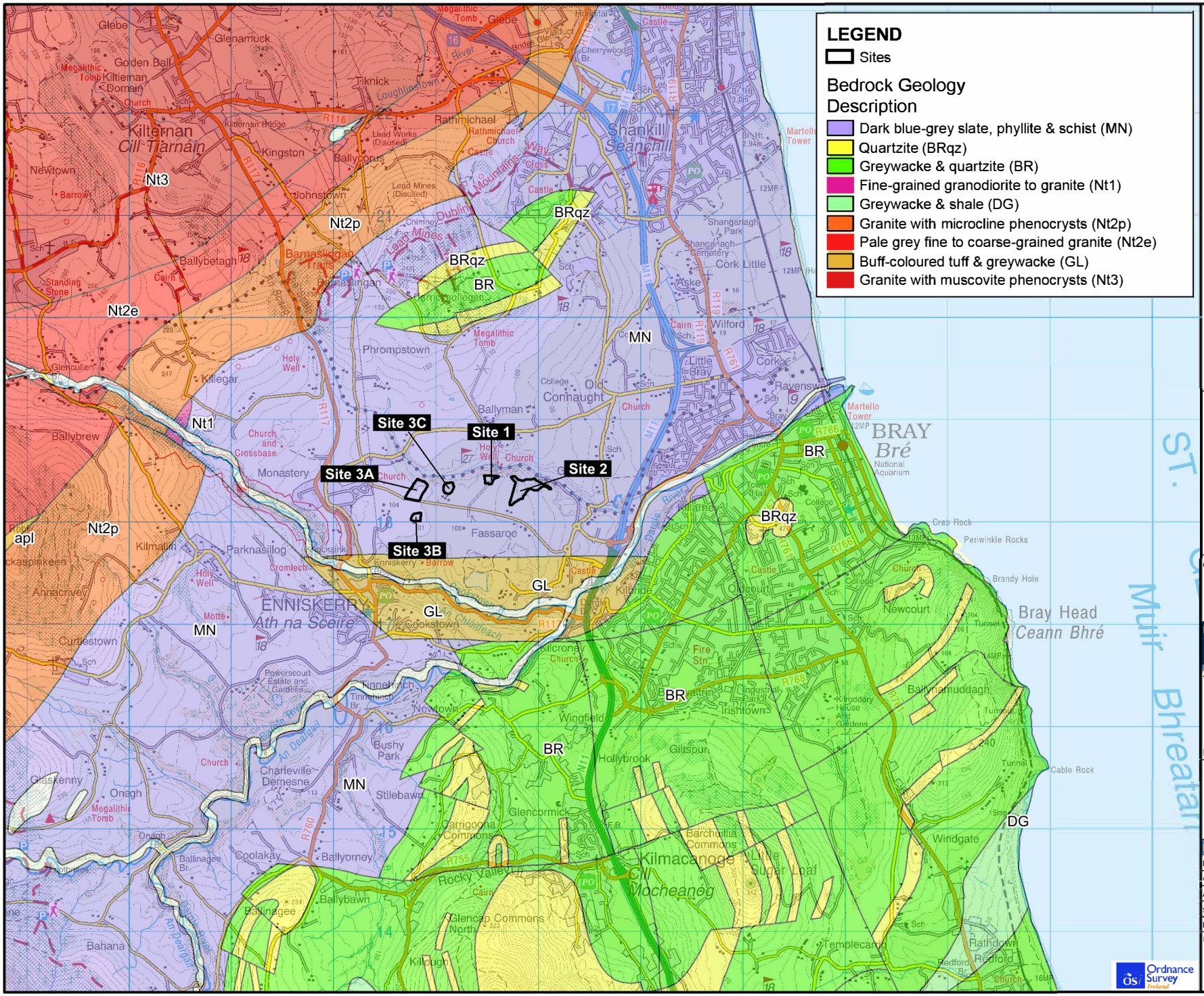
Plate 4 Bedrock outcrop within the river north of Site 1



3.4.3 Local Geological Conditions

Topsoil has an average thickness of 0.2 m and normally overlies consolidated or lightly over consolidated alluvial clays consisting soft to firm sandy, gravely silts and clays with an approximate thickness of 3.4-4.0 metres. The alluvium is considered by GSI to be largely cohesive in nature and is underlain by granular glacio-fluvial deposits of sands and gravels. These sand and gravel deposits are of variable thickness but increases to approx. 18 m towards the river. The granular deposits can be underlain by glacial till (boulder clay) deposits consisting of stiff to very stiff grey sandy gravelly clay containing numerous cobbles and occasional boulders.

Historic boreholes did not intersect the bedrock or boulder clay units.





DATA SOURCE:
Geological Survey Ireland (GSI)



Client

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Project

Fassaroe Historic Landfill

Title

Bedrock Geology

Figure 8

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3.5 HYDROGEOLOGY

3.5.1 Aquifer Classification

The Enniskerry groundwater body (IE_EA_G_038) is designated a locally important gravel aquifer (Lg). Although the aquifer is permeable, the groundwater flow velocity is will be comparatively low due to a high storativity and subdued water-table elevations expected. As a result the discharge to rivers will not be flashy and will be sustained through drier periods of the year (GSI, 2016).

The bedrock beneath the gravel aquifer, i.e. the Maulin Formation, is classified by the GSI as a locally important, moderately productive bedrock aquifer in local zones (Ll) (See **Figure 9**). Fracture flow is the dominant pathway for groundwater movement in the bedrock aquifer however the permeability is expected to be moderately low with most groundwater flow in within the top 20m of rock head.

3.5.2 Aquifer Vulnerability

Groundwater vulnerability maps are based on the type and thicknesses of subsoils and the presence of certain karst features. Groundwater is most at risk of contamination where the subsoils are absent or thin and, in areas of karstic limestone, where surface streams sink underground at swallow holes.

The aquifer vulnerability at the Fassaroe site is classified as High due to the presence of greater than 3m thick unsaturated zone overlying a gravel aquifer (DoELG & GSI 1999). (See **Figure 10**) and **Table 3.2** below.

Table 3.2 – GSI Vulnerability Categories

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 - 10.0m	3.0 - 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 - 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

3.5.3 Groundwater Flow and Recharge

The Enniskerry groundwater body is recharged by rainwater that percolates through the topsoil and the unsaturated sand and gravel deposits. Surface runoff is estimated at approximately 20% of effective rainfall (GSI, 2016). The GSI recharge map (www.gsi.ie) for the area presents an annual

recharge value of 575mm/year, due to the presence of the relatively permeable gravels at the surface.

Groundwater flow within the granular aquifer is expected to be towards the local river, where groundwater discharges emerge as springs and seeps along the lowest boundary of the groundwater body and regionally towards the Irish Sea. Previous reports have shown the local groundwater regime over the site is dominated by the County Brook River (Fassaroe Stream) valley to the north, and the valley of the River Dargle to the east.

3.5.4 Groundwater Quality

According to the EPA (Envision Maps) the Water Framework Directive (WFD) status for the Enniskerry Gravel water body has been assigned as 'Good' between 2007 and 2012.

The Ballyman Glen SAC which runs along the County Brook River (Fassaroe Stream) adjacent to the Fassaroe landfill sites comprises riparian wet woodland and contains a small strip of fen. The fen is very alkaline and is associated with petrifying springs and seepage areas, which have given rise to thick deposits of marl. The nature of the springs suggests they are discharging from the gravel unit, which is mainly derived from limestone. The earth of the banks around the landfill is unstable, and as a result, silt is being released into the County Brook River (Fassaroe Stream).

3.5.5 Groundwater Users/ Private Wells

Groundwater users are identified in Figure 11. The GSI well database lists a number of springs and old boreholes (from 1965) in the surrounding areas of Enniskerry and Bray, of which only a small number of have been assigned as domestic use.

The nearest spring, St Kevin's Well (GSI code 3224SWW137) is located immediately north of the site, noted on the original six inch (c. 1830) maps. The GSI well data-base is not a fully comprehensive list and additional groundwater using wells may be present in the area.

There are no recorded large abstractions from the Enniskerry groundwater body.



Legend

- Sites
- Lg — Gravel
- LI — Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl — Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones

DATA SOURCE:
Geological Survey Ireland (GSI)

Client
Comhairle Contae Chill Mhantáin

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Fassaroe Historic Landfill

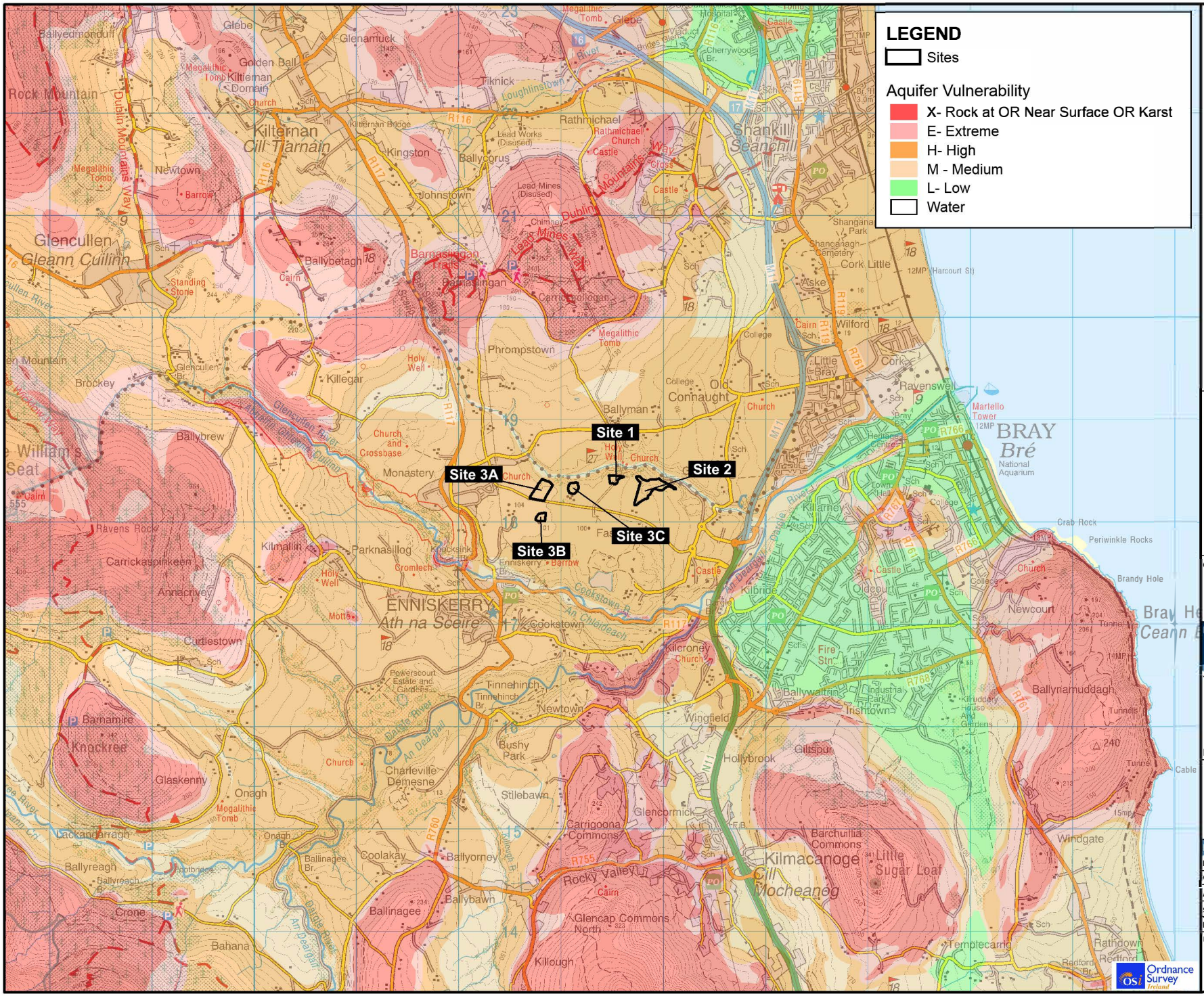
Title
Aquifer Bedrock

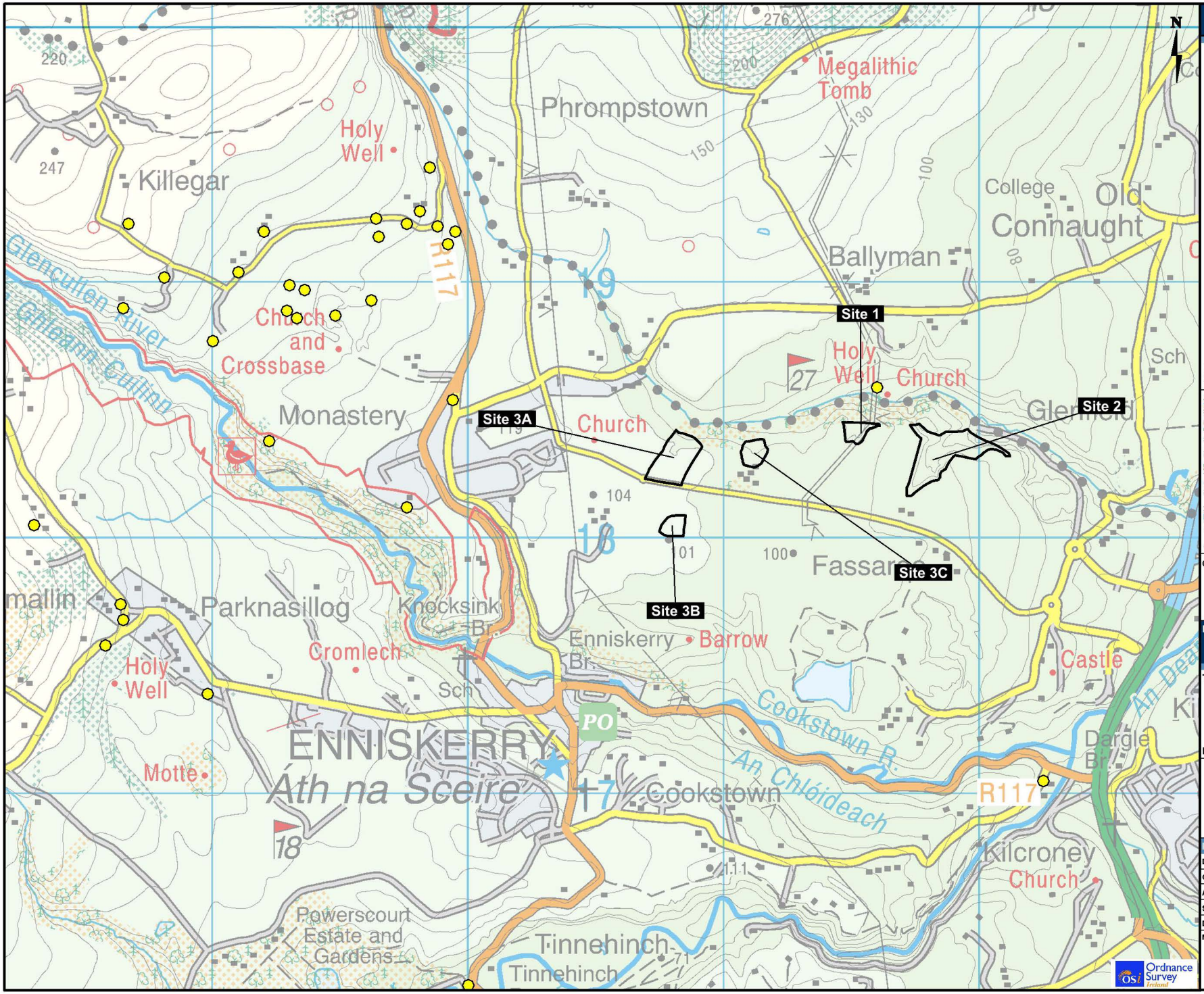
Figure 9

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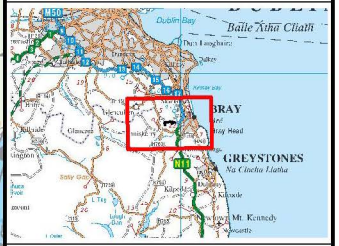

LEGEND
Sites
Aquifer Vulnerability
X- Rock at OR Near Surface OR Karst
E- Extreme
H- High
M - Medium
L- Low
Water
Site 1
Site 2
Site 3A
Site 3B
Site 3C
N
BRAY
Bré
ENNISKERRY
Ath na Sceire
Kilmacanoge
Cill Mocheanóg
Glencullen
Gleann Cuilinn
Kilternan
Cill Tiarnáin
Shankill
Seanchill
Rock Mountain
Ballyedmonduff
Golden Ball
Kilternan Domain
Tiknick
Rathmichael
Ballycorus
Kingston
Newtown
Johnstown
Lead Mines (Disused)
Ballybetagh
Barnaslingan
Carrickgollogan
Phrompstown
Killegar
Brockey
Ballybrew
Monastery
Kilmalum
Parknasillog
Carrickaspinkeen
Annacrivey
Curtlestown
Barnamire
Knockree
Glaskenny
Onagh
Lackandarragh
Ballyreagh
Crone
Bahana
Coolakay
Ballyorney
Ballinagee
Ballybawn
Killough
Rocky Valley
Glencap Commons North
Carrigoona Commons
Glencormick
Stillebawn
Bushy Park
Charleville Demesne
Tinnehinch
Powerscourt Estate and Gardens
Wingfield
Hollybrook
Gillspur
Barchuilla Commons
Little Sugar Loaf
Windgate
Templecarrig
Rathdown
Redford
Ballynamuddagh
Tunnels
Irishtown
Ballywaltrim
Kilruddery House And Gardens
Industrial Park
Fire Stn
Kilcroney
Kilbride
Oldcourt
Newcourt
Killarney
Martello Tower
Periwinkle Rocks
Crab Rock
Brandy Hole
Cork Little
Wilford
Ravenswell
Old Connaught
Ballyman
Shanganagh Park
Shanganagh Cemetery
Aske
Cork
Little Bray
Bray Head
Greystones
Na Clocha Liatha
Mt. Kennedy
Cookstown
Castle
Church
Holy Well
Cairn
Standing Stone
Megalithic Tomb
Barrow
Mottes
Lead Works (Disused)
Chimney
Viaduct
Cherrywood Br.
Glebe
Glenamuck
Rathmichael Church
Kilternan Bridge
Dublin Mountains Way
Lead Mines Way
Wicklow Way
Glencullen River
Glencullen Br.
Ballybrew
Ravens Rock
William's Seat
Mountain
Ballyman
College
Church and Crossbase
Holy Well
Cromlech
Knocksink
Enniskerry Barrow
Cookstown River
An Chladeach
Tinnehinch Br.
Newtown
Baltic River
An Dealgan
Onagh Br.
Ballinagee Br.
Hotbridge
Ballyreagh Br.
Rocky Valley River
Dargle River
Parkle River
Dargle Br.
Killarney River
Bray Ceann
Bray Ho
Cable
Tunnel
Fassaroe Historic Landfill
Groundwater Vulnerability
Figure 10
DATA SOURCE:
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Legend

- Sites
- Groundwater Well

DATA SOURCE:
Geological Survey Ireland (GSI)



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Project

Fassaroe Historic Landfill

Title

GSI Groundwater Wells

Figure 11

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3.6 TIER 1 RISK ASSESSMENT

3.6.1 Initial Conceptual Site Model and Tier 1 Risk Screening

A review was undertaken of historic site investigations and previous reports at the sites in order to develop an initial Conceptual Site Model (CSM) and identify any gaps for which further data was required. The initial CSM is based on the concept of pollutant (source-pathway-receptor) linkages defined by the Tier 1 preliminary investigation described above. The Tier 1 risk prioritisation and classification approach outlined by the Code of Practice (EPA, 2007) is also base on the concept of pollutant linkages, herein after referred to as SPR linkages.

3.6.1.1 Sources

Four principal contamination sources have been identified for the purpose of the initial CSM:

- Leachate (S1)
- Waste (S2)
- Asbestos Containing Material (S3)
- Landfill Gas (S4)

3.6.1.2 Receptors

A variety of receptors have been identified with respect to the site environmental setting and site users (currently and following future development). Environmental and water receptors potentially relevant to the local site setting include the following:

- WFD Surface Water Body – County Brook River (R1)
- Surface Water Protected Area - Ballyman Glen SAC (R2)
- Private Wells – Groundwater abstraction sources (R3)
- Groundwater Dependent Terrestrial Ecosystem (GWDTE) - Ballyman Glen SAC (Site Code: 000713) (R4)
- Aquifer – Locally important gravel aquifer (Lg) - Enniskerry groundwater body (R5)
- Public Supply Well (R6)

Human health receptors potentially relevant to the landfill sites include the following:

- Current and Future Site Users (R7)
- Construction Workers (R8)
- Adjacent Buildings and Structures (R9)
- Non-designated land (R10)

3.6.1.3 Pathways

A number of pathways have been identified that potentially connect the sources of contamination associated with the five landfill sites and receptors. These include:

- Vertical migration to groundwater then horizontal flow through Surface Water (SW) drainage channels into the river (County Brook river) (P1);
- Vertical migration to groundwater and horizontal (lateral) flow through saturated groundwater / aquifer (P2);
- Surface Water drainage system (P3);
- Direct dermal contact, ingestion of dust and soil or inhalation of dust (P4);
- Lateral migration of landfill gas through subsoils, resulting in inhalation and/ or explosion (P5);
- Lateral migration of dissolved phase landfill gas through groundwater (P6);
- Vertical migration of landfill gas through subsoil (P7); and
- Migration of landfill gas through existing &/or proposed services routes (P8).

Tables 3.3, 3.4 and 3.5 detail the classification of probability, classification of consequence and risk matrix taken from CIRIA C552 (Contaminated Land Risk Assessment) (CIRIA, 2001) that was used in the development of the initial CSM.

The initial CSM developed from this review is presented in **Table 3.6** and addresses the Source, Pathway and Receptor elements across the five landfill sites. In order to complete **Table 3.6** the worst case scenario for each element from all five landfill sites was chosen.

Table 3.3 – Classification of Probability (from CIRIA C552, 2001)

Probability/ Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Table 3.4 – Classification of Consequence (from CIRIA C552, 2001)

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/ property. A short-term risk to a particular ecosystem or organisation forming part of such ecosystem (note: the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000)	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into the water environment. **Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).**
Medium	Chronic damage to Human Health ("significant harm" as defined by DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem or organism forming part of such ecosystem (note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR, 2000).	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated mature reserve. **Lesser toxic and asphyxiate effects of carbon dioxide**
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the Draft Circular on Contaminated Land, DETR, 2000). Damage to sensitive buildings/ structures/ services or the environment.	Pollution of non-classified groundwater. Damage to building rendering t unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily, repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discolouration of concrete

Table 3.5 – Risk Matrix – Comparison of Consequence and Probability (from CIRIA C552, 2001)

Risk = Probability x Consequences		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Moderate/ low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	Moderate risk	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

Table 3.6 – Initial Conceptual Site Model

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
Water Environment									
S1	Leachate	P1	Vertical to groundwater then horizontally through possible surface water drainage channels into the river	R1	WFD Surface Water Body	Unlikely	Medium	Low Risk	The Tier 1 preliminary investigation including site walkover investigations did not identify any surface water drainage system connecting the landfill sites to the SAC and/or County Brook River and hence no discharge to surface land drains.
				R2	Surface Water Protected Area	Unlikely	Medium	Low Risk	
		P2	Vertical & Horizontal via Groundwater	R3	Private Wells	None	Medium	No Risk	There are no residential properties or private wells situated down gradient of the landfill sites (water main connection in the area)
				R4	Groundwater Dependent Terrestrial Ecosystem (GWDTE)	Likely	Medium	Moderate Risk	GWDTE understood to be present within the SAC boundary.
				R5	Aquifer	Likely	Medium	Moderate Risk	The underlying bedrock and gravel aquifers are at risk by direct connection
				R6	Public Supply Well	None	Mild	No Risk	There are no public water supply wells in the area.
				R1	WFD Surface Water Body	Likely	Medium	Moderate Risk	The County Brook River (Fassaroe Stream) is at risk
		P3	Surface Water Drainage	R1	WFD Surface Water Body	Unlikely	Medium	Low Risk	The Tier 1 preliminary investigation including site walkover investigations have not identify any surface water drainage system connecting the landfill sites to the SAC and/or County Brook River and hence no discharge to surface land drains.
				R2	Surface Water Protected Area	Unlikely	Medium	Low Risk	
Human Health									
S2	Waste	P4	Direct dermal contact. Ingestion dust	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	No previous waste characterisation completed. Currently minimal clay cap in place.

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
			and soil. Inhalation of dust	R8	Construction Workers	Low Likelihood	Minor	Very Low Risk	No previous waste characterisation completed. Currently minimal clay cap in place.
S3	ACM	P4	Direct dermal contact. Ingestion dust and soil. Inhalation of dust.	R7	Current and Future Site Users	Unlikely	Severe	Moderate/ Low Risk	No analysis for ACM completed.
				R8	Construction Workers	Likely	Severe	High Risk	No analysis for ACM completed. Presence of C&D waste in Site 1 presents risk of presence of ACM. Currently minimal clay cap in place
S4	Landfill Gas	P5	Lateral Migration Subsoil Inhalation and/ or explosion	R7	Current and Future Site Users	Low Likelihood	Mild	Low Risk	Landfill gas known to be present onsite however no dataset available. No offsite gas monitoring completed. Age, extent, volume and composition of waste unknown. Potential for exposure to construction workers during excavations. Potential for ingress to existing buildings and structures. Potentially, landfill gas migration could occur into existing adjacent buildings through cracks within the floor slab construction and/or around service/utility routes. Risks associated with gas migration into existing buildings should be considered further by the Local Authority.
				R8	Construction Workers	Likely	Severe	High Risk	
				R9	Adjacent Buildings and Structures	Low Likelihood / Likely	Severe	Moderate/High Risk	
				R10	Non-designated land	Low Likelihood / Likely	Minor	Very Low/Low Risk	
S4	Landfill Gas	P6	Lateral Migration Groundwater	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	Landfill gas known to be present onsite however no dataset available. No offsite gas monitoring completed. Age, extent, volume and composition of waste unknown. Groundwater and leachate levels to be established
				R8	Construction Workers	Unlikely/Low Likelihood	Severe	Low/Moderate Risk	
				R9	Adjacent Buildings and Structures	Unlikely/Low Likelihood	Severe	Low / Moderate Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
S4	Landfill Gas	P7	Vertical Migration Subsoil	R7	Current and Future Site Users	Low Likelihood	Mild	Low Risk	Existing clay cap c.1-2m – information regarding composition and thickness lacking. The lack of an engineered cap will enable vertical migration of gas and atmospheric dispersion and dilution at surface. Landfill gas known to be present onsite however no credible dataset available. No offsite monitoring completed. Age, extent, volume and composition of waste unknown. Water level and effect on gassing regime unknown. Potential for exposure to construction workers during excavations. Potential for ingress to existing and proposed buildings and structures. Vegetation die back noted.
				R8	Construction Workers	Likely	Severe	High Risk	
				R9	Adjacent Buildings and Structures	Low Likelihood / Likely	Severe	Moderate / High Risk	
				R10	Non-designated Land	Likely	Minor	Low Risk	
S4	Landfill Gas	P8	Existing & Proposed Services Routes	R9	Adjacent Buildings and Structures	Low Likelihood / Likely	Severe	Low / Moderate Risk	No offsite gas monitoring known to have been completed.

3.6.2 Tier 1 – Risk Prioritisation & Classification

The EPA Code of Practice identifies eleven specific pollutant Source-Pathway-Receptor (SPR) linkages that should be considered within the CSM and assessed as part of the Tier 1 Risk Prioritisation process. Each of these linkages is scored using the scheme provided in the Code of Practice (EPA, 2007) in order to provide an overall risk categorisation for each landfill site.

An initial model was developed based on the information given above with consideration given to the eleven SPR linkages identified in the Code of Practice (EPA, 2007). During Tier 1 each aspect of each SPR linkage can be assessed according to particular criteria as defined within the Code of Practice (EPA, 2007). The Code of Practice uses a separate scoring matrix for each aspect of an SPR linkage, which are defined within Tables 1a to 3f of the Code of Practice. Where an individual aspect is not present or not relevant within the context of the conceptual model it is given a score of 0.

The score of each linkage is normalised with respect to 100 by dividing the score for each linkage by the maximum available points for that linkage to express as a percentage. The overall score for the site is taken as the maximum of the individual normalised scores. The site can then be placed in a prioritisation category depending upon the potential level of risk identified. Sites with a higher score represent those with either a higher level of risk, which may require remediation, or a high level of uncertainty, which requires further intrusive investigation. If a high score is due to a high level of uncertainty then the assessment should proceed to Tier 2 (Site Investigation and Testing) to refine the risk assessment.

The risk prioritisation and classification for each site is summarised in **Table 3.5** below. The full assessment, including relevant calculations, is presented in **Appendix B**. The risk category bands relating to site scores as defined in the EPA Code of Practice are presented in **Table 3.4**.

Table 3.7 - Risk Category and Prioritisation Class

Score	Priority Class	Risk Category	Definition
> 70%	A	High	High risk/high uncertainty sites. Further investigation required to confirm status. Presents potentially high risk to environment in current condition. Remediation / mitigation will be necessary. Highest priority with Regulating Authority.
40% to 70%	B	Moderate	Moderate risk/moderate uncertainty sites. Further investigation required to confirm status. Presents potentially moderate risk to environment in current condition. Remediation / mitigation may be required.
< 40%	C	Low	Low risk sites. Not considered to present risk to environment in current condition however further investigation may be required in case of change of land use.

Table 3.8 - Summary of Risk Category and Prioritisation

Site	Risk Classification	Priority Class	Highest SPR Score	SPR*	Comment
1	Low	C	5	SPR9	The Tier 1 Risk Ranking and Prioritisation suggests that Site 1 is a Low Risk based on the assumption that the waste type is C&D. The highest SPR linkage relates to the potential for leachate migration through the surface water network to surface water dependant terrestrial ecosystems.
2	High	A	70	SPR8 SPR9 SPR10	The SPR linkages of primary concern relate to the potential for leachate to impact surface water bodies and the SAC through surface water migration as well as the potential risk of lateral migration of landfill gas to a human presence.
3A	High	A	70	SPR9	The SPR linkage of primary concern relates to the potential for leachate migration through the surface water network to the Ballyman Glen SAC.
3B	Low	C	30	SPR10	The primary risk relates to the potential for lateral gas migration which should be investigated further due to the presence of buildings within c.100m of the site boundary.
3C	Moderate	B	50	SPR9 SPR10	The SPR linkages of primary concern relate to the potential for leachate to impact surface water bodies and the SAC through surface water migration as well as the potential risk of lateral migration of landfill gas to a human presence.

*SPR Linkage Number from EPA Code of Practice (2007)

3.7 SUMMARY OF TIER 1 ASSESSMENT

3.7.1 Site 1

The Tier 1 Risk Ranking and Prioritisation suggests that Site 1 is a Low Risk site (Class C) based on the assumption that the waste type is C&D.

Available intrusive data suggests the site comprises C&D waste however reference to the presence of domestic waste in TPB36 and the lack of available data to confirm the vertical and lateral extent of the waste body would raise some uncertainty on the overall classification/characterisation of the waste body.

Should the waste be classified as Municipal the risk classification would be upgraded to Moderate (Class B) due to the potential for leachate and gas generation and migration to relevant receptors.

It should also be noted that to RPS's knowledge no environmental monitoring (i.e. gas, leachate, groundwater or surface water) has been completed within Site 1, which leads to uncertainty in determining the intrinsic risk posed to receptors (i.e. human health or environmental).

3.7.2 Site 2

The Tier 1 Risk Ranking and Prioritisation suggests that Site 2 is a High Risk site (Class A) based on the nature and extent of the waste and proximity of receptors.

The SPR linkages of primary concern relate to the potential for leachate to impact surface water bodies and the SAC through surface water migration as well as the potential risk of lateral migration of landfill gas to a human presence.

Due to the lack of available information regarding the integrity of the leachate/gas monitoring boreholes sampled in 2010, coupled with the absence of landfill gas flow rates, groundwater monitoring boreholes, surface water monitoring data and off site landfill gas monitoring boreholes, uncertainty exists regarding the intrinsic risk posed to receptors.

Site 2 is located adjacent to the Ballyman Glen SAC (Site Code: 000713). The report entitled '*Disused Wicklow County Council Landfill Sites 3A, 3B and 3C at Fassaroe, County Wicklow Appropriate Assessment Screening Report – Altemar in association with Environmental Management Services, April 2013'* makes reference to Site 2 and concluded that an AA (Stage 2) would be required for Site 2 as the northern margins abutting the SAC had eroded with waste falling directly into the SAC and stream valley.

3.7.3 Site 3A

The Tier 1 Risk Ranking and Prioritisation suggests that Site 3A is a High Risk site (Class A). The SPR linkage of primary concern relates to the potential for leachate migration through the surface water network to the Ballyman Glen SAC.

Due to the absence of landfill gas flow rates, up-gradient/down-gradient groundwater monitoring boreholes and off site/perimeter landfill gas monitoring boreholes, uncertainty remains regarding the intrinsic risk posed to receptors.

3.7.4 Site 3B

The Tier 1 Risk Ranking and Prioritisation suggests that Site 3B is a Low Risk site (Class C) based on the extent of the waste body and proximity to receptors.

The primary risk relates to the potential for lateral gas migration which should be investigated further due to the presence of buildings within c.100m of the site boundary.

It should also be noted that no environmental monitoring (i.e. gas, leachate, groundwater or surface water) has been completed within Site 3B therefore uncertainty remains regarding the intrinsic risk posed to receptors.

3.7.5 Site 3C

The Tier 1 Risk Ranking and Prioritisation suggests that Site 3C is a Moderate Risk site (Class B).

The SPR linkages of primary concern relate to the potential for leachate to impact surface water bodies and the SAC through surface water migration as well as the potential risk of lateral migration of landfill gas to a human presence.

Due to the absence of landfill gas flow rates, up-gradient/down-gradient groundwater monitoring boreholes and off site/perimeter landfill gas monitoring boreholes, uncertainty remains regarding the intrinsic risk posed to receptors.

3.8 CONCLUSIONS

Sites 2 and 3A are classified as High Risk sites with Site 3C classified as a Moderate Risk site therefore all three require a sufficiently detailed site investigation programme to confirm (or otherwise) the relevant risk classifications and inform the Tier 3 quantitative risk assessment and subsequent recommendations for remediation as required.

Sites 1 and 3B are classified as Low Risk sites. It is recommended that additional investigations are required to assess the potential for lateral gas migration from Site 3B and to confirm the nature of waste within Site 1. The additional site investigation should provide sufficient information to verify the characterisation of the sites and inform any subsequent recommendations. The proposed site investigations aimed at addressing the data gaps identified in Table 3.9.

Table 3.9 – Identified Data Gaps

	Identified Gaps
1	Waste characterisation unknown. Chemical analysis and leachability testing of waste material not completed
2	The presence of ACM unknown as no sampling and analysis completed
3	Limited SI completed in the vicinity of the waste bodies to determine vertical and lateral extent of waste bodies
4	Limited or no monitoring locations available within the relevant waste bodies. Where boreholes are present, logs are unavailable therefore borehole construction and integrity are unknown.
5	No offsite gas monitoring locations have been installed to investigate potential lateral migration
6	Gas monitoring is limited, no reference to methodology utilised during monitoring, no flow measurements, atmospheric conditions not recorded.
7	Limited or no leachate monitoring locations, sampling and analysis. Lack of information regarding leachate quality and quantity
8	Limited information available regarding the thickness of the existing clay cap and no analysis completed to determine composition.
9	Limited or no groundwater quality data available. Groundwater monitoring to be completed following establishment of potential contaminants of concern.
10	Limited information available on location of springs within the SAC and therefore mapping and sampling of these is required to determine potential impacts on spring water quality and flow.
11	Limited dataset available for surface water quality.

4 TIER 2 – SITE INVESTIGATION & TESTING

4.1 INTRODUCTION & OBJECTIVES

The Tier 1 assessment recommended the completion of a Tier 2 site investigation and testing programme at all sites to further develop the initial CSM, confirm the relevant risk classifications for each landfill and inform the Tier 3 quantitative risk assessment and subsequent recommendations for remediation as required for Sites 2 and 3A.

The Tier 2 investigation and testing programme was designed to address gaps identified during the Tier 1 assessment and to provide further information on the following:

- The nature of the waste material;
- The lateral and vertical extent of the waste material;
- The volume and quality of leachate within the waste;
- The relationship between leachate and groundwater and the identification of leachate plumes beneath or outside of the waste bodies;
- The potential for landfill gas generation and migration;
- The ground conditions in the vicinity of the site, in particular the absence/presence of low permeability subsoil deposits between the waste and the aquifer;
- Determine time-series water quality within the aquifer, springs and surface waters to inform Tier 3 risk assessments determine potential risk to the environment and to human health.

The Tier 2 intrusive investigation included the following;

- Additional trial pitting within each site to inform the extent, composition and characterisation of the waste;
- Installation of leachate monitoring boreholes within the waste body of each site;
- Installation of additional groundwater monitoring boreholes;
- Installation of additional landfill gas monitoring boreholes to determine the presence and concentrations of landfill gas;
- Additional groundwater, surface water, spring, leachate and gas sampling to determine potential impact to human and environmental receptors;
- Additional soil sampling above and below the waste body to determine potential impact to human health and environmental receptors; and
- Pumping of existing boreholes (MW2, MW3 and MW4) remove silting and increase borehole performance.

4.2 TIER 2 METHODOLOGY

The Tier 2 investigation was conducted in two phases as follows:

Non Targeted Investigation

- **Geophysical Investigation:** This investigation was completed in December 2015 and further supplemented in March 2016 in order to assist in the delineation of the waste material, identify the presence of anomalous features and determine the extent of gravels below the

waste body. The survey was carried out using EM31 conductivity, Electrical Resistivity Tomography (ERT) and seismic refraction methods.

- **Non Targeted Ground Investigation:** This investigation was also completed in December 2015 and involved the excavation of twenty eight (28) trial pits and the collection of soil samples using 50m (Sites 1, 3b and 3C) and 75m (Sites 2 and 3A) sampling grids. Samples were taken from the waste body and the underlying undisturbed subsoil when encountered.

Targeted Investigation

- **Targeted Ground Investigation:** The intrusive targeted investigation involved the installation of twenty one (21) combined gas/leachate monitoring boreholes, twenty five (25) gas monitoring boreholes and eleven (11) groundwater monitoring boreholes between January and March 2016. The targeted investigation comprised cable and rotary percussive drilling, leachate, groundwater, surface water and soil sampling and landfill gas monitoring.

The investigations were carried out in accordance with;

- BS 10175:2011+A1:2013, Investigation of potentially contaminated sites - Code of practice;
- BS 5930:2015, Code of practice for ground investigation;
- Applicable CEN and ISO Standards for Analysis and Sampling;
- Environment Agency (EA) Guidance on Assessment of Risks from Landfill Sites;
- CIRIA C665, Assessing Risks Posed by Hazardous Ground Gases (2007)
- All relevant Health and Safety Regulations and Guidance ((including the Health, Safety and Welfare at Work Act 2005, and Safety, Health and Welfare at Work (Construction) Regulations 2006 as amended); and
- EPA Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites, 2007

4.3 INVESTIGATIVE FIELDWORKS

4.3.1 Geophysical Investigation

The objectives of the geophysical survey were to:

- Identify the lateral extent of the waste body;
- Identify the thickness of the waste body and presence of any anomalous features;
- Identify trace metals that could potentially be leaching from the site; and
- Identify any leachate plumes outside of or below the waste body.

The survey was carried out using electromagnetic EM131 ground conductivity, electrical resistivity tomography (ERT) and seismic refraction methods. EM31 ground conductivity mapping was completed over the filled area in order to map the extent of the fill, to map variations in the fill and to investigate the presence of any leachate plume and obtain background values for the soils and rock.

Fifteen (15) ERT profiles were completed across the five sites to investigate variations in the thickness and extent of the fill material and leachate, as well as to investigate the subsoil type and bedrock geology.

Five seismic refraction spreads were recorded on selected ERT profiles across all five sites to assist in determining the base of the landfill material which may be masked in the ERT results by the migration of leachate. Data quality was poor as signal transmission was limited due to the significant thickness and heterogeneous nature of the unconsolidated waste material.

The results of the geophysical survey were used in the development of the conceptual site model sections for the landfills. For instance the geophysical survey results suggest that the leachate plume (S1) has reached as far as 40 metres below the depth of waste, particularly to the northeast at Site 2. The surveys identified the potential migration of leachate from the landfills and the direction and depth of leachate migration. The surveys also provided information on the stratification of the subsoil and depth to waste.

The full report is presented in **Appendix C**.

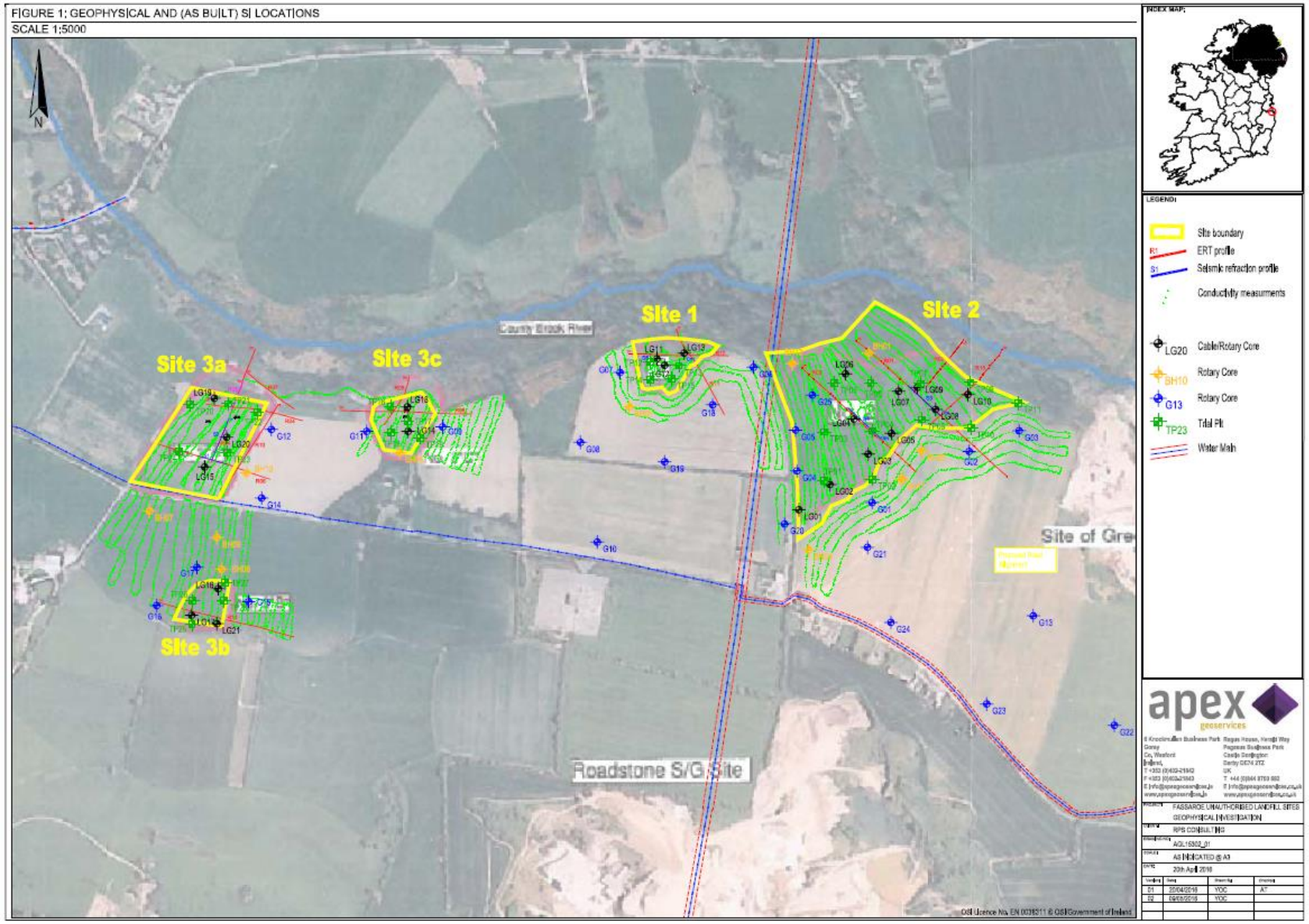


Figure 12 Geophysical Survey Locations (Apex Geoservices 2016)

4.3.2 Trial Pits

Given the size of the sites and the level of historic ground investigations a total of twenty eight (28) trial pits (TP1 – TP28) were excavated across the five sites to depths ranging between 3.5 to 4.6mbgl in December 2015. The proposed number of trial pits for each site is outlined in **Table 4.1.**

Table 4.1 – Proposed Number of Trial Pits

Site	No. of Trial Pits	Comments
Site 1	4	4 No. trial pits were excavated within a c.50m grid to characterise the waste, ascertain base of waste and identify natural ground.
Site 2	11	11 No. trial pits were excavated within a c. 75m grid to characterise the waste, ascertain base of waste and identify natural ground.
Site 3A	5	Site 3A – In light of the extensive ground investigations previously completed by WCC and the fact that depth of waste was established in boreholes MW3 and MW4 at 11.9mbgl and 10.5mbgl respectively, 5 No. trial pits were excavated to characterise the waste.
Site3B	4	Site 3B – In light of the size of the site (0.9ha) 4 No. trail pits were excavated to characterise the waste, ascertain base of waste and identify natural ground.
Site3C	4	Site 3C – Due to the extensive ground investigations previously completed by WCC and the fact that depth of waste was established in boreholes MW2 at 5.4mbgl, 4 No. additional trial pits were excavated to characterise the waste.

Detailed trail pit logs and photographs are presented in Appendix D with a summary of findings presented in **Table 4.2** below.

All trial pits were excavated using a mechanical excavator. The trial pits were excavated, under the supervision of Priority Geotechnical Limited, between 7th and 10th December 2015 and were back-filled on completion by replacing material in the order in which it was excavated. The locations of the trail pits are presented in **Figure 13**.

LEGEND

- ESB Overhead (38 kv)
- ESB Overhead (110kv)
- ESB Overhead (220kv)
- ESB Overhead (400kv)
- ESB Overhead (LV)
- ESB Overhead (MV)
- ESB Underground (38kv)
- ESB Underground (MV & LV)
- ESB Underground (Spare)
- Extent of Waste

Landownership

- Cosgraves
- Borg Developments
- Special Areas of Conservation (SAC's)

Site Investigation

- TP1 Proposed Trial Pit Locations

SITE INVESTIGATION CO-ORDINATES

ID	X Co-ordinate	Y Co-ordinate
As-Built Trial Pits		
TP1	723682.65	718266.99
TP2	723757.63	718269.22
TP3	723683.29	718342.00
TP4	723757.61	718343.86
TP5	723698.18	718417.17
TP6	723755.25	718417.29
TP7	723831.84	718416.68
TP8	723833.74	718361.20
TP9	723908.99	718418.51
TP10	723909.82	718348.09
TP11	723982.10	718386.82
TP12	723414.49	718450.11
TP13	723458.97	718444.41
TP14	723414.97	718423.27
TP15	723447.72	718424.38
TP16	723014.00	718380.99
TP17	723040.13	718358.27
TP18	723014.33	718340.98
TP19	723059.40	718333.16
TP20	722705.01	718384.46
TP21	722764.01	718385.63
TP22	722808.05	718372.09
TP23	722761.86	718310.22
TP24	722687.96	718312.14
TP25	722707.43	718045.32
TP26	722708.27	718080.97
TP27	722758.68	718109.21
TP28	722757.06	718081.29

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F02	04.05.18	DN/LD	COA APPLICATION	CC
F01	May '16	RH/LD	FINAL ISSUE	CC

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Drawn	RH
Checked	LD
Approved	CC
Date	May 2016
Scale	1:2500 @ A1
	1:5000 @ A3
Job No.	MDR1206

Project: **FASSAROE HISTORIC LANDFILL**

Title: PLAN SHOWING TRIAL PIT LOCATIONS

File Ref. MDR1206FG0013F02.dwg | Drg. No. Figure 13 | Rev. F02

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Table 4.2 - Summary of 2015 Trial Pit Investigations

TP ID	Site ID	Total Depth (m)	Depth of Waste (m)	Description of Waste	Notes
TP01	Site 2	4.4	0.8 - >4.4	Plastic, concrete, textiles, metals, timber, glass and plastic bottles. Household waste	Strong unidentified odour
TP02	Site 2	4.5	0.8 - >4.5	Plastic bags and bottles, bricks, textile, aerosol cans, household waste, car tyres	Strong unidentified odour
TP03	Site 2	4.6	0.9 - 3.7	Household waste described as plastic, glass, metals and rubber	Strong unidentified odour
TP04	Site 2	4.5	0.6 - >4.5	Plastic bags, paper, timber, glass bottles, metal, rubber	Strong unidentified odour
TP05	Site 2	4.5		No waste encountered	
TP06	Site 2	4	0.6 - >4	Plastic refuse, glass bottles, metals, timber, general household waste and a car door	Strong unidentified odour
TP07	Site 2	4.5	0.6 - >4.5	Rubber tyres, plastic refuse, paper, glass, tin cans, toys, wire and other metals and textiles	
TP08	Site 2	4.5	0.6 - >4.5	Black refuse bags, metals, paper, timber, tin cans, glass bottles, plastic and textiles (waste increases from 1.5mbgl)	
TP09	Site 2	4.5	0.5 - >4.5	Plastics, timber, textiles, glass bottles, paper, metals and general household waste	Strong unidentified odour
TP10	Site 2	4.5	0.7 - 3.5	Plastics, cardboard, timber, glass, textiles, tin cans	Strong unidentified odour
TP11	Site 2	4.5	0.8 - 1.3 2 - >4.5	Plastics, metals, glass, timber, paper, cardboard, styrofoam, general household waste and car wheel - waste dated from 1985	Strong unidentified odour
TP12	Site 1	4.5	0 - 1 1.5 - >4.5	Concrete, red bricks, steel parts, concrete posts, re-bar and concrete, tarmac, timber and slings	
TP13	Site 1	4.5	0 - >4.5	Some large blocks of concrete up to 1m in size and some red brick, plastics, paper, glass, medical waste (e.g. syringes), textiles and polystyrene	Slight hydrocarbon odour
TP14	Site 1	4.5	0 - >4.5	Large concrete slabs (approximately 1m in size), polystryene, red bricks, rebar, plastics, glass, metals, tin cans and paper. Waste dated back to 1976	
TP15	Site 1	4.5	1.5 - 3	Plastics, metals, textiles and polystyrene	Assume natural ground from 3-4.5mbgl, difficult to determine as walls of pit collapsing
TP16	Site 3C	4.5	0 - >4.5	Plastics, glass, textiles, household waste, timber, rubber tyres, small amount of steel shavings and tarmacadam	Strong unidentified odour
TP17	Site 3C	4.5	0.9 ->4.5	Household waste, plastics, glass, metals and timber	Strong unidentified odour
TP18	Site 3C	4.5	1.1 - >4.5	Plastics, rope, mattress, glass, paper, timber, textiles, household waste, shoes, coins and bones. Waste dated from 1992	Strong unidentified odour

TP ID	Site ID	Total Depth (m)	Depth of Waste (m)	Description of Waste	Notes
TP19	Site 3C	4.5	0.9 - >4.5	Plastics, household waste, glass, timber, textiles including rugs, rubber tyres and pipes	Strong unidentified odour
TP20	Site 3A	4.5	0.1 - 1.2 2.1 - >4.5	Occasional plastic fragments Household waste	Strong unidentified odour
TP21	Site 3A	4.5	1 - 2.2 2.2 - >4.5	Occasional plastic fragments Rubber, glass, paper and household waste	Strong unidentified odour
TP22	Site 3A	4.5	1.1	Thin layer of plastics at 1.1mbgl	
TP23	Site 3A	4.5	0.5 - 1 1.7 - >4.5	Plastics, paper, metal, textiles, footwear and general household waste	Strong unidentified odour
TP24	Site 3A	4.5	0.6 - >4.5	Car tyre, plastics, perspex, metals, wire, paper and household waste	Strong unidentified odour
TP25	Site 3B	4.5	0.8 - >4.5	Household waste, plastics, glass, timber, textiles and footwear. Waste dates to 1992.	Strong unidentified odour
TP26	Site 3B	4.5	1.2 - >4.5	Plastics, household refuse, paper, metals, timber and textiles	
TP27	Site 3B	4.5		No waste encountered	
TP28	Site 3B	3.5	0.7 - >3.5	Plastics, paper, household waste, copper, glass and textiles	Strong unidentified odour

No waste or base of waste encountered

4.3.3 Borehole Drilling

A targeted approach, based on the geophysical survey report, was completed for the installation of gas, combined gas/leachate and groundwater monitoring boreholes between the 15th January 2016 and 1st March 2016 with a total of fifty seven (57) monitoring boreholes installed across the five sites.

The objective of the installation of the groundwater monitoring boreholes was to demonstrate the local geological sequence; demonstrate the presence of a contamination plume where present; and confirm groundwater levels / flow directions.

Previously installed boreholes within Site 3A (MW3 & MW4) and Site 3C (MW2) have been included within this assessment as they provide useful monitoring locations situated within the waste body. The historic boreholes used within the risk assessment are as follows;

- MW2 - leachate monitoring borehole located within Site 3C – screened within the waste and will confirm quantity and quality of leachate
- MW3 and MW4 – leachate monitoring boreholes located within Site 3A – screened within the waste and will confirm quantity and quality of leachate

Combined gas/leachate monitoring boreholes were installed within the relevant waste bodies to enable monitoring of the worst case situation with respect to gas generation and to ascertain the quantity and quality of leachate.

The geophysical survey was utilised to identify the expected worst case gas monitoring locations within each of the waste bodies. The geophysical survey was also utilised in conjunction with the historic SI to site combined gas/leachate monitoring boreholes at peripheral locations within the waste masses to confirm the lateral extent of waste infill.

Gas monitoring boreholes were also sited and installed outside the fill areas to assess potential lateral migration. Offsite gas monitoring boreholes were installed to the maximum depth of the source i.e. the relevant waste body.

The EPA Landfill Monitoring Manual 2nd Edition recommends that locations for gas monitoring within the waste body should be at a density of at least one monitoring point per hectare of filled area in unlined landfills.

CIRIA report *Assessing risks posed by hazardous ground gases to buildings* (CIRIA C665) recommends that for 'even the smallest of sites a minimum of three wells is installed'. CIRIA C665 indicated that the spacing of gas monitoring wells will largely be dependent on the location and number of gas source as well as the sensitivity of the proposed end use and permeability of ground. In accordance with best practice, offsite gas monitoring boreholes were located a minimum of 20m from the perimeter of the waste body where practicable and installed to at least the maximum depth of the waste body in question.

All monitoring borehole installations were completed with 50mm diameter standpipes. Clean pea gravel was used as a gravel pack around the monitoring wells with bentonite seals above the slotted

screen sections to minimise the potential for surface water entering the monitoring boreholes. All monitoring boreholes were fitted with upright steel covers.

See **Figure 14** for borehole locations and Appendix D for Priority Geotechnical factual report containing borehole logs. A summary of the borehole installation details at each of the five sites are presented below in **Tables 4.3 – 4.7**.

SITE INVESTIGATION CO-ORDINATES

Drill Rig	ID	X Co-ordinate	Y Co-ordinate
Existing Boreholes			
	MW2	723021.66	718380.78
	MW3	722762.91	718368.44
	MW4	722696.61	718368.44
Gas Monitoring Boreholes			
Rotary	G01	723757.16	718233.48
Rotary	G02	723906.63	718311.72
Rotary	G03	723983.99	718344.07
Rotary	G04	723640.81	718281.92
Rotary	G05	723638.54	718344.71
Rotary	G06	723574.12	718441.70
Rotary	G07	723368.29	718433.97
Rotary	G08	723306.94	718326.45
Rotary	G09	723094.22	718349.85
Rotary	G10	723333.19	718171.75
Rotary	G11	722977.05	718343.28
Rotary	G12	722830.39	718345.89
Rotary	G13	724005.86	718058.15
Rotary	G14	722815.16	718240.44
Rotary	G15	722795.09	718080.09
Rotary	G16	722652.69	718073.96
Rotary	G17	722714.71	718133.46
Rotary	G18	723510.87	718384.05
Rotary	G19	723436.56	718295.62
Rotary	G20	723622.36	718199.82
Rotary	G21	723750.29	718164.27
Rotary	G22	724131.18	717889.25
Rotary	G23	723934.27	717921.64
Rotary	G24	723786.25	718048.22
Rotary	G25	723664.69	718398.81

SITE INVESTIGATION CO-ORDINATES

Drill Rig	ID	X Co-ordinate	Y Co-ordinate
Combined Gas/Leachate Monitoring Boreholes			
Rotary	LG01	723643.770	718221.920
Cable Percussive/Rotary	LG02	723692.440	718261.440
Rotary	LG03	723751.300	718307.500
Cable Percussive/Rotary	LG04	723728.580	718362.080
Rotary	LG05	723787.000	718340.400
Rotary	LG06	723716.450	718432.320
Cable Percussive/Rotary	LG07	723798.300	718404.520
Rotary	LG08	723854.760	718376.730
Rotary	LG09	723827.260	718410.840
Cable Percussive/Rotary	LG10	723905.210	718400.280
Cable Percussive/Rotary	LG11	723425.300	718455.260
Rotary	LG12	723436.860	718445.090
Rotary	LG13	723466.520	718463.670
Cable Percussive/Rotary	LG14	723040.800	718343.190
Cable Percussive/Rotary	LG15	722726.870	718288.020
Rotary	LG16	722747.850	718100.420
Cable Percussive/Rotary	LG17	722707.076	718059.122
Rotary	LG18	723040.160	718381.470
Cable Percussive/Rotary	LG19	722742.400	718394.040
Rotary	LG20	722760.540	718333.710
Cable Percussive/Rotary	LG21	722746.330	718045.610
Combined Groundwater/Gas Monitoring Boreholes			
Rotary	BH01	723751.990	718464.300
Rotary	BH03	723833.940	718313.090
Rotary	BH04	723658.950	718159.830
Rotary	BH05	723381.970	718381.360
Rotary	BH06	723028.340	718310.420
Rotary	BH07	722641.500	718220.000
Rotary	BH08	722752.550	718129.880
Rotary	BH09	722746.090	718179.230
Rotary	BH10	722791.600	718279.040
Rotary	BH11	723802.550	718268.990
Rotary	BH13	723633.990	718448.250

LEGEND

- ED — ESB Overhead (38 kv)
- ED1 — ESB Overhead (110kv)
- ED2 — ESB Overhead (220kv)
- ED3 — ESB Overhead (400kv)
- ED4 — ESB Overhead (LV)
- ED5 — ESB Overhead (MV)
- EU — ESB Underground (38kv)
- EU1 — ESB Underground (MV & LV)
- EU2 — ESB Underground (Spare)
- Extent of Waste

Landownership

- Cosgraves
- Borg Developments
- Special Areas of Conservation (SAC's)

Site Investigation

- MW1 — Existing Boreholes
- G01 — Gas Monitoring Borehole
- LG01 — Combined Gas/Leachate Monitoring Boreholes (Rotary)
- LG02 — Combined Gas/Leachate Monitoring Boreholes (Cable Percussive)
- Combined Gas/Leachate Monitoring Boreholes (Cable Percussive with Rotary follow on)
- BH01 — Combined Groundwater/Gas Monitoring Boreholes

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No.	Date	Drn/Chk	Amendment / Issue	App
F02	04.05.18	DN/KG	COA APPLICATION	CC
F01	May'16	RH/LD	FINAL ISSUE	CC

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Checked	LD
Approved	CC
Date	May 2016
Scale	1:2500 @ A1 1:5000 @ A3
Job No.	MDR1206

Project: **FASSAROE HISTORIC LANDFILL**

Title: PLAN SHOWING BOREHOLE LOCATIONS

File Ref. MDR1206FG0014F02.dwg | Drg. No. Figure 14 | Rev. F02

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Table 4.3 - Site 1: Borehole Installation Details

BH ID	BH type	Northing	Easting	BH Ground level (mAOD)	Standpipe level (mAOD)	Casing Height (cm)	Static Water Level *)	Water Elevation (mAOD)	Drilling Method	Drill Date (2016)	Total drilled depth (mbgl)	Blank pipe Interval (mbgl)	Slotted Pipe Interval (mbgl)	Screened Lithology
ONSITE														
LG11	Combined gas/leachate	723425.5	718455.0	95.371	95.638	31	11.30	84.3	Rotary	22/02	17.0	0-1	1 - 13	Waste
LG12	Combined gas/leachate	723437.1	718445.2	95.955	96.182	44	Dry	84.2	Rotary	27/01	24.0	0-1	1-12	Waste
LG13	Combined gas/leachate	723466.3	718463.4	96.048	96.476	53	9.12	87.4	Rotary	23/02	20.0	0-1	1-9	Waste
OFFSITE														
BH05	Groundwater	723382.0	718381.3	96.06	96.321	48	20.00	76.3	Rotary	28/01	29	0-19	19-29	Sand
G06	Offsite gas	723574.4	718441.7	90.99	91.303	41	Dry (wet sand)	80.3	Rotary	26/01	12	0-1	1-11	Sandy gravel
G07	Offsite gas	723368.3	718433.8	93.033	93.236	40	Dry	79.2	Rotary	28/01	14	0-1	1-14	Gravel/ sandy gravel/ sand
G08	Offsite gas	723307.1	718326.1	94.286	94.602	45	Dry	80.6	Rotary	01/02	14	0-1	1-14	Gravel
G10	Offsite gas	723333.0	718171.6	98.856	98.947	37	9.26	89.7	Rotary	04/02	20	0-1	1-18	Sand/ clay/ gravel/ silty sand
G18	Offsite gas	723510.3	718383.7	93.73	93.834	30	Dry	79.8	Rotary	01/02	14	0-1	1-14	Sandy clay/ gravel/ gravelly sand
G19	Offsite gas	723436.3	718295.9	98.244	98.393	40	7.92	90.5	Rotary	02/02	14	0-1	1-14	Sandy clay/ gravel/ gravelly sand

* Static water level is taken as metres below top of standpipe as measured following construction on 26/.04.2016. All groundwater level data provided in Table 4.15.

Table 4.4 - Site 2: Borehole Installation Details

BH ID	BH Type	Northing	Easting	BH Ground level (mAOD)	Standpipe level (mAOD)	Casing Height	Static Water Level *	Water Elevation (mAOD)	Drilling Method	Drill Date	Total depth (mbgl)	Blank pipe interval (mbgl)	Slotted Pipe Interval (mbgl)	Screened Geology
ONSITE														
LG01	Combined gas/leachate	723643.326	718221.9	83.758	84.16	34	4.21	80.0	Rotary	21/01/2016	16.0	0-1	1-5	Waste
LG02	Combined gas/leachate	723692.634	718261.4	83.185	83.408	31	8.48	74.9	Cable Percussive & Rotary	17/02/2016	12.0	0-1	1-9	Waste
LG03	Combined gas/leachate	723751.153	718307.3	82.248	82.525	23	14.89	67.6	Rotary	21/01/2016	29.0	0-1	1-18	Waste
LG04	Combined gas/leachate	723728.763	718362.2	81.883	82.044	19	12.45	69.9	Cable Percussive & Rotary	17/02/2016	18.0	0-1	1-15	Waste
LG05	Combined gas/leachate	723786.907	718340.6	80.14	80.199	38	13.74	66.5	Rotary	19/01/2016	25.5	0-1	1-14	Waste
LG06	Combined gas/leachate	723716.541	718432.1	82.678	83.119	40	6.56	76.6	Rotary	20/01/2016	17.5	0-1	1-6.4	Waste
LG07	Combined gas/leachate	723798.501	718404.3	74.868	75.126	27	11.46	63.7	Cable Percussive & Rotary	15/02/2016	17.1	0-1	1-16.1	Waste (base of waste not reached)
LG08	Combined gas/leachate	723855.048	718376.5	70.767	70.938	26	7.65	63.3	Rotary	01/02/2016	19.5	0-1	1-8	Waste
LG09	Combined gas/leachate	723827.321	718410.7	71.057	71.236	26	11.11	60.1	Rotary	02/02/2016	25.5	0-1	1-17	Waste
LG10	Combined gas/leachate	723905.291	718400.6	66.373	66.623	49	17.46	49.2	Cable Percussive & Rotary	11/02/2016	21.0	0-1	1-18	Waste
OFFSITE														
BH01	Groundwater	723751.86	718464.1	79.222	79.464	28	14.82	64.6	Rotary	05/02/2016	21	0-5	5-21	Clay with boulder content/ clayey sand/ clay gravel/ clay
BH03	Groundwater	723834.106	718313.2	78.651	78.796	33	Dry	59.3	Rotary	10/02/2016	19.5	0-2	2-19.5	Sand/ sandy gravel
BH04	Groundwater	723658.785	718159.8	84.409	84.532	42	Dry	59.0	Rotary	19/02/2016	25.5	0-13.5	13.5-25.5	Clayey gravel/ sandy gravel/ sand
BH11	Groundwater	723802.675	718269.4	82.653	82.826	42	Dry	49.8	Rotary	24/02/2016	33	0-1	1-33	Sandy clay/ sandy gravel/ gravel/ sand
BH13	Groundwater	723633.902	718448	87.985	87.990	30	Dry	68.5	Rotary	03/02/2016	19.5	0-4.5	4.5-19.5	Sandy clayey gravel/ sand/ sandy gravel/ gravel/ silty sandy clay
G01	Offsite gas	723757.346	718233.3	84.991	85.397	43	Dry	68.3	Rotary	23/02/2016	19.5	0-1	1-17.5	sandy gravel/ gravel
G02	Offsite gas	723906.485	718311.7	72.662	72.638	36	Dry	53.1	Rotary	10/02/2016	19.5	0-1	1-19.5	Clay/ sand/ gravel/ sandy gravel
G03	Offsite gas	723984.285	718343.9	69.504	69.626	45	Dry	50.1	Rotary	09/02/2016	19.5	0-1	1-19.5	Clay/ gravel/ sandy gravel/ gravel with boulder content/ sand
G04	Offsite gas	723640.86	718282.2	85.617	85.971	36	8.23	77.7	Rotary	22/02/2016	20	0-3	3-17	Sandy gravel/ sandy clayey gravel/ gravel
G05	Offsite gas	723638.096	718344.7	86.723	86.857	37	16.46	70.4	Rotary	25/01/2016	20	0-1	1-20	Sandy clayey gravel/ sandy gravel/ sand
G13	Offsite gas	724005.712	718058.5	75.822	76.001	44	Dry	56.0	Rotary	26/02/2016	20	0-1	1-20	Sandy clay/ sandy gravel/ sand
G20	Offsite gas	723622.08	718199.8	85.551	85.826	45	14.57	71.3	Rotary	02/02/2016	27	0-1	1-20	Sandy clayey gravel/ gravel/ sand
G21	Offsite gas	723750.429	718164.1	86.662	87.003	43	Dry	`70.0	Rotary	24/02/2106	19	0-1	1-17	Sandy clay/ sandy gravel/ sand
G22	Offsite gas	724131.346	717889.4	63.675	63.85	34	9.42	54.4	Rotary	30/02/2016	20	0-1	1-15	Sandy clay/ sandy gravel/ sand
G23	Offsite gas	723934.096	717921.8	78.954	78.943	42	17.24	61.7	Rotary	29/02/2016	20	0-1	1-20	Sandy silty clay gravel/ sand
G24	Offsite gas	723786.073	718048.2	86.831	86.835	22	Dry	66.8	Rotary	25/02/2016	20.5	0-1.5	1.5-20.5	Sandy gravel/ gravel/ sand
G25	Offsite gas	723664.356	718398.6	85.635	86.027	49	Dry	66.0	Rotary	04/02/2016	34	0-1	1-20	Sandy clay/ sandy clayey gravel/ gravel/ sandy gravel/ sand

* Static water level is taken as metres below top of standpipe as measured following construction on 26.04.2016. All groundwater level data provided in Table 4.15.

Table 4.5 - Site 3A: Borehole Installation Details

BH ID	BH type	Northing	Easting	BH Ground level (mAOD)	Standpipe level (mAOD)	Casing Height	Static Water Level *	Water Elevation (mAOD)	Drilling Method	Drill Date	Total depth (mbgl)	Blank pipe interval (mbgl)	Slotted Pipe Interval (mbgl)	Screened Geology
ONSITE														
LG15	Combined gas/leachate	722726.6	718288.1	103.972	104.13	33	6.85	97.3	Cable Percussive & Rotary	19/02/2016	19.0	0-1	1-8	Waste
LG19	Combined gas/leachate	722742.6	718394.3	103.897	104.179	27	14.58	89.6	Cable Percussive & Rotary	18/02/2016	26.0	0-1	1-15	Waste
LG20	Combined gas/leachate	722760.5	718333.9	103.823	104.354	51	Dry	92.4	Rotary	10/02/2016	23.0	0-1	1-12	Waste
MW3	Combined gas/leachate **(25mm)**	722773.2	718362.3	103.105	104.254	115	10.44	93.8	Rotary	03/09/2012	11	0-3	3-11	Waste
	Combined gas/leachate (50mm)						16.55	87.7			18.1	0-14.1	14.1-18.1	Gravel & sand
MW4	Combined gas/leachate	722728.3	718355.6	104.543	105.587	108	7.72	97.9	Rotary	06/09/2012	13.3	0-2	2-10	Waste
OFFSITE														
BH07	Groundwater	722641.5	718220.4	106.107	106.371	38	14.13	92.2	Rotary	09/02/2016	21	0-11	11-21	Sandy clayey gravel/ gravel/ sandy gravelly clay silt
BH09	Groundwater	722746.2	718179.4	97.969	98.140	32	6.96	91.2	Rotary	09/02/2016	12	0-2	2-12	Sandy clayey gravel/ gravelly sand/ sandy gravel
BH10	Groundwater	722791.5	718278.6	99.305	99.505	17	8.73	90.8	Rotary	11/02/2016	14	0-4	4-14	Sand/ sandy gravel/ sandy clayey gravel
G12	Offsite gas	722830.1	718346	98.913	99.016	21	10.75	88.3	Rotary	12/02/2016	14	0-1	1-14	Sandy clayey gravel/ sandy gravel
G14	Offsite gas	722814.8	718240.5	98.624	98.834	25.5	7.94	90.9	Rotary	11/02/2016	14	0-1	1-14	Sandy clay gravel/ wet gravel/ dry silty sandy clay

* Static water level is taken as metres below top of standpipe as measured following construction on 26.04.2016. All groundwater level data provided in Table 4.15.

Table 4.6 - Site 3B: Borehole Installation Details

BH ID	BH type	Northing	Easting	BH Ground level (mAOD)	Standpipe level (mAOD)	Casing Height	Static Water Level*	Water Elevation (mAOD)	Drilling Method	Drill Date	Total depth (mbgl)	Blank pipe interval (mbgl)	Slotted Pipe Interval (mbgl)	Screened Geology
ONSITE														
LG16	Combined gas/leachate	722748.1	718100.4	99.516	99.725	33	3.34	96.4	Rotary	05/02/2016	16.0	0-1	1-2.5	Waste
LG17	Combined gas/leachate	722707.2	718058.9	100.506	100.874	38	3.61	97.3	Cable Percussive	18/02/2016	5.40	0-1	1-3.9	Waste
LG21	Combined gas/leachate	722746.5	718045.7	100.58	100.849	28	Dry	96.8	Cable Percussive	18/02/2016	5.75	0-1	01-Apr	Waste
OFFSITE														
BH08	Groundwater	722752.2	718129.7	98.801	98.950	14	7.62	91.3	Rotary	10/02/2016	13.5	0-1	1-4.5	Sandy gravel/ sand
G15	Offsite gas	722795.2	718080.3	99.172	99.509	35	Dry	93.5	Rotary	08/02/2016	6	0-1	1-6	Gravel
G16	Offsite gas	722652.6	718073.7	100.38	100.762	41	4.35	96.4	Rotary	08/02/2016	6	0-1	1-6	Sandy clay/ sandy clay gravel
G17	Offsite gas	722714.9	718133.7	98.415	98.764	27	Dry	91.3	Rotary	08/02/2016	6	0-1	1-6	Sandy clay/ sandy clay gravel

* Static water level is taken as metres below top of standpipe as measured following construction on 26.04.2016. All groundwater level data provided in Table 4.15.

Table 4.7 - Site 3C: Borehole Installation Details

BH ID	BH type	Northing	Easting	BH Ground level (mAOD)	Standpipe level (mAOD)	Casing Height	Static Water Level*	Water Elevation (mAOD)	Drilling Method	Drill Date	Total depth (mbgl)	Blank pipe interval (mbgl)	Slotted Pipe Interval (mbgl)	Screened Geology
ONSITE														
LG14	Combined gas/leachate	723040.4	718343.2	93.44	93.873	45	5.21	83.7	Cable Percussive & Rotary	16/02/2016	23.0	0-1	1-12	Waste
LG18	Combined gas/leachate	723040	718381.3	92.417	92.854	45	10.21	82.9	Rotary	16/02/2016	22.0	0-1	1-10	Waste
MW2	Combined gas/leachate	723033.7	718362.9	93.398	94.222	92	9.99	89.0	Rotary	31/08/2012	8.1	0-2	2-5	Waste
OFFSITE														
BH06	Groundwater	723028.4	718310.6	95.273	95.396	38	12.78	89.6	Rotary	17/02/2016	14	0-2	2-14	Sandy gravel/ silty sandy gravel
G09	Offsite gas	723094.1	718349.4	93.562	93.875	29	10.18	81.1	Rotary	17/02/2016	14	0-1	1-14	Sandy clay/ gravelly sand/ sandy clay gravel
G11	Offsite gas	722976.7	718343.4	97.207	97.395	32	5.78	87.2	Rotary	18/02/2016	15	0-1	1-15	Sandy clay/ sandy gravel/ sand/ gravel

* Static water level is taken as metres below top of standpipe as measured following construction on 26.04.2016. All groundwater level data provided in Table 4.15.

4.4 SAMPLING PROCEDURES & CHEMICAL ANALYSES

4.4.1 Soils/Waste

4.4.1.1 Trial Pits

All environmental samples taken between 7th and 10th December 2015 were collected in laboratory sample containers by Priority Geotechnical Ltd and shipped to Chemtest (UKAS Accredited) in Newmarket, Suffolk, England for analysis.

The collection and analysis soil/waste samples from the trial pits was based on the requirement to characterise the waste and determine the base of waste where possible.

Environmental samples were obtained from 25 trial pits excavated in December 2015, with samples taken from the waste and soils beneath where encountered. A total of 28 samples were obtained from the 25 trial pits excavated (22 No. from the waste and 6 No. from soils) as outlined in **Table 4.8**.

Table 4.8 - Trial Pits Sampled

Site ID	TP ID
Site 1	TP12,TP13,TP14,TP15
Site 2	TP1,TP2,TP3,TP4,TP5,TP6,TP7,TP8,TP9,TP10,TP11
Site 3A	TP20,TP21,TP22,TP23,TP24
Site 3B	TP25,TP26,TP27,TP28
Site 3C	TP16,TP17,TP18,TP19

4.4.1.2 Boreholes

All environmental samples taken between 8th and 19th February 2016 were collected by RPS staff in laboratory sample containers and shipped to Chemtest (UKAS Accredited) in Newmarket, Suffolk, England.

The collection and analysis of waste/ soil samples from the boreholes was based on the requirement to characterise material encountered during investigative works in terms of environmental contamination. A total of 46 soil/ waste samples (11 from capping material, 25 from waste and 10 from subsoil) were collected from 11 boreholes in February 2016.

Table 4.9 - Boreholes Sampled

Site ID	BH ID
Site 1	LG11,LG13
Site 2	LG2,LG4,LG7,LG10
Site 3A	LG15,LG19
Site 3B	LG17,LG21
Site 3C	LG14

4.4.2 Leachate

Three rounds of leachate sampling and analysis have been undertaken on the Fassaroe site:

- Round 1 (High Groundwater Level) - 15th - 23rd of March 2016;
- Round 2 (Low Groundwater Level) – 30th August – 1st September 2016; and
- Round 3 (High Groundwater Level) - 15th March 2018.

All leachate samples were collected by RPS staff in laboratory supplied sample containers and shipped to ALS Environmental Ltd. (UKAS Accredited), Torrington Avenue, Coventry, CV4 9GU, England.

To minimise cross contamination between sampling locations new sampling equipment was used to collect each discrete sample. Sufficient sample volume could not be recovered from all installed leachate monitoring boreholes. A total of 12 leachate samples were collected from the 5 sites in Round 1, including from historic boreholes MW2 (Site 3C) and MW4 (Site 3A). A total of 11 leachate samples Round 2. A total of 10 leachate samples were taken in Round 3.

Leachate levels measured in each monitoring well during each round is summarised in **Table 4.1**.

Historic leachate monitoring wells are in existence across Sites 1 and 2 however borehole logs were not available therefore the integrity of existing monitoring infrastructure could not be established and were not utilised during the monitoring regime.

Table 4.10 - Leachate Monitoring Boreholes Sampled

Site ID		Round 1 – March 2016 (leachate depth in m)	Round 2 – August 2016 (leachate depth in m)	Round 3 – March 2018 (leachate depth in m)
Site 1	Sampled	LG11 (1-3)	LG11 (0.88)	LG11 (6.29)
	Not Sampled	*LG12 (dry), LG13 (dry)*	*LG12 (dry), LG13 (dry)*	*LG12, LG13*
Site 2	Sampled	LG01 (<1), LG03 (5.0), LG07 (7.0), LG09 (6.7), LG10 (1-3)	LG03 (0.43), LG07 (5.5), LG09 (9.95), LG10 (5.0)	LG07 (10.65), LG09 (12.6), LG10 (4.0)
	Not Sampled	*LG02, LG04, LG05 (dry), LG06 (<40cm of leachate), LG08 (dry)*	*LG01 (dry), LG02 (dry), LG04 (dry), LG05 (dry), LG06 (<40cm leachate), LG08 (dry)*	*LG01, LG02, LG03, LG04, LG05, LG06, LG08)*
Site 3A	Sampled	LG15 (1-3), MW4 (<1), LG19 (<1)	LG15 (1.0), MW4, LG19 (0.5)	LG15 (1.4), MW4, LG19 (4.5)
	Not Sampled	*LG20 (dry), MW3*	*LG20 (dry), MW3*	*LG20, MW3*
Site 3B	Sampled	LG17 (<1)	LG17 (0.33)	LG17 (0.48)
	Not Sampled	*LG16 (<15cm of leachate), LG21 (<20cm of leachate)*	*LG16 (<15cm of leachate), LG21 (<20cm of leachate)*	*LG16, LG21*
Site 3C	Sampled	LG14 (<1), MW2 (<1.0)	LG14 (0.8), MW2 (nk)	LG14 (1.2), MW2 (1.0)
	Not Sampled	*LG18 (dry)*	*LG18 (dry)*	*LG18*

4.4.3 Groundwater

Three rounds of groundwater sampling and analysis have been undertaken on the Fassaroe site:

- Round 1 (High Groundwater Level) - 15th to 23rd of March 2016;
- Round 2 (Low Groundwater Level) – 30th August to 1st September 2016; and
- Round 3 (High Groundwater Level) – 14th and 15th March 2018

Groundwater samples were taken from up to 8 newly installed groundwater monitoring boreholes (including one gas borehole G20), targeting both up-gradient and down-gradient locations where possible. The groundwater locations sampled in each round are summarised in **Table 4.11**. All groundwater samples were taken by RPS staff in laboratory supplied sample containers.

Groundwater samples were obtained following purging a minimum of three well volumes prior to sample collection. To minimise cross contamination between sampling locations dedicated sampling equipment was used to collect each sample. Field parameters were also recorded during sampling, including pH, electrical conductivity, oxidation-reduction potential (ORP) and temperature.

Table 4.11 - Groundwater Monitoring Boreholes Sampled

Site ID	Sampled / Not Sampled *(Position in groundwater flow field)*	Round 1 – March 2016	Round 2 – August 2016	Round 3 – March 2018
Site 1	Sampled (Up gradient)	BH05	BH05	none
	Not Sampled	none	None	*None*
Site 2	Sampled (Up gradient)	G20 (gas well)	G20 (gas well)	G20 (gas well)
	Sampled (Down gradient)	BH01	BH01	BH01
	Not Sampled	*Up gradient: BH03 (dry); BH04(dry); BH11(dry); BH13(dry)*	*Up gradient: BH03 (dry); BH04(dry); BH11(dry); BH13(dry)*	*Up gradient: BH03; BH04; BH11; BH13*
Site 3A	Sampled (Up Gradient / Lateral)	BH07, BH09, BH10(d)	BH07, BH09, BH10(d)	BH07, BH09, BH10(d)
	Not Sampled	none	None	none
Site 3B	Sampled (Down Gradient)	BH08	none	none
	Not Sampled	none	*Down gradient:* BH08(dry)	*Down gradient:* BH08
Site 3C	Sampled (Up-gradient)	BH06	BH06	BH06
	Not Sampled	none	None	none

SITE INVESTIGATION CO-ORDINATES		
ID	X Co-ordinate	Y Co-ordinate
Surface Water Monitoring Locations		
SW1	724137.00	718407.00
SW2	723733.00	718594.00
SW3	723598.00	718560.00
SW4	722837.00	718475.00
SW5	722609.00	718667.00

SITE INVESTIGATION CO-ORDINATES		
ID	X Co-ordinate	Y Co-ordinate
Spring Locations		
Spring 1	724052.00	718436.00
Spring 2	723554.00	718552.00
Spring 3	723365.00	718567.00
Spring 4	723200.00	718486.00
Spring 5	723100.00	718489.00
Spring 6	723038.00	718488.00
Spring 7	722982.00	718476.00
Spring 8	722842.00	718471.00
Spring 9	722780.00	718489.00
Spring 10	722783.12	718446.41

LEGEND

- ESB Overhead (38 kv)
- ESB Overhead (110kv)
- ESB Overhead (220kv)
- ESB Overhead (400kv)
- ESB Overhead (LV)
- ESB Overhead (MV)
- ESB Underground (38kv)
- ESB Underground (MV & LV)
- ESB Underground (Spare)
- Extent of Waste
- Special Areas of Conservation (SAC's)

Site Investigation

- MW1 — Existing Boreholes
- G01 — Gas Monitoring Borehole
- LG01 — Combined Gas/Leachate Monitoring Boreholes (Rotary)
- LG02 — Combined Gas/Leachate Monitoring Boreholes (Cable Percussive)
- Combined Gas/Leachate Monitoring Boreholes (Cable Percussive with Rotary follow on)
- BH01 — Combined Groundwater/Gas Monitoring Boreholes
- SW1 — Surface Water Monitoring Location
- Spring 1 — Spring Location
- SP1 — Spring Sampling Location

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Comhairle Contae Chill Mhantáin

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No.	Date		Amendment / Issue	App
F02	04.05.18	DM/KG	COA APPLICATION	
F01	May'16	RH/LD	FINAL ISSUE	

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Drawn	RH
Checked	LD
Approved	CC
Date	May 2016
Scale	1:2500 @ A1 1:5000 @ A3
Job No.	MDR1206

Project
FASSAROE HISTORIC LANDFILL

Title
PLAN SHOWING MONITORING LOCATIONS

File Ref. MDR1206FG0015F02.dwg | Drg. No. Figure 15 | Rev. F02

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4.4.4 Surface Water

Surface water sampling was completed at 10 locations including 5 springs and 5 targeted locations along the County Brook River (Fassaroe Stream). Monitoring locations of surface water locations are presented in **Figure 15**. The position of the springs relative to the waste bodies is identified in **Table 4.12.**

Table 4.12 – Spring Monitoring Locations

Site ID	Round 1 March 2016	Round 2 August 2016	Round 3 March 2018	Location
Spring 1	SP1	SP1	SP1	60m down gradient of Site 2
Spring 2	SP2	SP2	SP2	85m down gradient of Site 1
Spring 3	-	-	-	85m down gradient of Site 1
Spring 4	SP3	SP3	SP3	140m down gradient of Site 3C
Spring 5	-	-	-	80m down gradient of Site 3C
Spring 6	-	-	-	75m down gradient of Site 3C
Spring 7	-	-	-	75m up gradient of Site 3C
Spring 8	SP5	SP5	SP5	60m down gradient of Site 3A
Spring 9	-	-	-	55m down gradient of Site 3A
Spring 10	SP4	SP4	SP4	25m down gradient of Site 3A

All surface water grab samples were obtained by placing the dedicated laboratory sampling bottles directly into the surface water body. Samples were obtained from areas where river level and flow was observed to ensure samples were representative. The sample inlet was placed below the surface flow while care was taken not to disturb the base/bed of the surface water body.

Indicative field parameters of electrical conductivity, oxidation-reduction potential (ORP) and temperature were also taken for each sampling locations.

4.4.5 Laboratory Analysis

Surface water, spring water, leachate and groundwater have been analysed for the following suite of parameters:

- Metals (including Al, As, Ba, B, Cd, Ca, Cr, Cu, Fe, Pb, Mn, Hg, Ni, K, Na, V, Zn);
- Biochemical Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD);
- pH;
- Electrical Conductivity (EC);
- Alkalinity as CaCO3
- Ammonical Nitrogen as N
- Chloride as Cl
- Cyanide

- Extractable Petroleum Hydrocarbons
- Fluoride
- Nitrite as N
- Nitrogen, Total Oxidised as N
- Phenols
- Phosphate, Ortho as P
- Polycyclic aromatic Hydrocarbons (PAHs)
- Semi-Volatile Organic Compound (SVOCs)
- Sulphate as SO4
- Total Dissolved Solids
- Total Suspended Solids
- Total Organic Carbon
- Volatile Organic Compounds (VOCs)

In addition during the second monitoring round in August 2016, leachate and groundwater samples were also scheduled for the analysis of dissolved gases that include: methane, oxygen and carbon dioxide.

All surface water, spring water, leachate and groundwater samples were collected by RPS staff in laboratory supplied sample containers and shipped in cooler boxes including ice packs on the same day. The following UKAS Accredited laboratories were used for analysis:

- Round 1 (March 2016) – ALS Environmental Ltd. (Torrington Avenue, Coventry, England, UK);
- Round 2 (August 2016) – Chemtest Ltd. (Depot Road, Newmarket, CB8 0AL, England, UK); and
- Round 3 (March 2018) – ALS Environmental Ltd. (Torrington Avenue, Coventry, England, UK);

Confirmation of receipt was received the following day that all three batches of samples arrived in good condition.

4.4.6 Landfill Gas

Historical guidance generally suggest that a minimum of 6 to 10 readings are required to make decisions regarding a gas regime (Harries et al 1995 and Environment Agency et al 2000) however of utmost importance is that the monitoring period covers the 'worst case' scenario which occurs during falling atmospheric pressure and particular weather events including rainfall, frost and dry weather. Gas sampling has been undertaken in accordance with published guidance *Evaluation Of Development Proposals On Sites Where Methane And Carbon Dioxide Are Present* (Rpt. Ed. No. 4), which recommends that gas monitoring covers varying climatic conditions (including falling atmospheric pressure and after heavy rainfall)in accordance with CIRIA Guidance (R150).

A total of eighteen gas monitoring rounds have been undertaken on the Fassaroe site and includes the following:

- 8 No. weekly gas monitoring rounds between 7th March and 27th April 2016; and

- 10 No. monthly gas monitoring round (May 2016 to February 2017).

The monitoring undertaken generally conforms to the recommendations of Wilson et al (2005) and CIRIA Guidance C665 present typical/idealised periods and frequencies of monitoring, which suggest a 12-24 period of monitoring on a fortnightly or monthly frequency for sites with a high sensitivity of development (i.e. houses with gardens) and a high to very high source potential (i.e. landfill gas).

The gas monitoring network is summarised in **Table 4.13**. The majority of these boreholes were monitored in each of each of the 18 No. monitoring rounds (see gas monitoring sheets provided in Appendix J)

Table 4.13 - Gas Monitoring Boreholes

Site ID		BH ID
Site 1	Onsite	LG11,LG12,LG13
	Offsite	BH05,G06,G07,G08,G10,G18,G19
Site 2	Onsite	LG01,LG02,LG03,LG04,LG05,LG06, LG07,LG08,LG09,LG10
	Offsite	BH01,BH03,BH04,BH11,BH13,G01,G02,G03,G04,G05,G13,G20,G21,G22,G23,G24,G25
Site 3A	Onsite	LG15,LG19,LG20,MW3,MW4
	Offsite	BH07,BH09,BH10,G12,G14
Site 3B	Onsite	LG16,LG17,LG21
	Offsite	BH08,G15,G16,G17
Site 3C	Onsite	LG14,LG18,MW2
	Offsite	BH06,G09,G11

4.4.7 Investigation Limitations

All new monitoring borehole locations were installed on lands within the ownership of Cosgrave Developments which combined with the proximity to the SAC and access/slope stability constraints restricted the siting and availability of down gradient groundwater monitoring locations although this is mitigated by the location of spring sampling locations within the river valley.

Ownership and access constraints combined with the presence of existing services and associated wayleaves and hazard working zones also restricted the siting of up-gradient groundwater monitoring locations.

The thickness of the gravels and depth to bedrock was not established at any location during the drilling programme as it extended below the maximum reach of the drilling rig (30m).

Sufficient sample volume could not be recovered from all installed leachate monitoring boreholes.

Limitations associated with laboratory analysis are summarised in **Appendix E.**

4.5 OBSERVED GROUND CONDITIONS

4.5.1 Made Ground

Waste visually identified during the excavation of trial pits and borehole drilling was generally consistent across all five sites with the exception of Site 1 which recorded a high proportion of C&D waste. A summary of the depth and nature of waste encountered is presented in **Table 4.14**. For a full list of waste encountered see trial pit and borehole logs in the Priority Geotechnical Factual Report included in **Appendix D**.

Table 4.14 - Maximum Depth of Waste

Site ID	Maximum Depth of Waste (mbgl) (from BHs)	Location of Maximum Depth of Waste (BH ID)	Geophysical Interpretation of Waste Depth (mbgl)	Waste Type
Site 1	14.7	LG13	c. 16	Mixed municipal and C&D
Site2	19	LG03	c. 26	Mixed municipal
Site 3A	16	LG19	c. 20	Mixed municipal
Site3B	3.7	LG17 & LG21	c. 8.5	Mixed municipal
Site3C	12.5	LG14	c. 20.5	Mixed municipal

Waste encountered at Site 2, Site 3A, Site 3B and Site 3C was generally composed of mixed municipal waste that comprises plastic, paper, textiles, glass, timber, metals and glass. Visual characterisation of waste within Site 1 indicated a predominantly C&D waste that comprises concrete, bricks, rebar, tarmac and timber. Large plastic syringes assumed to be of agricultural origin were noted in TP13.

Evidence of waste dating back to the 1970s was noted during the trial pitting in Site 1, 1980s in Site 2 and 1990s in Sites 3B and 3C.

Waste was encountered in all combined gas/leachate monitoring boreholes (LG01-LG21) with waste varying in depth from 13-15mgbl (Site 1); 6-19mbgl (Site 2); 9-16mbgl (Site 3A); 4-4.5mgbl (Site 3B) and 11-12.5mbgl (Site 3C).

No waste was noted in TP05 (Site 1) and TP27 (Site 3B) and potential natural ground was noted in TP15 (at 3mbgl).

Malodours were detected across all five sites. There was slight olfactory evidence of hydrocarbons noted in TP13 in site 1.

4.5.2 Natural Ground

Undisturbed natural ground was encountered in TP05 (Site 1) and TP27 (Site 3B) which comprised topsoil (0.4-0.5m) underlain by slightly sandy, slightly gravelly SILT and slightly sandy gravelly CLAY at Site 1 and sandy GRAVEL and gravelly SAND at Site 3B.

The area is underlain by a thick sequence of up to 30m of unsaturated sand and gravels. The waste is overlain by a clay cap which is approximately 1 to 2m thick. The condition of the cap varies between the sites but is considered generally to be moderately poor at the sites.

The thickness of the sand and gravel unit was not established during the drilling programme as it extended below the maximum reach of the drilling rig on site (30m below ground level). However, bedrock outcrop was noted in the river bed to the north of the Site 1 at the County Brook River (Fassaroe Stream) at an elevation of 55maod.

See borehole logs included in Priority Geotechnical's Factual Report (Appendix D) for detailed depths and descriptions of the unconsolidated sand and gravel deposits.

4.5.3 Land Stability

Evidence of landslide/slip material is suggested from the geophysical survey on the northern/north eastern slopes of Sites 2, 3A and 3C. Due to access and slope stability constraints, the installation of directly down-gradient groundwater boreholes was unfeasible with the exception of BH1 at Site 2 and BH8 at Site 3B.

Site surveys were undertaken by Atkins Consulting Engineers for the purposes of a recent planning application (Wicklow County Council Reg. Ref. 16/999) prepared in respect of development lands at Fassaroe (including landfill Site 1, Site 2 and Site 3B). The site surveys identified four areas where landslips have previously occurred or where they might potentially occur in the future to the north of Site 2. Site visits for geophysical surveys undertaken at all landfill sites identified areas of possible previous slippage on the northern sides of Sites 3A and 3C also. Slope stabilisation works will be required in these areas. This will involve physical works within /adjacent to the edge of the Ballyman Glen SAC which are considered in the NIS prepared to accompany the Certificate of Authorisation application by Wicklow County Council.

4.5.4 Surface Water Drainage System

Observations made during the intrusive investigations and subsequent monitoring rounds have confirmed the absence of any formal surface water drainage system in the vicinity of the five landfill sites. This precludes a direct connection with the Ballyman Glen SAC and/or County Brook River therein.

4.5.5 Groundwater Observations

Groundwater was identified in 17 boreholes (both groundwater and gas monitoring boreholes) completed in the sands and gravel deposits, both onsite and offsite of the former landfills in March monitoring rounds (2016). 19 boreholes, most of which were gas monitoring boreholes, were dry.

Groundwater levels have been recorded during all 18 No. gas monitoring rounds and on a single occasion for Round 2 (August 2016) and Round 3 (March 2018). A summary of groundwater water levels is presented in **Table 4.16**.

The groundwater level dataset (29th of March 2016) demonstrates that the flow direction in all sites does follow topography being orientated towards the river to the north and northeast. The hydraulic gradient steepens towards the valleys and is flatter on the plateau. As a result there is a steeper hydraulic gradient underlying Sites 1 and 2 than Sites 3A, B and C.

4.5.6 Leachate Observations

In the absence of surface water drainage in the vicinity of the landfill sites there is no evidence of leachate breakout, although some evidence of vegetation die back has been recorded around Site 2 and Site 3B which is attributed to the generation of landfill gas.

There are no instances of leachate emergences at the foot of the waste body that directly link via overland drainage to the down-gradient stream, although at Site 2 there is possible seepage from exposed waste at a collapsed river bank. There are a number of spring flows emerging as diffuse seepages with some showing ochre staining, particularly those found close to Site 2 (Spring SP1) and Site 3A (Spring SP4). Spring monitoring has confirmed visual evidence of contamination at several points of groundwater emergence with the Ballyman Glen SAC principally in the form of orange / red ochre deposition and/or sheening. Visual observations are summarised in **Table 4.15.**

Table 4.15 – Field Observation for Springs

Spring Ref.	Round 1 (March 2016)	Round 2 (August 2016)	Round 3 (March 2016)
SP1	Ochre staining and hydrocarbon sheening	Ochre, red discoloration & hydrocarbon sheen	Tufa Deposition
SP2	Not recorded	Calcite Deposits / Tufa	Tufa Deposition
SP3	Not recorded	Calcite Deposits / Tufa	Tufa Deposition
SP4	Not recorded	Ochre Deposition.	Ochre Deposition.
SP5	Not recorded	Calcite Deposits / Tufa	Tufa Deposition

Table 4.16 – Summary of water levels for March and April 2016

BH ID	Type	Site	Installation depth (mbgl)	Standpipe Level (mOD)	15/03/2016		22/03/2016		29/03/2016		05/04/2016		14/04/2016		20/04/2016		26/04/2016					
					mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD				
G19	Gas	1	14.0	98.39	7.94	90.45	7.97	90.42	dry	<84.4	8.03	90.36	7.93	90.46	7.9	90.49	7.92	90.47				
G08	Gas	1	14.0	94.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6				
G07	Gas	1	14.0	93.236	dry	na	dry	na	dry	<79.2	dry	<79.2	19.99	73.246	dry	73.246	dry	73.246				
BH05	GW	1	29.0	96.32	20.43	75.89	20.07	76.25	20.1	76.22	20.06	76.26	dry	76.26	19.95	76.37	20	76.32				
G18	Gas	1	14.0	93.83	dry	<79.8	dry	<79.8	dry	<79.8	dry	<79.8	dry	<79.8	dry	<79.8	dry	<79.8				
G06	Gas	1	11.0	91.303	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3				
BH04	GW	2	25.5	84.53	dry	<59.9	dry	<59.9	dry	<59.9	dry	<59.9	dry	<59.9	dry	<59.9	dry	<59.9				
G04	Gas	2	20.0	85.97	8.76	77.21	9.05	76.92	9.48	76.49	7.75	78.22	2.19	83.78	6.46	79.51	8.23	77.74				
G05	Gas	2	20.0	86.86	16.06	70.8	16.16	70.7	16.23	70.63	16.36	70.5	16.45	70.41	16.46	70.4	16.46	70.4				
G25	Gas	2	20.0	86.027	dry	<66.86	dry	<66.86	dry	<66.86	dry	<66.86	dry	<66.86	dry	<66.86	dry	<66.86				
BH13	GW	2	19.5	87.99	dry	<68.5	dry	<68.5	dry	<68.5	dry	<68.5	dry	<68.5	dry	<68.5	dry	<68.5				
BH01	GW	2	21.0	79.46	14.38	65.08	14.14	65.32	14.49	64.97	14.65	64.81	14.71	64.75	14.86	64.6	14.82	64.64				
G03	Gas	2	19.5	69.63	dry	<50.1	dry	<50.1	dry	<50.1	dry	<50.1	dry	<50.1	dry	<50.1	dry	<50.1				
G02	Gas	2	19.5	72.64	dry	<53.1	dry	<53.1	dry	<53.1	dry	<53.1	dry	<53.1	dry	<53.1	dry	<53.1				
G13	Gas	2	20.0	99.87	dry	<79.9	dry	<79.9	dry	<79.9	dry	<79.9	dry	<79.9	dry	<79.9	dry	<79.9				
G22	Gas	2	20.0	63.85					~9.38	54.47			9.27	54.58	9.38	54.47	9.42	54.43				
G23	Gas	2	20.0	78.94					dry	<58.94	17	61.94	17.05	61.89	dry	61.89	17.24	61.7				
G24	Gas	2	20.0	86.84	dry	<66.8	dry	<66.8	dry	<66.8	dry	<66.8	dry	<66.8	dry	<66.8	dry	<66.8				
BH03	GW	2	19.5	78.8	dry	<66.8	dry	<66.8	dry	<66.8	dry	<66.8	dry	<66.8	dry	<66.8	dry	<66.8				
G20	Gas	2	20.0	85.826	14.43	71.396	14.41	71.416	14.45	71.376	14.49	71.336	14.53	71.336	16.57	69.256	14.57	71.256				
G21	Gas	2	17.0	87	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0				
G01	Gas	2	17.5	85.4	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9				
BH11	GW	2	33.0	82.83	dry	<49.8	dry	<49.8	dry	<49.8	dry	<49.8	dry	<49.8	dry	<49.8	dry	<49.8				
G10	Gas	2	18.0	98.95	9.22	89.73	9.24	89.71	9.27	89.68	9.32	89.63	9.23	89.72	9.24	89.71	9.26	89.69				
G12	Gas	3A	14.0	99.02	10.13	88.89	10.29	88.73	10.44	88.58	10.55	88.47	10.64	88.38	10.73	88.29	10.75	88.27				
BH10	GW	3A	14.0	99.51	8.43	91.08	8.5	91.01	8.61	90.9	8.63	90.88	8.71	90.8	8.7	90.81	8.73	90.78				
G14	Gas	3A	14.0	98.83	7.53	91.3	7.63	91.2	7.75	91.08	7.81	91.02	7.87	90.96	7.91	90.92	7.94	90.89				
BH09	GW	3B	12.0	98.14	6.43	91.71	6.57	91.57	6.75	91.39	6.85	91.29	6.88	91.26	6.94	91.2	6.96	91.18				
G17	Gas	3B	6.0	98.76	dry	<92.8	dry	<92.8	dry	<92.8	dry	<92.8	4.4	94.36	dry	94.36	dry	94.36				
BH08	GW	3B	13.5	98.95	6.61	92.34	6.92	92.03	7.09	91.86	7.26	91.69	7.35	91.6	7.47	91.48	7.62	91.33				
G15	Gas	3B	6.0	99.51	5.41	94.1	dry	<93.5	dry	<93.5	dry	<93.5	dry	<93.5	dry	<93.5	dry	<93.5				
G16	Gas	3B	6.0	100.76	4.08	96.68	4.11	96.65	4.18	96.58	4.27	96.49	4.27	96.49	4.31	96.45	4.35	96.41				
BH07	GW	3B	21.0	106.37	13.71	92.66	13.76	92.61	13.81	92.56	13.88	92.49	13.97	92.4	14.09	92.28	14.13	92.24				
G11	Gas	3C	15.0	97.4	9.83	87.57	9.87	87.53	10	87.4	10.05	87.35	10.13	87.27	10.17	87.23	10.18	87.22				
BH06	GW	3C	14.0	95.4	5.53	89.87	5.57	89.83	5.65	89.75	5.74	89.66	5.7	89.7	5.75	89.65	5.78	89.62				
G09	Gas	3C	14.0	98.14	12.3	85.84	12.38	85.76	12.47	85.67	12.6	85.54	12.65	85.49	12.74	85.4	12.78	85.36				

Table 4.16 – Summary of water levels for March and April 2016 (Continued)

BH ID	Type	Site	Installation depth (mbgl)	Standpipe Level (mOD)																	
G19	Gas	1	14.0	98.39																	
G08	Gas	1	14.0	94.6																	
G07	Gas	1	14.0	93.236																	
BH05	GW	1	29.0	96.32																	
G18	Gas	1	14.0	93.83																	
G06	Gas	1	11.0	91.303																	
BH04	GW	2	25.5	84.53																	
G04	Gas	2	20.0	85.97																	
G05	Gas	2	20.0	86.86																	
G25	Gas	2	20.0	86.027																	
BH13	GW	2	19.5	87.99																	
BH01	GW	2	21.0	79.46																	
G03	Gas	2	19.5	69.63																	
G02	Gas	2	19.5	72.64																	
G13	Gas	2	20.0	99.87																	
G22	Gas	2	20.0	63.85																	
G23	Gas	2	20.0	78.94																	
G24	Gas	2	20.0	86.84																	
BH03	GW	2	19.5	78.8																	
G20	Gas	2	20.0	85.826																	
G21	Gas	2	17.0	87																	
G01	Gas	2	17.5	85.4																	
BH11	GW	2	33.0	82.83																	
G10	Gas	2	18.0	98.95																	
G12	Gas	3A	14.0	99.02																	
BH10	GW	3A	14.0	99.51																	
G14	Gas	3A	14.0	98.83																	
BH09	GW	3B	12.0	98.14																	
G17	Gas	3B	6.0	98.76																	
BH08	GW	3B	13.5	98.95																	
G15	Gas	3B	6.0	99.51																	
G16	Gas	3B	6.0	100.76																	
BH07	GW	3B	21.0	106.37																	
G11	Gas	3C	15.0	97.4																	
BH06	GW	3C	14.0	95.4																	
G09	Gas	3C	14.0	98.14																	

4.6 RESULTS OF LABORATORY ANALYSIS

4.6.1 Waste Characterisation

Of the 28 No. trial pits excavated and 21 No. combined gas/leachate boreholes installed across the five sites, waste was encountered at all locations with the exception of TP05 (Site 1) and TP27 (Site 3B).

EU Council Decision 2003/33/EC (*establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*) establishes criteria and procedures for the testing and classification of waste for acceptance at inert, non-hazardous and hazardous landfills throughout Europe.

Analysis of waste acceptance criteria (WAC) was conducted on all waste and subsoil samples recovered from the trial pits and exceedances of the inert, non-hazardous and hazardous waste acceptance criteria are summarised below.

A detailed summary of the waste characterisation analysis is presented in **Appendix F**. The result of the assessment of the nature of the waste and its classification is presented below in Table 4.16.

4.6.1.1 Site 1

Elevated concentrations of pH, total organic carbon, antimony, total PCBs (7 congeners) and sulphate were noted in Site 1.

pH ranged from 7.4 to 8.4 with the WAC for non-hazardous landfills (>6).

Exceedances of Total Organic Carbon (TP13 and TP15) were noted above the WAC limit for inert landfills.

There are two elevated concentrations of Antimony 0.08mg/kg at TP15 (exceeding the inert limit of 0.06mg/kg) and 1.0mg/kg at TP13 (exceeding the non-hazardous limit of 0.7mg/kg).

One sample exceeds the inert limit for sulphate of 1000mg/kg. The maximum concentration of 2,700mg/kg was recorded in TP14.

4.6.1.2 Site 2

Elevated concentrations of pH, TOC, antimony, sulphate, molybdenum and Total Dissolved Solids (TDS) were noted in Site 2.

pH ranged from 8.0 to 8.7 with the WAC for non-hazardous landfills (>6).

Exceedances of Total Organic Carbon (TP03 and TP06) were noted above the WAC limit for inert landfills.

Antimony concentrations exceed the WAC limit for inert landfills at TP02 and TP07.

Sulphate concentrations exceeded the WAC limit for inert landfills at TP01, TP03 and TP08 with a maximum concentration of 5,100mg/kg being recorded at TP03.

Exceedances of Molybdenum above the WAC for inert landfills were recorded at TP01, TP02 and TP07 with a maximum concentration of 0.55mg/kg noted in TP02.

TP02 and TP08 recorded exceedances of TDS above the WAC for inert landfills (4,000mg/kg) with a maximum concentration of 6,500mg/kg recorded at TP03.

4.6.1.3 Site 3A

Elevated concentrations of pH, TOC, antimony, sulphate, molybdenum, TDS, Loss on Ignition (LoI), lead and TPH were noted at Site 3A.

All five samples exceeded the WAC for non-hazardous landfills for pH with a maximum concentration of 8.7 recorded at TP24.

TOC exceeded the WAC for inert landfills (3%) at TP23 (4.5%).

Exceedances of antimony above the WAC for inert landfills were noted at TP21 and TP23 with the maximum concentration recorded at TP23 (0.42mg/kg).

One sample exceeded the inert limit for sulphate. This occurred at TP24 with a reading of 3,000mg/kg at a depth of 2mbgl.

The WAC for inert landfills was exceed for molybdenum (TP21 – 0.71mg/kg), TDS (TP24 – 5,300mg/kg), lead (TP23 – 0.59mg/kg) and TPH (TP24 – 1,200mg/kg).

LoI exceeded the WAC for non-hazardous landfills at TP23 (13mg/kg).

4.6.1.4 Site 3B

Elevated concentrations of pH, TOC, antimony, molybdenum and TPH were noted at Site 3B.

All four samples (TP25, TP26, TP27 and TP28) exceeded the WAC for non-hazardous landfills with a maximum concentration of 8.7 noted at TP27.

The WAC for inert landfills was exceeded for TOC (TP25 – 3.2%), antimony (TP25 and TP26), molybdenum (TP26 – 0.5mg/kg) and TPH (Tp25 and TP26).

4.6.1.5 Site 3C

Elevated concentrations of pH, TOC, antimony, molybdenum, TDS, lead, TPH, mercury, nickel, selenium and chloride were recorded at Site 3C.

All four samples (TP16, TP17, TP18 and TP19) exceeded the WAC for non-hazardous landfills for pH with a maximum concentration of 8.2 recorded at TP19.

The WAC for inert landfills was exceeded for TOC (TP17 – 3.1%), antimony (TP17 and TP19), molybdenum (TP16 and TP18), TDS (TP18 – 15,000mg/kg), lead (TP18 – 1.8 mg/kg), TPH (TP17 and TP18), mercury (TP18- 0.028mg/kg), nickel (TP18 – 1.3mg/kg), selenium (TP18 – 0.13mg/kg) and chloride (TP18 – 3,000mg/kg).

The WAC for hazardous landfills was exceeded for TOC at TP18 (8.6mg/kg) with the WAC for non-hazardous landfills also being exceed at TP18 for antimony (0.88mg/kg).

Table 4.17 - Summary Analysis Results from WAC samples

Contaminant	No. of samples	No. of Exceedances	Range (mg/kg)	No. of samples below detection limit	WAC (mg/kg)		No. of samples exceeding WAC	Site ID	Location and Depth (mbgl)
pH	28	5	7.4 - 8.7	0	Non- hazardous	>6	28	Site 1	TP12 (2.5); TP13 (2.5); TP14 (3); TP15 (2); TP15 (4.5)
		10						Site 2	TP1 (2.7); TP2 (3.5); TP3 (2); TP3 (4.2); TP5 (3); TP6 (2); TP7 (3); TP8 (2); TP10 (2.5); TP10 (4)
		5						Site 3A	TP20 (4); TP21 (3); TP22 (1.5); TP23 (2.5); TP24 (2)
		4						Site 3B	TP25 (2.5); TP26 (2.5); TP27 (2.5); TP28 (2)
		4						Site 3C	TP16 (3); TP17 (2.5); TP18 (1.5); TP19 (2)
Total Organic Carbon	28	5	<0.2 - 8.6	20	Inert	3	7	Site 1	TP13 (2.5); TP15 (2)
		10						Site 2	TP3 (2); TP6 (2)
		5						Site 3A	TP23 (2.5)
		4						Site 3B	TP25 (2.5)
		4						Site 3C	TP17 (2.5)
		4		27	Hazardous	6	1	Site 3C	TP18 (1.5)
Antimony	28	5	<0.01 - 1.0	17	Inert	0.06	9	Site 1	TP15 (4.5)
		10						Site 2	TP2 (3.5); TP7 (3)
		5						Site 3A	TP21 (3); TP23 (2.5)
		4						Site 3B	TP25 (2.5); TP26 (2.5)
		4						Site 3C	TP17 (2.5); TP19 (2.5)
		5		26	Non- hazardous	0.7	2	Site 1	TP13 (2.5)
		4						Site 3C	TP18 (1.5)
Total PCBs (7 Congeners)	28	5	<0.10 - 1.9	27	Inert	1	1	Site 1	TP14 (3)

Contaminant	No. of samples	No. of Exceedances	Range (mg/kg)	No. of samples below detection limit	WAC (mg/kg)		No. of samples exceeding WAC	Site ID	Location and Depth (mbgl)
Sulphate	28	5	10 - 5900	23	Inert	1000	5	Site 1	TP14 (3)
		10						Site 2	TP1 (2.7); TP3 (2); TP8 (2)
		5						Site 3A	TP24 (2)
Molybdenum	28	10	<0.05 - 0.71	21	Inert	0.5	7	Site 2	TP1 (2.7); TP2 (3.5); TP7 (3)
		5						Site 3A	TP21 (3)
		4						Site 3B	TP26 (2.5)
		4						Site 3C	TP16 (3); TP18 (1.5)
Total Dissolved Solids	28	10	610 - 15,000	23	Inert	4000	4	Site 2	TP3 (2); TP8 (2)
		5						Site 3A	TP24 (2)
		4						Site 3C	TP18 (1.5)
Loss on Ignition	28	5	0.93 - 13	27	Hazardous	10	1	Site 3A	TP23 (2.5)
Lead	28	5	<0.010 - 1.8	26	Inert	0.5	2	Site 3A	TP23 (2.5)
		4						Site 3C	TP18 (1.5)
TPH Total WAC (Mineral Oil)	28	5	<10 - 1,200	23	Inert	500	5	Site 3A	TP24 (2)
		4						Site 3B	TP25 (2.5); TP26 (2.5)
		4						Site 3C	TP17 (2.5); TP18 (1.5)
Mercury	28	4	<0.005 - 0.028	27	Inert	0.01	1	Site 3C	TP18 (1.5)
Nickel	28	4	<0.05 - 1.3	27	Inert	0.4	1	Site 3C	TP18 (1.5)
Selenium	28	4	<0.01 - 0.13	27	Inert	0.1	1	Site 3C	TP18 (1.5)
Chloride	28	4	<10 - 3,000	27	Inert	800	1	Site 3C	TP18 (1.5)

4.6.2 Leachate Characterisation

Field measurements of electrical conductivity, temperature, total dissolved solids and oxidation-reduction potential (ORP) for leachate samples taken at each of the sites are used as indicators of generic leachate properties.

Waste leachate concentrations obtained from chemical laboratory analysis have been compared to the most recent water quality criteria for groundwater as presented in European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (Statutory Instruments No. 366 of 2016) (GW Regs 2016). Other possible water quality assessment criteria include: Interim Guideline Values (IGV) for Groundwater as presented in EPA interim report "Towards Setting Guideline Values for the Protection of Groundwater in Ireland" 2002; and Groundwater Threshold Values (GTV) in the Groundwater Regulations (SI 9 of 2010). All the above water quality assessments are applicable to groundwater and are therefore extremely conservative when applied to leachate data. See **Appendix G** for tabulated summary of leachate quality results for Sites 1-3C.

Table 4.18 – Leachate Quality Comparison with Typical Data for Methanogenic Landfills

Parameter	Min	Mean	Max	Site 1	Site 2	Site 3A	Site 3B	Site 3C
pH-value	6.8	**7.52**	8.2	6.9	7.0	6.9	6.9	6.8
EC (µS/cm)	5,990	**11,502**	19,300	1,680	5,407	6,277	11,600	7,253
alkalinity	3,000	**5,376**	9,130	1,880	2,332	3,387	4,640	3,525
COD	622	**2,307**	8,000	2,790	707	1852	8,140	3,544
BOD5	97	**374**	1,770	188	64	234	4,851	1,727
TOC	184	**733**	2,270	22	248	133	2,500	922
Ammoniacal-N	283	**889**	2,040	32	342	385	893	525
nitrate-N	0.2	**0.86**	2.1	0.35	0.35	0.50	0.35	0.35
nitrite-N	0.005	**0.17**	1.3	0.04	0.04	0.04	0.04	0.04
Sulphate	2.5	**67**	322	119	68	6	2	2
phosphate	0.3	**4.3**	18.4	0.3	2.8	1.1	0.3	0.6
Chloride	570	**2,074**	4,710	57	706	703	978	679
Sodium	474	**1,480**	3,650	14	285	428	566	333
potassium	100	**854**	1,580	20	188	254	567	297
Calcium	23	**151**	501	954	162	480	336	461
chromium	0.015	**0.09**	0.56	0.13	0.03	0.07	0.04	0.06
manganese	0.04	**0.46**	3.59	10.20	1.91	6.87	10.30	8.61
Iron	1.6	**27.4**	160	190	134	101	87	120
Nickel	0.015	**0.17**	0.6	0.20	0.07	0.20	0.20	0.21
Copper	0.01	**0.13**	0.62	0.14	0.08	0.12	0.02	0.07
Zinc	0.03	**1.14**	6.7	9.97	0.43	5.04	0.83	2.97
Arsenic	0.0005	**0.034**	0.485	0.17	0.15	0.11	0.49	0.89
Cadmium	0.005	**0.015**	0.08	0.02	0.003	0.009	0.001	0.009
Mercury	<0.00005	**0.0002**	0.0008	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Lead	0.02	**0.2**	1.9	2.46	0.19	1.07	0.12	0.62

Results in mg/l except pH-value and conductivity (µS/cm)

The average leachate quality for each site in Round 1 (March 2016) has been screened against the typical values for methanogenic leachate from large landfills as presented in the EPA Landfill Manual (Table 7.2) as summarised in **Table 4.18**. The data screening is generally consistent with methanogenic conditions in landfill sites, most notably SA, SB and 3C. Notable features of the dataset include elevated arsenic and manganese in the landfill sites and generally elevated metals in Site 1.

4.6.2.1 Site 1

Field parameters for the leachate samples taken from Site 1 during each monitoring round are summarised in Table 4.19**.**

Table 4.19 – Site 1 Field Parameters for Leachate

Borehole ID	Round	Ph	Temp (deg C)	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
LG11	1	-	12.6	1,924	964	-92	black/ dark brown turbid sample, foul odour, traces of hydrocarbons
	2	7.01	15.7	2,473	-	-	Dark grey, very turbid, slight foul odour
	3	5.86	11.5	2,100	1,050	-180	-

Leachate samples from Site 1 showed concentrations above relevant water quality assessment criteria (i.e. GW Regs 2016, IGV or GTV) for the parameters listed in **Table 4.20**.

Table 4.20 – Leachate Sample LG11 Exceedances

Round 1	Round 2	Round 3
Inorganics		
Electrical Conductivity	Electrical Conductivity	Electrical Conductivity
Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids
Ammoniacal Nitrogen	Ammoniacal Nitrogen, Nitrite	Ammoniacal Nitrogen, Orthophosphate
Chloride	Chloride	Chloride
Calcium		Calcium
Metals* including: Aluminium, Arsenic, Cadmium, Copper, Iron, Lead, Nickel, Zinc	Metals** including: Chromium, Iron	Metals* including: Aluminium, Arsenic, Iron, Lead, Zinc
Manganese, Potassium	Manganese, Potassium	Manganese, Potassium
Barium	Barium, Boron	Barium
Cyanide		Sulphate
Organics		
Total Polycyclic Aromatic Hydrocarbons (PAHs) including Fluoranthene, Benzo (a) pyrene, Benzo (b) fluoranthene.	None	Total Polycyclic Aromatic Hydrocarbons (PAHs
Total Petroleum Hydrocarbons		Benzene***

* Metals measured as totals; ** Metal measured as dissolved. *** TPH not measured in R3;

A small number of trace organics were detected above the laboratory Limit of Detection (LoD) for which there are currently no water quality criterial appropriate for a screening exercise.

4.6.2.2 Site 2

Field parameters for the leachate samples taken from Site 2 during each monitoring round are summarised in **Table 4.20.** It is evident that leachate from Site 2 is typically characterised by high EC, TDS and low ORP, indicating a concentrated leachate and strongly reducing conditions.

Table 4.21 – Site 2 Field Parameters for Leachate

Borehole ID	Round	pH	Temp (deg C)	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
LG01	R1	-	9.9	938	472	-8.4	black colour, foul odour
	R2	-	-	-	-	-	dry
	R3	-	-	-	-	-	Dry
LG03	R1	-	10.5	>3,999	>2,000	-77	brown turbid, foamy; foul odour
	R2	6.99	15.3	>3,999	-	-	-
	R3	-	-	-	-	-	Not enough water to purge / bail
LG07	R1	-	11.7	>3,999	>2,000	-121	dark brown, turbid sample, foul odour
	R2	7.18	15	>3,999	-	-	Brown/grey, speckles of hydrocarbon sheen, strong foul odour.
	R3	5.34	11.2	>3,999	>2,000	-122	Dark grey/black, turbid with flecks of hydrocarbon. Strongly reducing smell & hydrocarbon odour.
LG09	R1	-	11.6	>3,999	>2,000	-113	red/brown, turbid sample
	R2	7.19	14.2	>3,999	-	-	Dark brown, speckles of hydrocarbon sheen, strong foul odour.
	R3	5.72	11.7	>3,999	>2,000	-140	-
LG10	R1	-	13.2	>3,999	>2,000	-127	light brown, cloudy sample
	R2	7.17	15	>3,999	-	-	Dark brown, speckles of hydrocarbon sheen, strong foul odour.
	R3	4.17	10	1,908	954	-86	Dark grey/black, turbid with flecks of hydrocarbon. Strongly reducing smell & hydrocarbon odour

Leachate samples at Site 2 showed concentrations above relevant water quality assessment criteria (i.e. GW Regs 2016, IGV or GTV) for the parameters listed in **Table 4.22**.

Table 4.22 – Site 2 Leachate Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
Electrical Conductivity, Total Dissolved Solids	Electrical Conductivity, Total Dissolved Solids	Electrical Conductivity, Total Dissolved Solids
Ammoniacal Nitrogen, Orthophosphate	Ammoniacal Nitrogen, Orthophosphate	Ammoniacal Nitrogen, Total phosphate
Chloride	Chloride	Chloride
Metals* including: Aluminium, Arsenic, Copper, Iron, Lead, Nickel, Zinc	Metals** including: Arsenic, Chromium, Copper, Iron, Mercury, Nickel	Metals* including: Aluminium, Arsenic, Copper, Iron, Lead, Nickel, Zinc
Manganese, Potassium, Sodium	Manganese, Potassium, Sodium	Manganese, Potassium, Sodium
Sodium	Sodium	Sodium
Barium, Boron	Barium, Boron	Barium, Boron
Organics		
Total PAHs including Naphthalene		Total PAHs including Naphthalene
Total Petroleum Hydrocarbons	Total Petroleum Hydrocarbons	Benzene***

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3.

A small number of other trace organics were detected above the LoD for which there are currently no water quality criterial appropriate for a screening exercise.

4.6.2.3 Site 3A

Field parameters for the leachate samples taken from Site 3A during each monitoring round are summarised in **Table 4.23**.

Table 4.23 – Site 3A Field Parameters (Leachate)

Borehole ID	Round	Temp (deg C)	pH	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
MW4	Round 1	10.5	-	>3,999	>2,000	-136	brown, cloudy sample, foul odour
	Round 2	-	-	-	-	-	-
	Round 3	9.7	5.74	>3,999	>2,000	-97	Pale brown & fizzing at the top. Very strong reducing / detergent/ bitter odour
LG15	Round 1	9.0	-	1,993	996	-77	brown, turbid sample, foul odour
	Round 2	19	6.82	3,467	-	-	Black colour, strong foul odour
	Round 3	8.5	5.31	1,464	731	-95	Light grey, not cloudy but turbid, hydrocarbon/reducing odour
LG19	Round 1	9.5	-	>3,999	>2,000	-157	brown, cloudy sample, foul odour
	Round 2	14	7.2	>3,999	-	-	Slight black colour, strong foul odour
	Round 3	-	-	-	-	-	-

Leachate samples taken from Site 3A showed concentrations above relevant water quality assessment criteria (i.e. GW Regs 2016, IGV or GTV) for the parameters listed in **Table 4.24**.

Table 4.24 – Site 3A Leachate Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
Electrical Conductivity, Total Dissolved Solids	Electrical Conductivity, Total Dissolved Solids	Electrical Conductivity, Total Dissolved Solids
Ammoniacal Nitrogen, Orthophosphate	Ammoniacal Nitrogen, Orthophosphate	Ammoniacal Nitrogen
Chloride	Chloride	Chloride
Calcium	Calcium	Calcium
Metals* including Aluminium, Arsenic, Cadmium, Copper, Iron, Lead, Nickel, Zinc	Metals** including Arsenic, Chromium, Copper, Iron, Lead, Nickel, Zinc	Metals* including Aluminium, Arsenic, Iron, Lead, Nickel, Zinc
Manganese, Potassium, Sodium	Manganese, Sodium	Manganese, Potassium, Sodium
Barium, Boron	Barium, Boron	Barium, Boron
*Organics****		
Total Polycyclic Aromatic Hydrocarbons (PAH) including Naphthalene	Total Polycyclic Aromatic Hydrocarbons (PAH) including Naphthalene	Total Polycyclic Aromatic Hydrocarbons (PAH) including Naphthalene
Total Petroleum Hydrocarbons including Toluene, Ethyl Benzene, MTBE	Total Petroleum Hydrocarbons including Benzene, Toluene	Benzene, Toluene, xylene
Phenol		
Trans-1,2-dichloroethene, Vinyl chloride	Vinyl chloride	Vinyl chloride

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3.

A small number of other trace organics were detected above the laboratory LoD for which there are currently no water quality criterial appropriate for a screening exercise.

4.6.2.4 Site 3B

Field parameters for the leachate samples taken from Site 3B during each monitoring round are summarised in **Table 4.25**.

Table 4.25 – Site 3B Field Parameters (Leachate)

Borehole ID	Temp (deg C)	pH	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
LG17	11.0	-	>3,999	>2,000	-126	black colour, foul odour
	16.2	7.23	>3,999	-	-	Dark grey cloudy, strong foul odour
	10.1	5.93	1,220	610	-78	-

Leachate samples taken from Site 3B showed concentrations above relevant water quality assessment criteria (i.e. GW Regs 2016, IGV or GTV) for the parameters listed in **Table 4.26**.

Table 4.26 – Site 3B Leachate Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
Electrical Conductivity, Total Dissolved Solids	Electrical Conductivity, Total Dissolved Solids	Electrical Conductivity
Ammoniacal Nitrogen	Ammoniacal Nitrogen, Orthophosphate	Ammoniacal Nitrogen, Total Phosphate
Chloride	Chloride	Chloride
Calcium		
Barium, Boron	Barium, Boron	Barium
Metals* including Aluminium, Arsenic, Iron, Lead, Nickel, Zinc	Metals** including Arsenic, Chromium, Copper, Iron, Lead, Nickel	Metals* including Aluminium, Arsenic, Iron, Lead, Nickel, Zinc
Manganese, Potassium, Sodium	Manganese, Potassium, Sodium	Manganese, Potassium
*Organics****		
Total Polycyclic Aromatic Hydrocarbons (PAH)		Total Polycyclic Aromatic Hydrocarbons (PAH)
Total Petroleum Hydrocarbons	Total Petroleum Hydrocarbons including Benzene, Toluene	Toluene
Phenol (Note elevated concentration of 3+4-Methylphenol & 3,5-Dimethylphenol)	Phenol	
	Vinyl Chloride	

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3.

A small number of other trace organics were detected above the laboratory LoD for which there are currently no water quality criterial appropriate for a screening exercise.

Leachate data for Site 3B (LG17) is characterised by the presence of short chain TPH including BTEX hydrocarbons and a larger range of VOCs and SVOCs than seen at the other sites. The dataset for Site 3B is also considerably more dilute in Round 3 relative to the two previous rounds.

4.6.2.5 Site 3C

Field parameters for the leachate samples taken from Site 3C during each monitoring round are summarised in **Table 4.27**.

Table 4.27 – Site 3C Field Parameters (Leachate)

Borehole ID	Round	pH	Temp (deg C)	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
MW2	R1	-	10.3	1,139	620	-109	black/dark brown colour, high levels of suspended solids
	R2	-	-	-	-	-	-
	R3	6.55	7.4	733	382	-102	Light grey tint, specs of black, strong reducing odour
LG14	R1	-	11.6	>3,999	>2,000	-175	black/dark brown colour, high levels of suspended solids
	R2	7.34	17	>3,999	-	-	Dark grey, very turbid, strong foul odour
	R2	5.47	11.6	>3,999	>2,000	-118	-

Leachate samples taken from Site 3C showed concentrations above relevant water quality assessment criteria (i.e. GW Regs 2016, IGV or GTV) for the parameters listed in **Table 4.27**.

Table 4.28 – Site 3C Leachate Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
Electrical Conductivity, Total Dissolved Solids	Electrical Conductivity, Total Dissolved Solids	Electrical Conductivity, Total Dissolved Solids
Ammoniacal Nitrogen, Orthophosphate	Ammoniacal Nitrogen, Orthophosphate	Ammoniacal Nitrogen, Total Phosphate
Chloride	Chloride	Chloride
Calcium	Calcium	Calcium
Metals* including Aluminium, Arsenic, Cadmium, Copper, Iron , Lead , Nickel , Zinc	Metals** including Arsenic, Chromium, Copper, Iron , Lead , Nickel	Metals* including Aluminium, Arsenic, Cadmium, Copper, Iron , Lead , Nickel , Zinc
Barium	Barium, Boron	Barium, Boron
Manganese, Potassium, Sodium	Manganese, Potassium, Sodium	Manganese, Potassium, Sodium
*Organics****		
Polycyclic Aromatic Hydrocarbons (PAH) including Naphthalene	Naphthalene	Polycyclic Aromatic Hydrocarbons (PAH) including Naphthalene
Total Petroleum Hydrocarbons	Total Petroleum Hydrocarbons	
Phenol		

A small number of other trace organics were detected above the laboratory LoD for which there are currently no water quality criterial appropriate for a screening exercise.

4.6.3 Soil Characterisation

See section 6.1.2 for human health risk assessment results.

4.6.4 Groundwater Quality Characterisation

The tabulated and screened groundwater quality dataset for all 5 landfill sites is presented in **Appendix H**. Field measurements of electrical conductivity, temperature, total dissolved solids and oxidation-reduction potential (ORP) for groundwater samples taken at each of the sites are used as indicators of generic groundwater properties.

The groundwater quality dataset collected for each landfill site has been compared with the most relevant water quality assessment criteria available for groundwater. The most relevant water quality criteria are Schedule 5 Groundwater Threshold Values (GTV) as presented in the Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (Statutory Instruments No. 366 of 2016) which update the Schedule 5 GTV's presented in Environmental Objectives (Groundwater) Regulations 2010 (SI No. 9, 2010).

Interim Guideline Values (IGV) for Groundwater as presented in EPA interim report "Towards Setting Guideline Values for the Protection of Groundwater in Ireland" (EPA, 2003) also represent potential groundwater quality assessment criteria and have been included in the assessment presented herein. There are currently no published generic assessment criteria for groundwater derived specifically to be protective of human health via direct contact. However it can be assumed that if water is considered safe for human consumption then there are no risks from direct contact.

Due to access and slope stability constraints, the installation of directly down-gradient groundwater boreholes was unfeasible with the exception of BH1 at Site 2 and BH8 at Site 3B. Sampling from springs down-gradient of the sites were used to indicate the down A comparison between up-gradient and down-gradient groundwater quality for each site is made for each Site where applicable.

4.6.4.1 Site 1

Field parameters for groundwater sample taken during each monitoring on Site 1 are summarised in **Table 4.28**. It should be noted that borehole BH5 appears to be located in an up-gradient location relative to the Landfill Site 1 based on the local groundwater flow direction in the area, however the water quality indicates there the groundwater at this location is potentially impacted by the leachate.

Table 4.29 – Site 1 Field Parameters (Groundwater)

Borehole ID	Round	pH	Temp (deg C)	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
BH5 (up-gradient)	R1	-	10.0	886	443	221	brown turbid colour
	R2	7.12	13.3	972	-	-	Slight brown colour, very silty
	R3	-	-	-	-	-	Well silted up

Groundwater samples taken from Site 1 (i.e. BH5) demonstrated groundwater concentrations in excess of the relevant GTV or IGV for the parameters summarised in **Table 4.30**.

Table 4.30 – Site 1 Groundwater Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
Ammoniacal Nitrogen	Ammoniacal Nitrogen	No Sample
Calcium	Calcium	
Metals* including Aluminium, Arsenic, Cadmium, Iron, Lead, Nickel, Zinc	Metals** including chromium	
Barium	Boron	
Manganese		
*Organics****		
Total Petroleum Hydrocarbons	None	No Sample
[No PAHs, VOCs or SVOCs above LoD]		

* Metals measured as totals; ** Metal measured as dissolved;

There are a number of exceedances of IGV and GTV thresholds for heavy metals, ammonia and total hydrocarbons at the up-gradient borehole (BH5) at Site 1.

4.6.4.2 Site 2

Field parameters for groundwater sample taken during each monitoring on Site 2 are summarised in **Table 4.31.**

Table 4.31 – Site 2 Field Parameters (Groundwater)

Borehole ID	Round	pH	Temp (deg C)	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
G20 (up-gradient)	R1	-	10.0	585	294	194	brown colour, silty sample
	R2	7.76	14	523	-	-	Brown, very silty
	R3	5.52	10.4	735	288	-15	Light brown, very silty, no odour
BH1 (down-gradient)	R1		10.7	921	461	268	brown colour, silty sample
	R2	6.68	12.1	927	-	-	Brown, turbid, very silty
	R3	-	-	-	-	-	Tubing lodged down well, irretrievable, well blocked

Groundwater samples taken from Site 2 demonstrated groundwater concentrations in excess of the relevant GTV or IGV for the parameters summarised in Table 4.32.

Table 4.32 – Site 2 Groundwater Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
Ammoniacal Nitrogen	Ammoniacal Nitrogen	
Calcium		Calcium
Metals* including Aluminium, Arsenic, Iron, Lead, Nickel, Zinc	Metals** including Iron	Metals* including Aluminium, Cadmium, Nickel, Zinc
Barium	Boron	Barium
Manganese		Manganese, Potassium
*Organics****		
None	None	None

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3

As expected, concentrations of heavy metals in up-gradient borehole G20 are generally slightly lower than those measured in BH1. Furthermore, down-gradient borehole BH1 shows exceedances above GTV for parameters of lead and ammonia which are not observed in up-gradient borehole G20.

There are no detections of trace organic compounds in either of the groundwater at Site 2.

4.6.4.3 Site 3A

Field parameters for groundwater sample taken during each monitoring on Site 3A are summarised in **Table 4.33**.

Table 4.33 – Site 3A Field Parameters (Groundwater)

Borehole ID	Round	pH	Temp (deg C)	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
BH7 (up-gradient)	R1	-	8.9	676	339	148	Very silty
	R2	7.43	16.5	709	-	-	Brown, very silty
	R3	6.42	10.4	660	330	-33	Brown, silty, no odour
BH9 (up-gradient)	R1	-	9.8	572	267	182	Silty
	R2	7.06	13.8	740	-	-	Silty brown
	R3	5.38	9.5	668	336	94	Brown, silty, no odour
BH10 (down gradient / lateral)	R1	-	10.6	606	346	314	Silty
	R2	7.35	13.6	727	-	-	Brown, very silty
	R3	5.5	8.6	738	336	92	Brown, very silty, ammonium odour

Groundwater samples taken from Site 3A demonstrated groundwater concentrations in excess of the relevant GTV or IGV for the parameters summarised in **Table 4.34**.

Table 4.34 – Site 3A Groundwater Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
	Ammoniacal Nitrogen	Total Phosphates
Calcium		Calcium
Metals* including Aluminium, Arsenic, Cadmium, Iron, Lead, Nickel, Zinc	Metals** including Chromium, Iron	Metals* including Aluminium, Arsenic, Cadmium, Copper, Iron, Lead, Nickel, Zinc
Manganese	Manganese, Potassium	Manganese, Potassium
Barium, Boron	Boron	Barium,
*Organics****		
None	None	None

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3

A number of metal concentrations in up-gradient borehole BH9 are slightly lower than concentrations in down-gradient borehole BH10, however this is not the case for all heavy metals (e.g. aluminium and iron concentrations are slightly lower in the down-gradient groundwater). Note BH9 is up-gradient of Site 3A but also downgradient of 3B and as such, may not be representative of local groundwater quality (background) concentrations. Furthermore, while BH10 is considered to be down-gradient of Site 3A it is not located within the direct path of leachate migration as indicated by geophysical surveys.

There are no detections of trace organic compounds any of the groundwater boreholes at Site 3A.

4.6.4.4 Site 3B

Field parameters for groundwater sample taken during each monitoring on Site 3B are summarised in **Table 4.35**.

Table 4.35 – Site 3B Field Parameters (Groundwater)

Borehole ID	Round	pH	Temp (deg C)	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
BH8 (down-gradient)	R1	-	10.9	900	509	252	Very silty
	R2	-	-	-	-	-	Dry
	R3	-	-	-	-	-	-

Groundwater samples taken from Site 3B (i.e. BH8) demonstrated groundwater concentrations in excess of the relevant GTV or IGV for the parameters summarised in **Table 4.36**.

Table 4.36 – Site 3B Groundwater Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
Calcium	-	-
Metals* including Aluminium, Cadmium, Iron, Lead, Nickel, Zinc	-	-
Manganese, Potassium	-	-
*Inorganics****		
none	-	-

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3

There are no detections of ammonia or trace organic compounds in groundwater at Site 3B.

4.6.4.5 Site 3C

Field parameters for groundwater sample taken during each monitoring on Site 3C are summarised in **Table 4.37**.

Table 4.37 – Site 3C Field Parameters (Groundwater)

Borehole ID	Round	pH	Temp (deg C)	EC (µS/cm)	TDS (ppm)	ORP (mV)	Comment
BH6 (up-gradient)	R1	-	10.3	664	333	298	Brown turbid colour
	R2	6.88	14.5	867	-	-	Silty brown
	R3	5.36	9	735	360	96	-

Groundwater samples taken from Site 3C (i.e. BH6) demonstrated groundwater concentrations in excess of the relevant GTV or IGV for the parameters summarised in **Table 4.38**.

Table 4.38 – Site 3C Groundwater Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
	Ammoniacal Nitrogen	
Metals* including Aluminium, Arsenic, Cadmium, Copper, Iron, Lead, Nickel, Zinc	Metals** including Chromium, Iron	Metals* including Aluminium, Arsenic, Copper, Iron, Lead, Nickel, Zinc
Calcium		Calcium
Potassium, Manganese	Potassium	Potassium, Manganese
Barium, Boron	Boron	Barium
Chloride		
*Organics****		
None	None	None

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3

There are no detections of trace organic compounds in groundwater at Site 3C.

4.6.5 Surface Water Characterisation

Water samples were collected from 5 springs and 5 locations along the County Brook River (Fassaroe Stream). Sampling locations are illustrated in **Figure 15**. The samples were analysed for the broad suite of parameters as presented in Appendix I. The analytical suite was selected to be consistent with the parameters analysed in the waste, leachate and groundwater samples to allow comparison across the results..

Surface water samples were compared to Environmental Quality Standards (EQS) protective of Freshwater bodies as presented in Environmental Objectives (Surface Waters) (Amendment) Regulations 2015 (S.I. No. 386 of 2015) which update the Surface Water Regulations (SI 327 of 2012). These standards are considered to be the most appropriate generic assessment criteria for assessing the risk to surface water courses.

There are no instances of leachate emergences at the foot of the waste body that directly link via overland drainage system to the down-gradient stream. However, there a number of spring flows emerging as diffuse upwellings with some showing ochre staining, particularly those found close to Site 3A and Site 2.

4.6.5.1 River Water Samples

Field parameters for the 5 surface water sampling locations along the County Brook River (Fassaroe Stream) are summarised in **Table 4.39**. Monitoring location SW1 is the most downstream sampling location and SW5 is the most up-stream sampling location along the County Brook River (Fassaroe Stream).

Table 4.39 – Surface Water Field Parameters

Surface water ID	Location	Round	Temp (deg C)	EC (µS/cm)	pH (-)	Comment
SW1	Down-gradient of Site 2	R1	5.5	515	6.5	Clear
		R2	12.9	547	8.28	Clear
		R3	5.5	442	7.81	Clear
SW2	Down-Gradient of Site 1	R1	5.3	570	7.6	Clear
		R2	12.5	539	8.52	Clear
		R3	6.5	436	8.07	Clear
SW3	Down-gradient of site 1	R1	5.3	475	7.93	Cloudy
		R2	12.4	558	8.61	Clear
		R3	6.5	421	7.69	Clear
SW4	Down-gradient of Site 3A	R1	5.3	538	7.97	Cloudy
		R2	12.1	550	8.47	Clear
		R3	7.7	531	6.95	Clear
SW5	Up-gradient of all sites	R1	5.8	425	8.09	Cloudy
		R2	11.8	548	8.18	Clear
		R3	8.0	405	7.01	Clear

Surface water quality samples showed exceedances above EQS for the parameters summarised in **Table 4.40**.

Table 4.40 – Surface Water Quality Parameter Exceedances

Round 1	Round 2	Round 3
Inorganics		
Biochemical Oxygen Demand		Biochemical Oxygen Demand
Metals* including Copper, Chromium, Lead, Nickel, Vanadium.	Mercury**	
Ammoniacal Nitrogen, Orthophosphate	Ammoniacal Nitrogen	Orthophosphate
*Organics****		
Polycyclic Aromatic Hydrocarbons including Benzo(a) pyrene, Fluorine		

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3

In Round 1, the water quality exceedances correspond primarily to sampling location SW3, SW4 and SW5 (upstream of Site 1, close to Site 3A and up-gradient of all sites respectively). Similarly, detection of hydrocarbons are observed in SW3, SW4 and SW5 in Round 1. In Round 1 There are no exceedances observed at SW1 and SW2, suggesting that Sites 2 is not having a measurable effect on water quality in County Brook River (Fassaroe Stream) despite the leachate quality on the site and water quality observed at Spring 1.

It is evident that in Round 2 and Round 3, relevant EQSs were not generally exceeded. However a variety of VOCs and SVOCs were identified in surface water at concentrations above the analytical LoD at multiple locations in Round 3 and Round 1, most notably at location SW3. These included 2-chlorophenol, 2-methylphenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 2,4,6-tichlorophenol and a variety of other PAHs

4.6.5.2 Spring Water Samples

Field parameters for the 5 spring sampling locations along the County Brook River (Fassaroe Stream) are summarised in **Table 4.41**.

Table 4.41 – Spring Field Parameters

Spring ID	Round	Temp (deg C)	EC (µS/cm)	pH	Comment	Approx. Location
SP1	R1	2.7	1330	6.6	Ochre staining	Down-gradient of Site 2
	R2	14.8	1,379	7.67	Ochre, red discolouration & hydrocarbon sheen	
	R3	3.4	614	7.53	Tufa, clear	
SP2	R1	2.9	615	7.9	Calcite deposits present	Down-gradient of Site 1
	R2	14.1	660	8.51	Calcite deposits present	
	R3	5.8	843	7.73	Tufa, clear	
SP3	R1	3.3	490	8.0	Calcite deposits present	Down-gradient of Site 3C
	R2	15.2	607	7.77	Calcite deposits present	
	R3	7.3	531	6.95	Tufa, clear	
SP4	R1	7.4	750	7.5	Ochre staining	Down-gradient of Site 3A
	R2	15.6	976	7.49	Ochre deposits present	
	R3	8.9	966	6.53	Ochre	
SP5	R1	4.1	572	7.9	Calcite deposits present	Down-gradient of Site 3A
	R2	15.2	646	7.95	Calcite deposits present	
	R3	9.2	453	6.5	Tufa clear (note redox potential negative)	

Water quality samples showed exceedances above EQS for the parameters summarised in **Table 4.42**.

Table 4.42 – Spring Water Quality Parameter Exceedances

Round 1	Round 2	Round 3~
Inorganics		
Biochemical Oxygen Demand	Biochemical Oxygen Demand	Biochemical Oxygen Demand
Ammoniacal Nitrogen	Ammoniacal Nitrogen	
Metals* including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel and Zinc	Metals** including Nickel and Zinc	Metals* including copper, Lead, Nickel and Zinc.
Organics **		
None	None	None

* Metals measured as totals; ** Metal measured as dissolved; *** TPH not measured in R3; ~ SP5 not sampled in R3

The spring quality is variable between the 5 different spring locations sampled and between successive rounds at each spring. This in part relates to the analytical approaches adopted as identified in Table 4.42 but does imply a variable water quality in subsequent rounds.

In Round 1, the poorest water quality was observed at Spring SP1 (down-gradient of Site 2) and is characterised by the highest concentration of ammoniacal nitrogen and heavy metals. Spring SP1 was the only spring sampling location where petroleum hydrocarbons (and di-n-Butylphthalate) were detected above the analytical Limit of Detection. The water quality observed at Spring 3 (down-gradient/lateral of Site 3C) in Round 1 included exceedances above the EQS for multiple heavy metals and BOD. Spring SP4 (down-gradient of Site 3A) shows exceedances above EQS for

arsenic, nickel, BOD and ammonia and SP2 (down-gradient of Site 1) shows exceedances above EQS for lead, nickel, zinc and BOD. Spring SP5 shows an exceedance of the EQS for lead and orthophosphate in Round 1. In comparison to water quality of up-gradient groundwater, which showed elevated concentrations of ammonia and heavy metals, SP5 water quality is likely to be affected by a component some overland flow. Note the sampling was undertaken on a relatively wet period in March (2016). There is no detection of any other trace organic contaminants, hydrocarbons contaminants in the spring water samples with the exception of SP1.

The analytical results for Round 2 and Round 3 are characterised lower concentrations for potential contaminants of concern with fewer exceedances, most notably for heavy metals and absence of petroleum hydrocarbons. In Round 3 ammoniacal nitrogen concentrations did not exceed the analytical limit of detection.

The results for Round 1 provided some supporting evidence to suggest that springs characterised by the absence of tufa formation, the presence of in-channel ochre deposition and potential sheening were associated with spring water characterised by a of low pH and elevated heavy metal / ammoniacal nitrogen concentrations. However this relationship was not seen in subsequent monitoring rounds, with no systematic relationship between pH, contamination status and tufa formation observed.

4.6.6 Landfill Gas Monitoring Results

Gas monitoring was carried out on eighteen occasions between 7th March 2016 and 21st February 2017. The gas monitoring dataset is summarised on a site by site basis in the follow tables and time series charts. Atmospheric pressure during the monitoring events ranged from 983 to 1020mbar. Gas monitoring data is presented in Appendix J.

4.6.6.1 Site 1

In total ten boreholes were monitored for gas at Site 1, three onsite combined gas/leachate boreholes and seven offsite boreholes including six gas boreholes and one groundwater borehole.

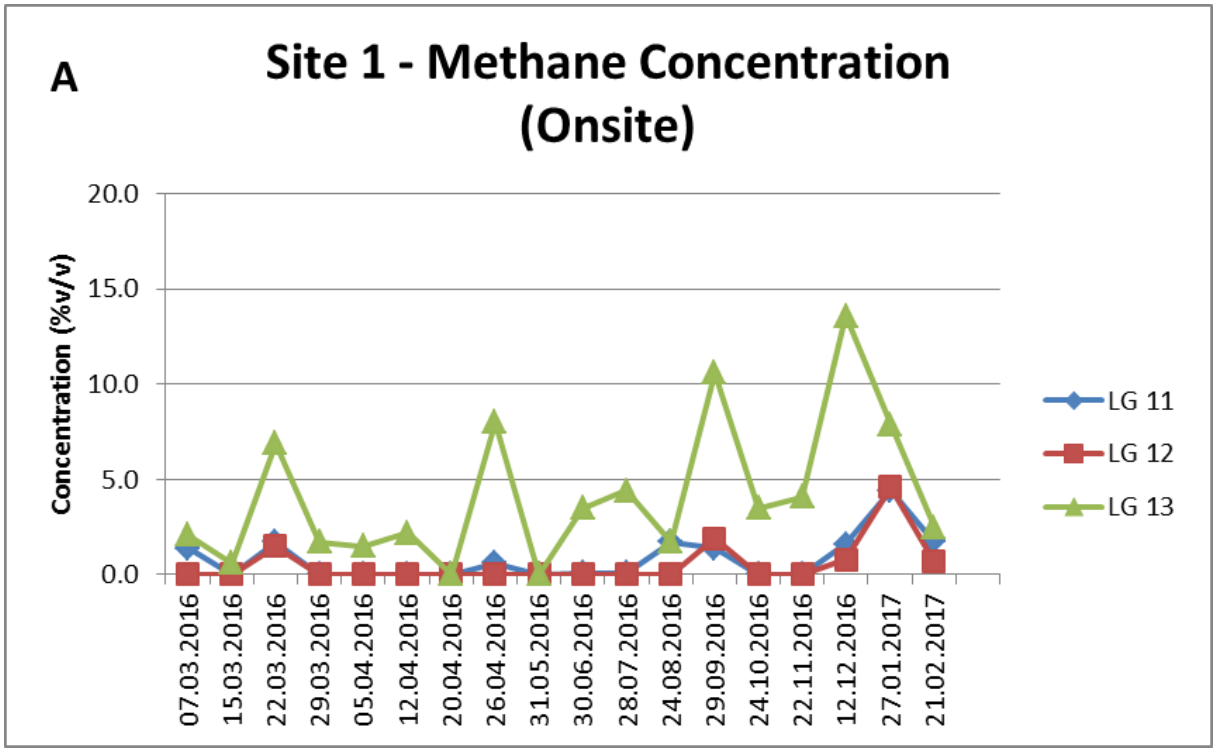
A summary of gas monitoring data for Site 1 is presented in **Table 4.35** below.

Table 4.43 – Site 1: Summary of Landfill Gas Monitoring Data

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow * (l/hr)	Water level (mbgl)	Range of atmospheric pressure (mbar)
Site 1							
Onsite							
LG11	In waste	18	0-4.4	0.1-11.7	0 – 0.4	dry -12.2	983-1020
LG12	In waste	18	0-1.5	0.1 - 18.9	0 – 2.8	dry	983-1020
LG13	In waste	18	0-13.6	2.0 – 18.7	0 = 4.0	8.7 - 9.5	983-1020
Offsite							
G06	No	18	11.0 – 23.9	3.2 - 8.1	0 - 3.5	dry	983-1020
G07	No	18	0	0 - 3.3	-3.2 - 6.9	dry	983-1020
G08	No	18	0	0 - 2.8	-3.7 – 6.3	dry	983-1020
G10	No	18	0	0.3 - 1.9	-1.5 – 3.1	dry - 9.2	983-1020
G18	No	18	0	0 – 2.5	-3.2 - 0.3	dry – 8.0	983-1020
G19	No	18	0	0.2 - 2.0	-0.1 – 0.6	dry - 7.9	983-1020
BH05	No	18	0	0 - 5.9	0 - 9.0	dry - 20.7	983-1020
* only 7 monitoring rounds for flow as flow tube damaged for monitoring on 7-8th March							

The gas monitoring data is presented graphically in Chart 4.1 and Chart 4.2.

Chart 4.1 – Site 1 Methane Concentrations



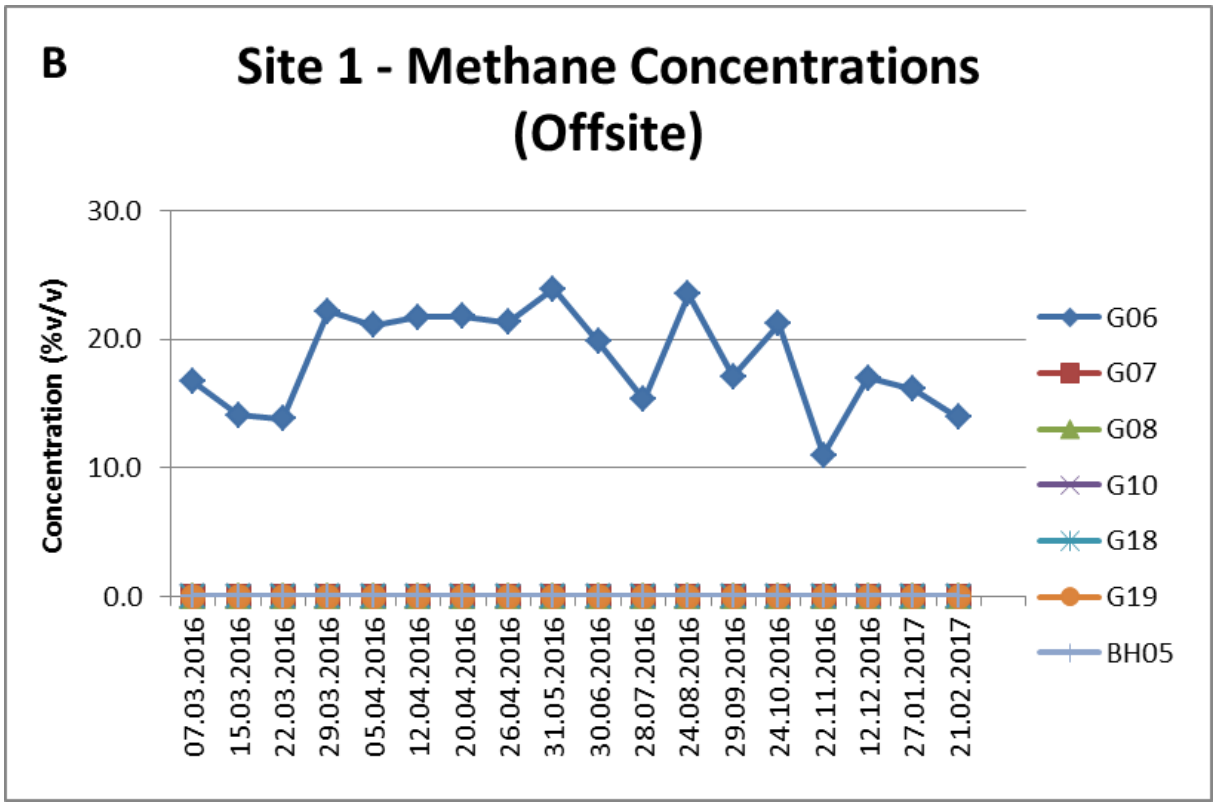
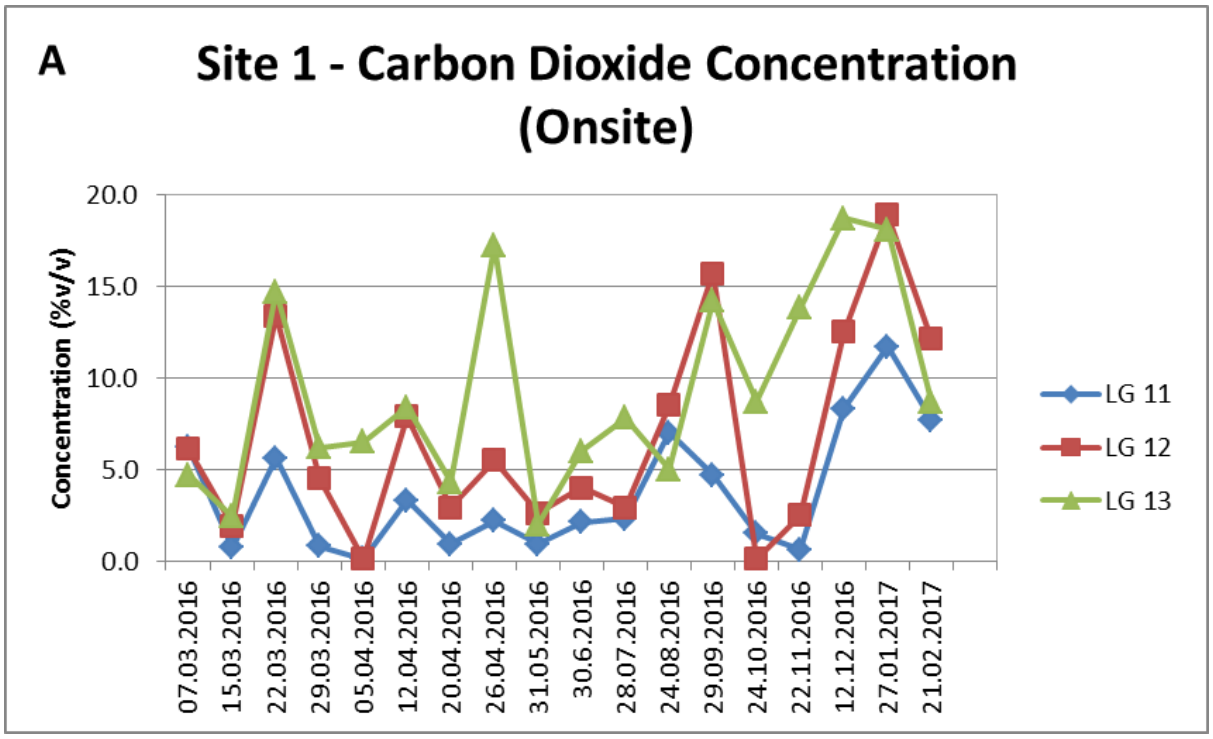
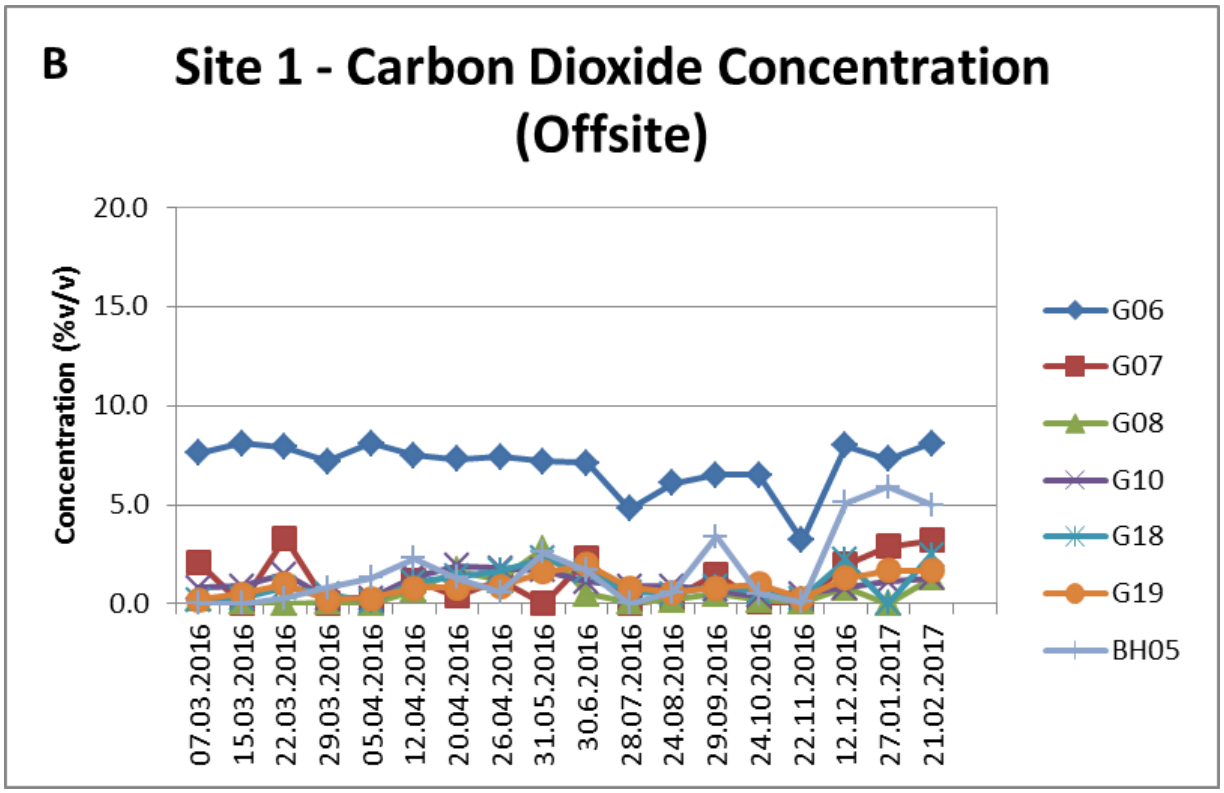


Chart 4.2 – Site 1 Carbon Dioxide Concentrations





Summary of Site 1 Gas Conditions Onsite

The gas monitoring data collected from onsite monitoring boreholes at Site 1 recorded methane concentrations up to 13.6% v/v and carbon dioxide concentrations up to 18.9% v/v. The observed conditions encountered during site investigation indicate Site 1 predominantly comprises construction and demolition (C&D) waste with some municipal waste.

There is some suggestion of possible increasing methane and carbon dioxide concentrations within the waste mass on Site 1. Flows are typically very low and do not exceed 4.0 l/hr in any borehole suggesting low surface emission rates.

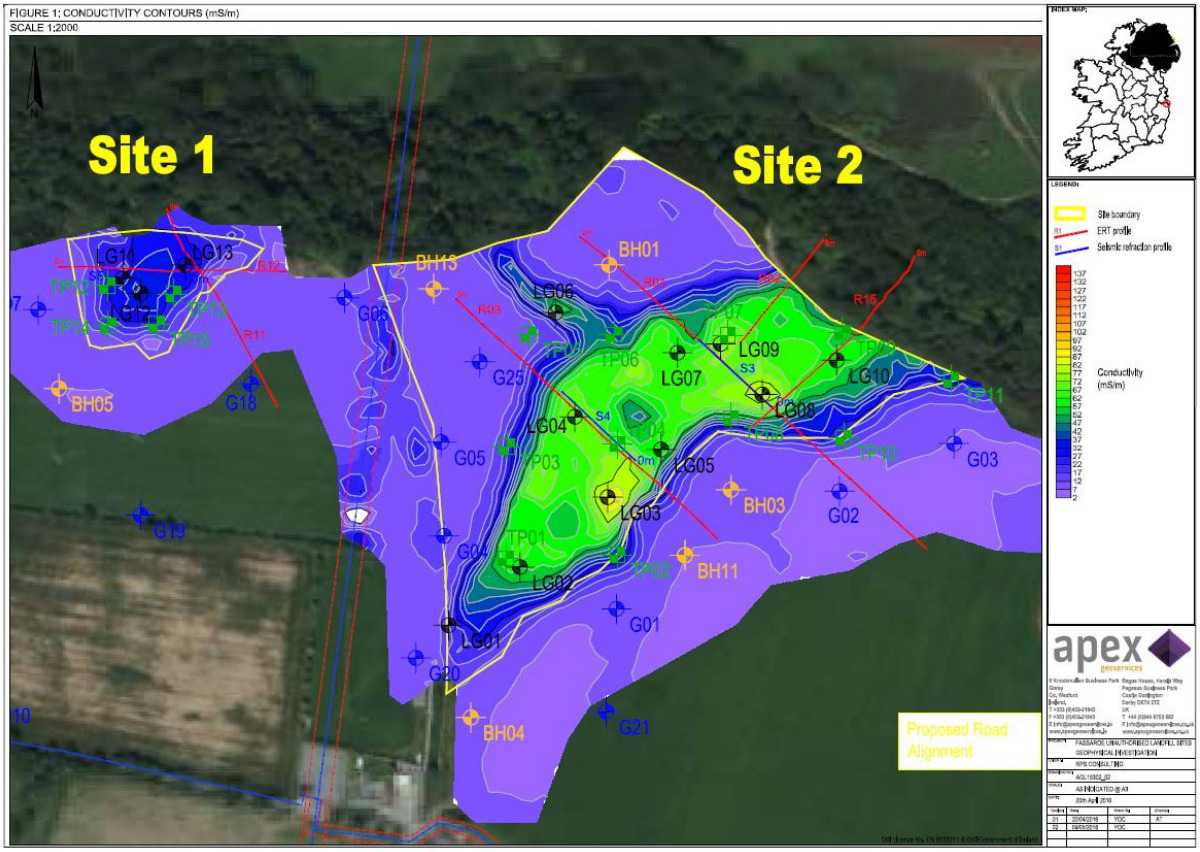
Summary of Site 1 Gas Conditions Offsite

With the exception of G06 methane concentrations in off-site boreholes are zero and carbon dioxide concentrations low, typically below 3.0 % v.v. In contrast G06 has elevated methane concentrations of 11 to 23.9% v/v and carbon dioxide concentration of 3.2 to 8.1 % v.v. Monitoring point G06 is located immediately to the west of the existing 33" water main which runs in a north south direction.

On review of site investigation data it is noted that elevated Electrical Conductivity (EC) has been recorded within the vicinity of G06. This appears to correspond to the backfilling activities associated with the water main routing in this area, as shown in **Figure 16** below taken from the geophysical survey (Appendix C).

The methane concentrations recorded at G06 are significantly higher than those recorded at the initially perceived source (worst case) location i.e. within Site 1, and may therefore be reflective of a separate gassing regime associated with the made ground/backfill surrounding the water main.

Figure 16 Site 1 and 2 Conductivity Contours (extract from Apex Geophysical Survey)



4.6.6.2 Site 2

A total of twenty seven (27) boreholes were monitored for gas at Site 2 which included ten (10) onsite combined gas/leachate boreholes, seventeen (17) offsite boreholes comprising twelve (12) gas boreholes and five (5) groundwater monitoring boreholes.

A summary of gas monitoring data collected during the monitoring period is presented in **Table 4.36** below.

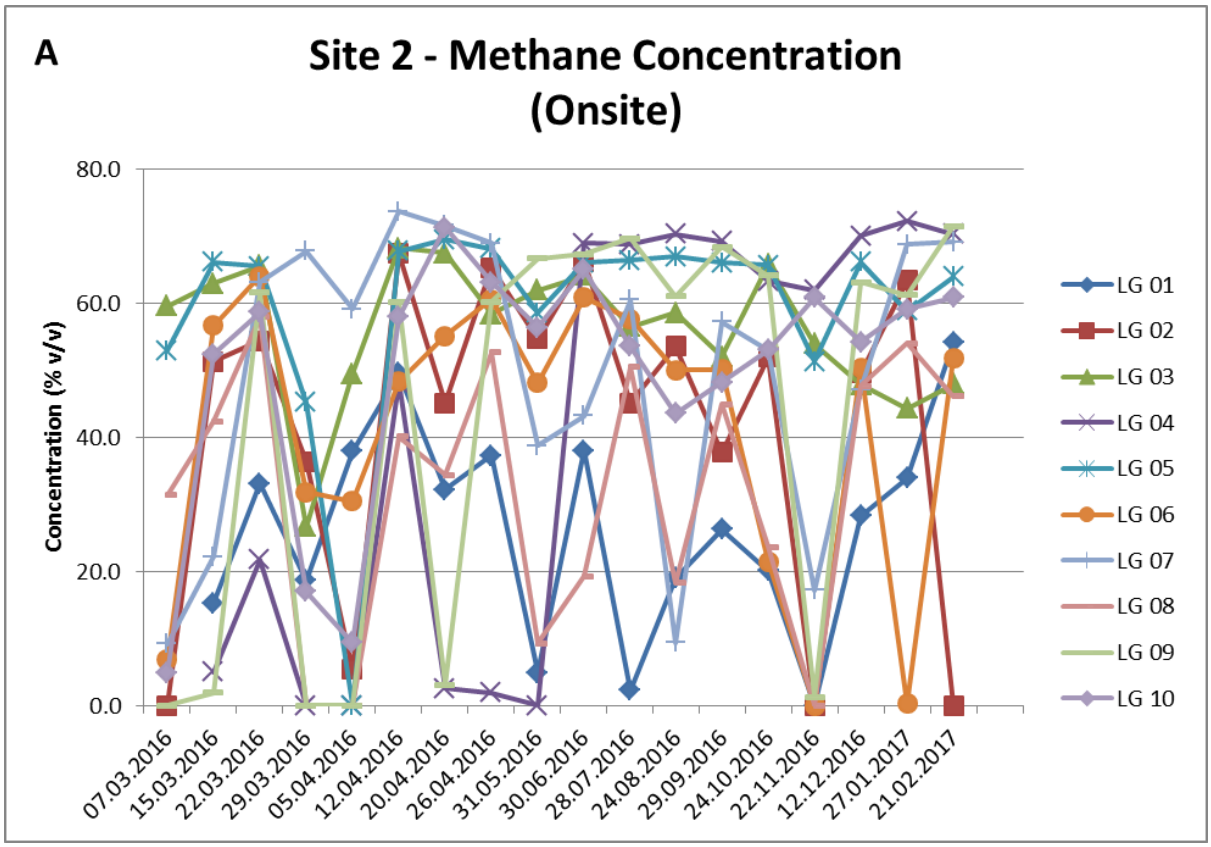
Table 4.44 – Site 2: Summary of Landfill Gas Monitoring Data

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow * (l/hr)	Water level***(mbgl)	Range of atmospheric pressure (mbar)
Site 2							
Onsite							
LG01	In waste	17	0.0-54.1	0.4-22.0	-0.6 to 2.5	3.7-3.95	983-1020
LG02	In waste	18	0-67.4	0-29.8	-2.5 to 7.0	7.95-8.33	983-1020
LG03	In waste	18	26.6-68.2	11.7-29.7	-1 to 4.3	12.65-15.67	983-1020
LG04	In waste	18	0-72.2	0-27.7	-5.2 to 7.6	11.76-12.29	983-1020
LG05	In waste	18	0-69.5	0-36.1	-6.2 to 7	12.56-13.85	983-1020
LG06	In waste	18	0-64	0.3-30.3	0-3.3	6.11-6.18^	983-1020
LG07	In waste	18	9.4-73.7	2.2-26.6	-0.3 to 3.9	1.95-11.20	983-1020
LG08	In waste	18	0-57.9	0-36.6	-3.1 to 4.6	dry-7.65	983-1020
LG09	In waste	18	0-71.5	0-24.4	-6.6 to 6.0	9.26-11.36	983-1020
LG10	In waste	18	4.8-71.3	2.3-27.9	-1.2-4.8	11.95-17.25	983-1020
Offsite							
G01	No	18	0-8.0~	0-4.9~~	-15.9 to 3.8	dry	983-1020
G02	No	18	0-0.1	0-9.5	-3.3 to 5.0	dry	983-1020
G03	No	18	0-4.9	0-17.2	-5.3 to 4.7	dry^	983-1020
G04	No	18	0	0-2.6	-0.3 to 0.1	1.84 - 9.13	983-1020
G05	No	18	0-55.7	0-8.1	-4.2-6.3	15.93 - 16.33	983-1020
G13	No	18	0	0-1.4	-8.2 to 6.4	dry	983-1020
G20	No	18	0-0.1	0-1.1	-10.9 to 13.6	14.14 - 16.3	983-1020
G21	No	18	0	0.1-2.2	-7.6 to 5.8	dry	983-1020
G22	No	18	0	0-2.5	-2.7 to 19.8	9.09 - 9.24^^	983-1020
G23	No	18	0	0-1.5	-10.3 to 3.4	dry to 17.25^^^	983-1020
G24	No	18	0	0-1.6	-15.9 to 10.5	dry	983-1020
G25	No	18	0-55.3	0-11.6	-0.3 to 9.0	dry	983-1020
BH01	No	18	0	0-4.8	-0.4 to 3.4	13.9 - 14.62	983-1020
BH03	No	18	0-8.6	0-15.4	-9.3 to 10.2	dry	983-1020
BH04	No	18	0	0-2.0	-18.6 to 10.8	dry	983-1020
BH11	No	18	0-16.3	0-16.5	-14.1 to 7.2	dry	983-1020
BH13	No	18	0-21.7	0.1-9.5	-0.2 to 4.7	dry	983-1020

~ Single reading of 45.4
~~ Single reading of 25.5

The gas monitoring data is presented graphically in Chart 4.3 and Chart 4.4.

Chart 4.3 – Site 2 Methane Concentrations



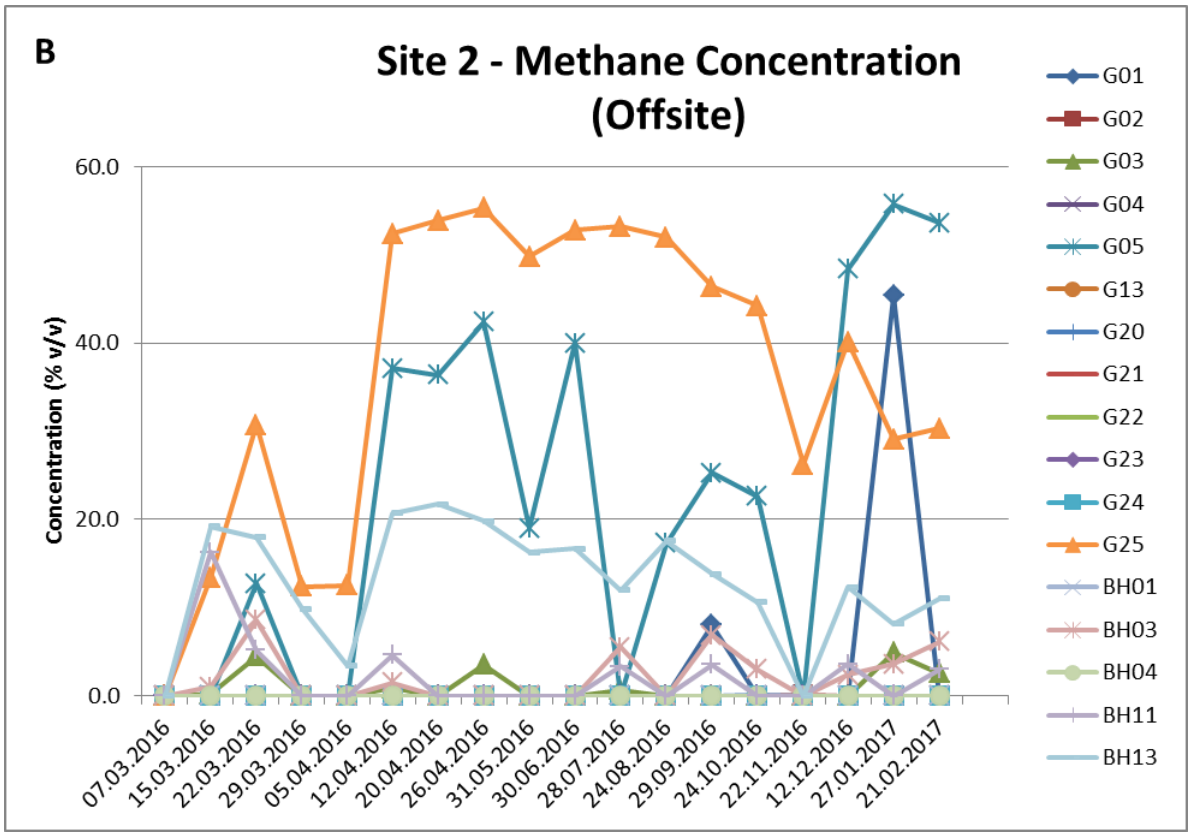
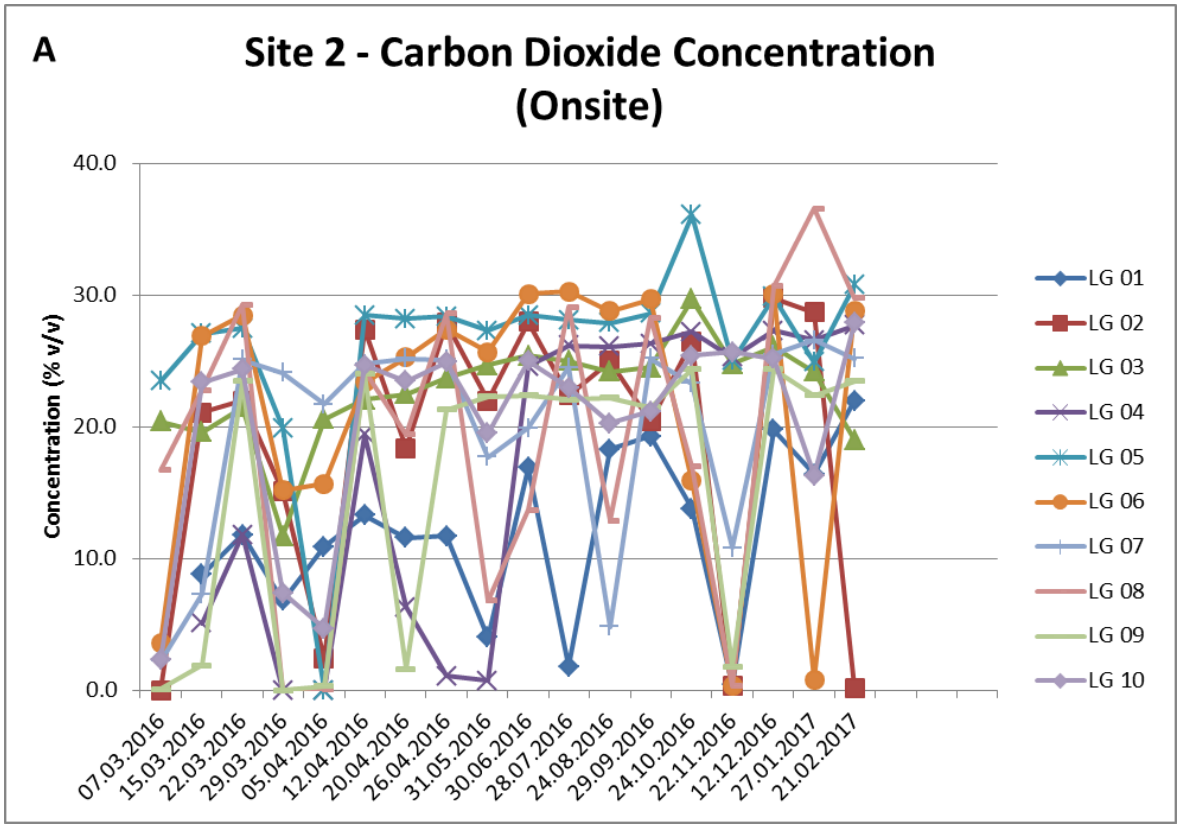
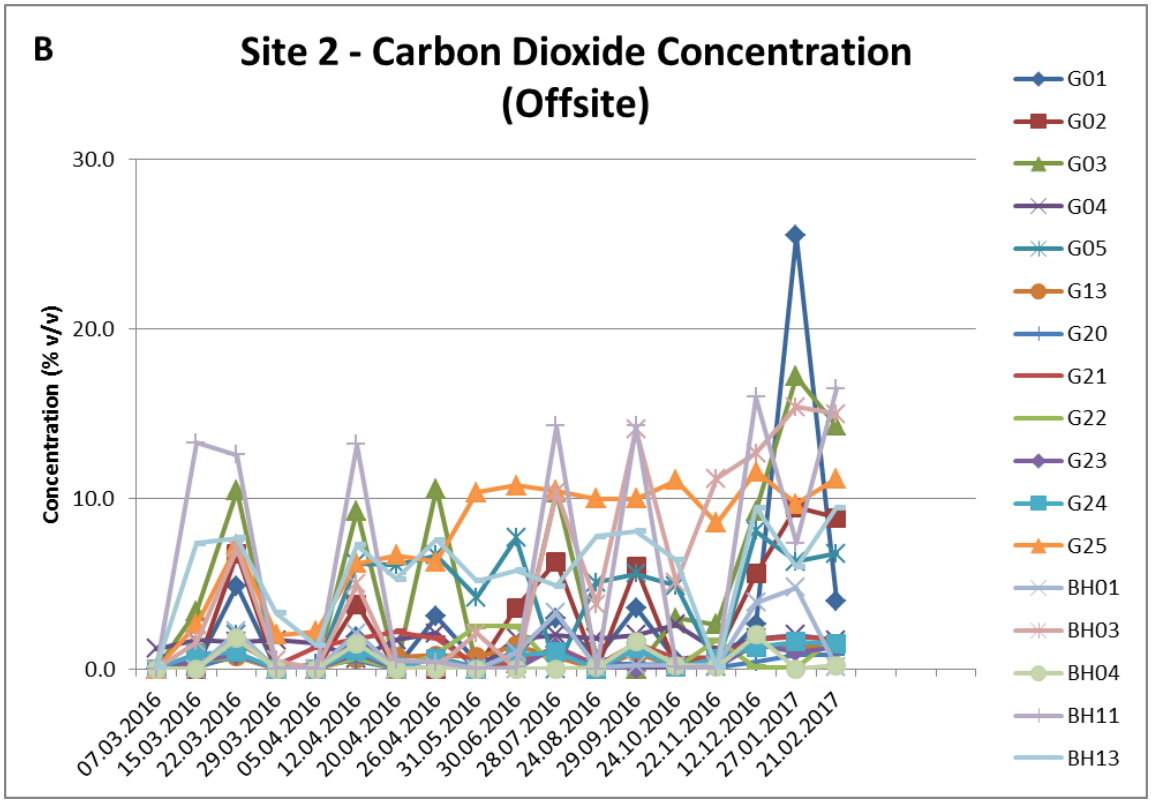


Chart 4.4 – Site 2 Carbon Dioxide Concentrations


A
Site 2 - Carbon Dioxide Concentration (Onsite)
Concentration (% v/v)
40.0
30.0
20.0
10.0
0.0
07.03.2016
15.03.2016
22.03.2016
29.03.2016
05.04.2016
12.04.2016
20.04.2016
26.04.2016
31.05.2016
30.06.2016
28.07.2016
24.08.2016
29.09.2016
24.10.2016
22.11.2016
12.12.2016
27.01.2017
21.02.2017
LG 01
LG 02
LG 03
LG 04
LG 05
LG 06
LG 07
LG 08
LG 09
LG 10


B
Site 2 - Carbon Dioxide Concentration (Offsite)
Concentration (% v/v)
30.0
20.0
10.0
0.0
07.03.2016
15.03.2016
22.03.2016
29.03.2016
05.04.2016
12.04.2016
20.04.2016
26.04.2016
31.05.2016
30.06.2016
28.07.2016
24.08.2016
29.09.2016
24.10.2016
22.11.2016
12.12.2016
27.01.2017
21.02.2017
G01
G02
G03
G04
G05
G13
G20
G21
G22
G23
G24
G25
BH01
BH03
BH04
BH11
BH13

Summary of Site 2 Gas Conditions Onsite

The gas monitoring data collected for onsite monitoring locations within Site 2 over the complete monitoring period recorded methane concentrations ranging from no detections to 73.7% v/v and carbon dioxide concentrations ranging from no detection to 36.6% v/v. Methane concentrations are consistently elevated with peak readings in excess of 60% v/v in LG02, LG03, LG05, LG06, LG07, LG09 and LG10. Flow rates are extremely variable ranging from -6.2 to +7.6 l/hr.

Summary of Site 2 Gas Conditions Offsite

The gas monitoring data collected for offsite monitoring locations generally recorded no detections or very low methane concentrations in the majority of monitoring locations (G02, G04, G13, G20-24, BH01 and BH04). The notable exceptions are G25, G05 and BH13 where methane concentrations range from zero up to 55.3, 55.7 and 21.7 % respectively. It notable that methane concentrations recorded at the 3 location typically increase after 5th April 2016.

Offsite carbon dioxide concentrations are extremely variable ranging from 0 to 16.5 % v/v, but are elevated on occasions at most offsite monitoring locations. Sustained elevated concentrations are characteristic of G25 and BH13 (the latter located between the existing 33" water main and Site 2).

Flow rates are correspondingly variable, ranging between -16 l/hr to +19.8 l/hr.

4.6.6.3 Site 3A

A total of ten (10) boreholes were monitored for gas at Site 3A; five onsite comprising three combined gas/leachate boreholes and two existing boreholes, five offsite comprising two gas boreholes and three groundwater boreholes.

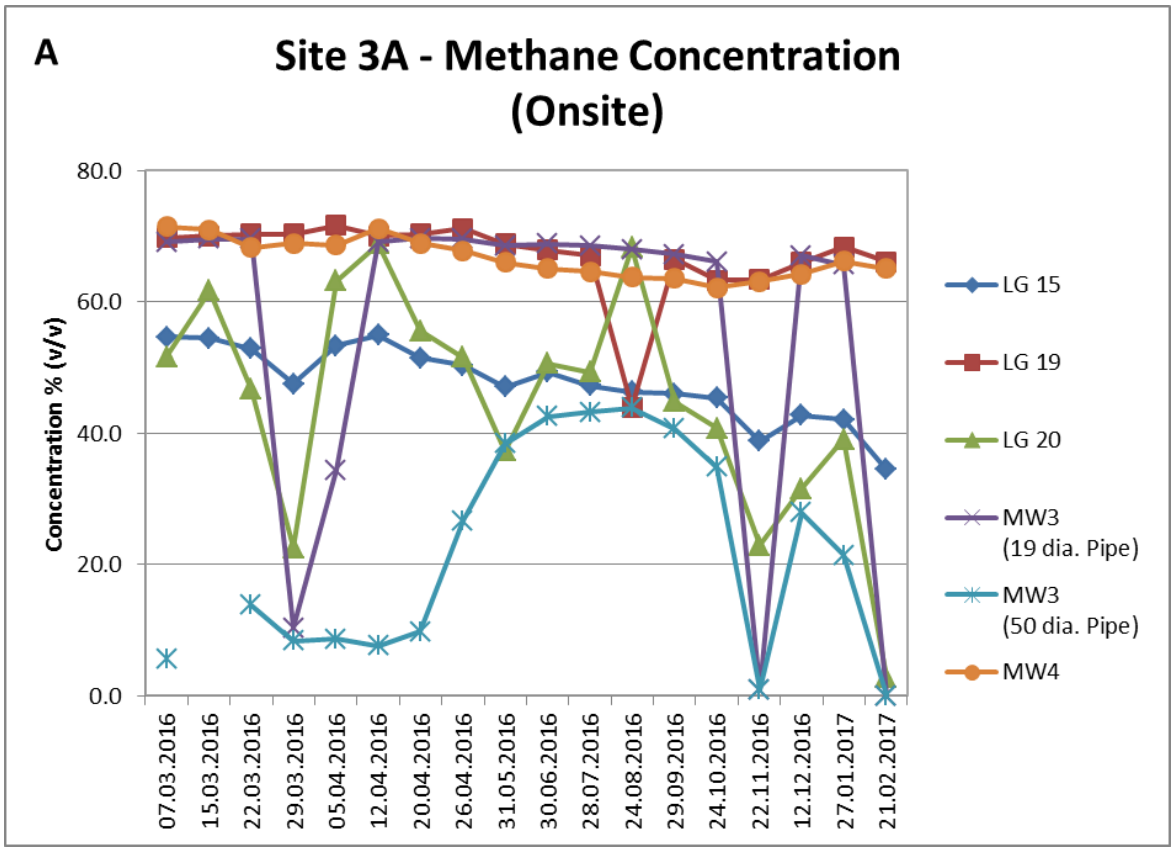
A summary of gas monitoring data is presented in **Table 4.37** below.

Table 4.45 – Site 3A: Summary of Landfill Gas Monitoring Data – Onsite & Offsite

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow * (l/hr)	Water level (mbgl)	Range of atmospheric pressure (mbar)
Site 3A							
Onsite							
LG15	In waste	18	34.5 - 55	19.4-26.8	0-5.8	6.47-6.97^	983-1020
LG19	In waste	18	44.0 - 71.7	21.7-35.9	0-45	6.19-14.3^	983-1020
LG20	In waste	18	2.8 - 68.9	4.3-33.1	-1.3 to 26.5	dry	983-1020
MW3 (19mm) **MW3 (50mm)**	In waste	18	0-69.7 0-43.9	0-32.9 0.1-14.4	0-1.5 -0.3 to 4.9	5.95-15.31	983-1020
MW4	In waste	18	62.2-71.5	28.5-37.0	-0.8-43.0	5.9-6.65^	983-1020
Offsite							
G12	No	18	0	0-1.9	0-1.4	10.03-10.65^	983-1020
G14	No	18	0	0.8-2.1	0-1.3	7.32-7.73^	983-1020
BH07	No	18	0	0-1.4	-0.1 to 1.6	13.45-13.87^	983-1020
BH09	No	18	0	0.1-2.3	-0.2 to 1.6	6.26-6.79^	983-1020
BH10	No	18	0	0.1-3.2	-0.3 to 1.6	8.23-8.53^	983-1020

The gas monitoring data is presented graphically in Chart 4.5 and Chart 4.6.

Chart 4.5 – Site 3A Methane Concentrations



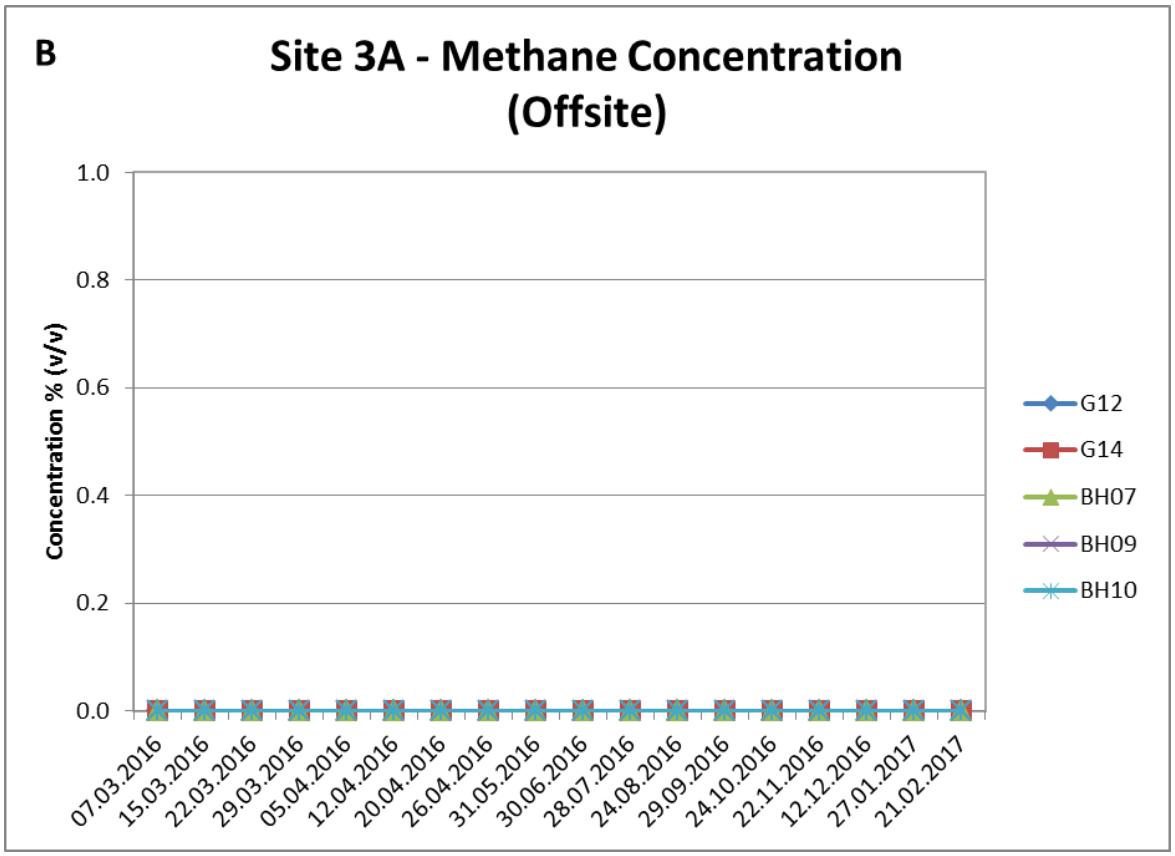
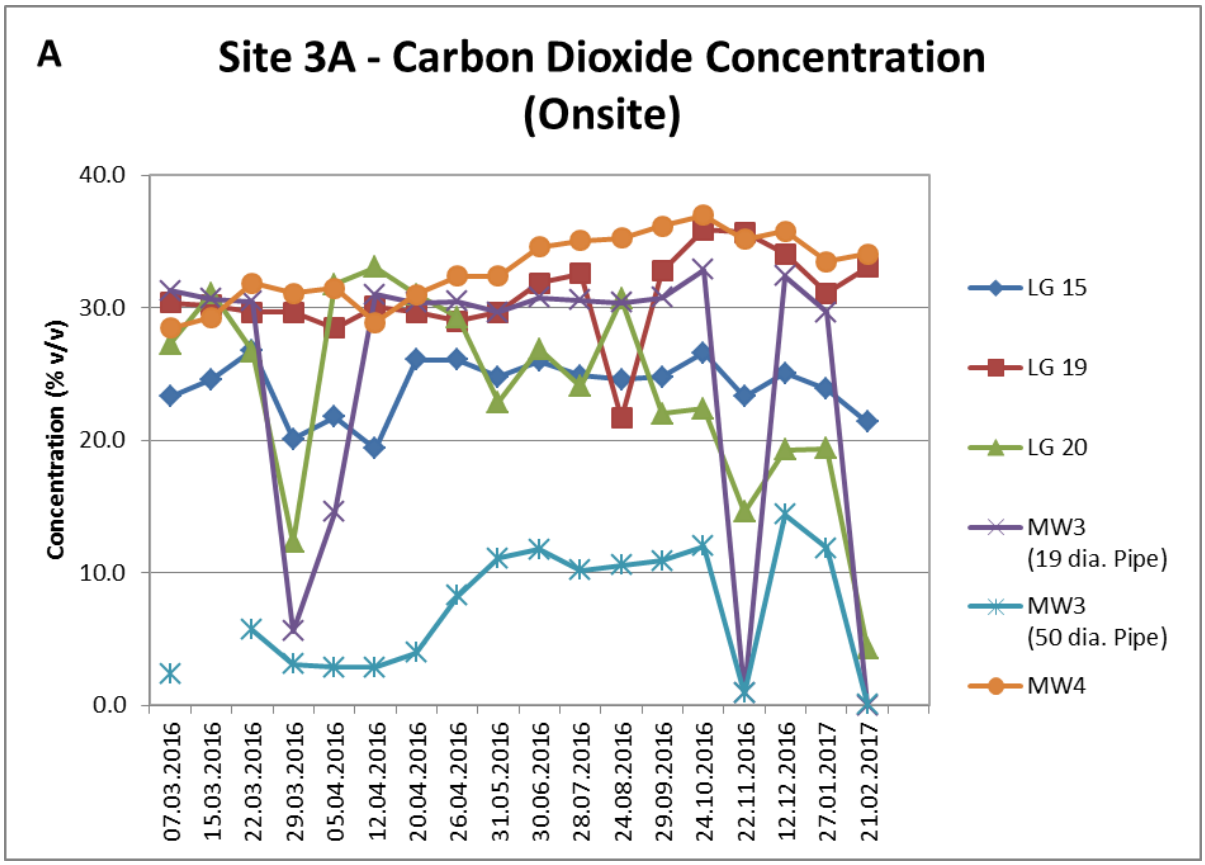
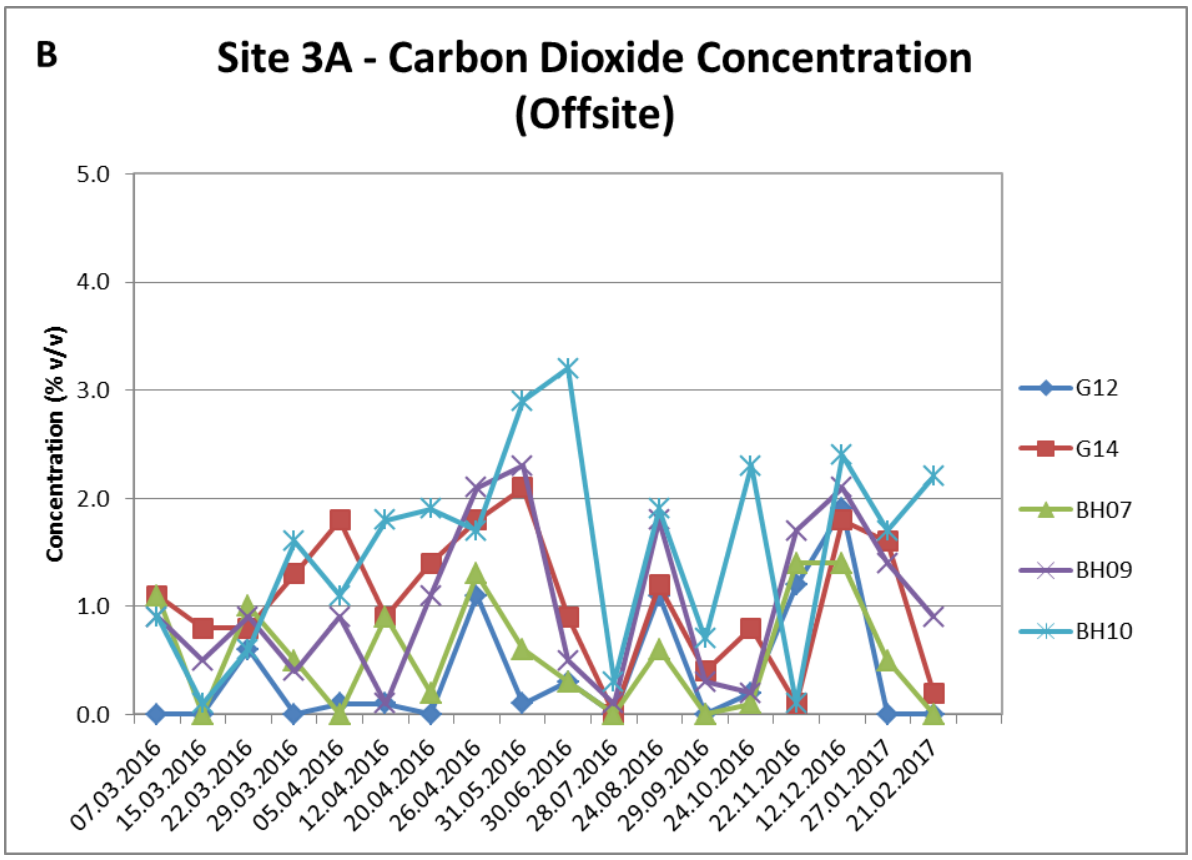


Chart 4.6 – Site 3A Carbon Dioxide Concentrations





Summary of Site 3A Gas Conditions Onsite

The gas monitoring data collected at onsite monitoring boreholes recorded methane concentrations ranging from 0% v/v to 71.7% v/v with carbon dioxide concentrations ranging from 0% v/v to 37% v/v. The lowest gas concentrations were observed at the dual installation within MW3. All other in-waste boreholes demonstrate methane and carbon dioxide concentrations above zero. MW3 is a 19 or 25mm diameter historic standpipe installed within the waste horizon, with the 50mm standpipe is installed within the underlying sands and gravels. Removing MW3 from the dataset provides a more consistent range of results with methane concentrations between. Typically methane concentrations are elevated between 30 and 70 % v/v. Similarly carbon dioxide concentrations are continuously elevated between 20 and 30 % v/v.

Flow rates are extremely variable, although high flow rates typically in excess of 30l/hr have been recorded at all in-waste boreholes. The results of the flow readings are considered to be consistent with a waste mass that is still degrading in pockets or 'hot spots' of the landfill. This is producing large volumes of gas under pressure driven, advective flow conditions.

Summary of Site 3A Gas Conditions Offsite

The gas monitoring data collected at offsite monitoring locations did not record any methane detections during the course of the monitoring period and carbon dioxide concentrations ranging from no detection to 3.2% v/v.

Flow rates in boreholes located outside the landfill body have remained consistently low, typically below 1.6 l/hr.

4.6.6.4 Site 3B

A total of seven (7) boreholes were monitored for gas at Site 3B; three (3) onsite combined gas/leachate boreholes and four (4) offsite boreholes comprising three gas boreholes and one groundwater borehole.

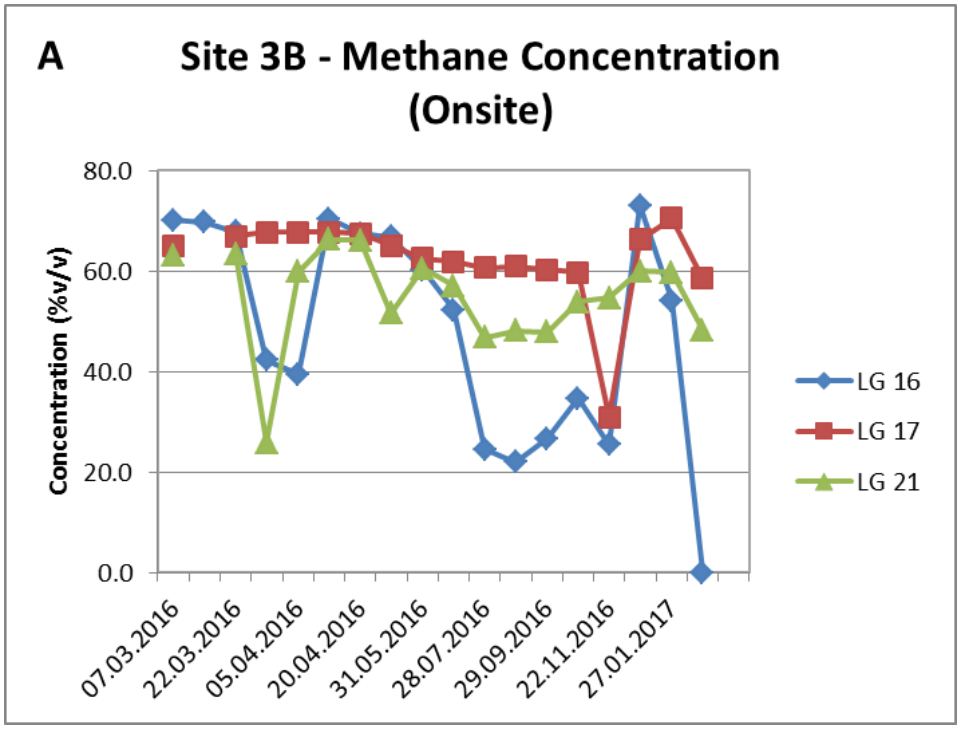
A summary of gas monitoring data is presented in **Table 4.38** below.

Table 4.46 – Site 3B: Summary of Landfill Gas Monitoring Data – Onsite & Offsite

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow * (l/hr)	Water level (mbgl)	Range of atmospheric pressure (mbar)
Site 3B							
Onsite							
LG16	In waste	18	22.0-73.1~	19.5-34.7~	0 to 3.3	3.11-3.19	983-1020
LG17	In waste	18	30.9-70.5	19.9-39.4	-0.1 to 6.2	3.14-3.29***	983-1020
LG21	In waste	18	25.8-66.2	17.2-37.4	0 to 2.5	dry***	983-1020
Offsite							
G15	No	18	0	0.8-3.6	0 to 1.3	dry - 5.07	983-1020
G16	No	18	0-2.1	0.7-3.3	-0.5 to 0.1	3.7-3.97	983-1020
G17	No	18	0	0.1-3.2	0 to 2.2	dry-4.05	983-1020
BH08	No	18	0	0.0-4.2	-1 to 1.4	6.46-7.47	983-1020
~ single anomalous reading of zero in final round							

The gas monitoring data is presented graphically below:

Chart 4.7- Site 3B Methane Concentrations



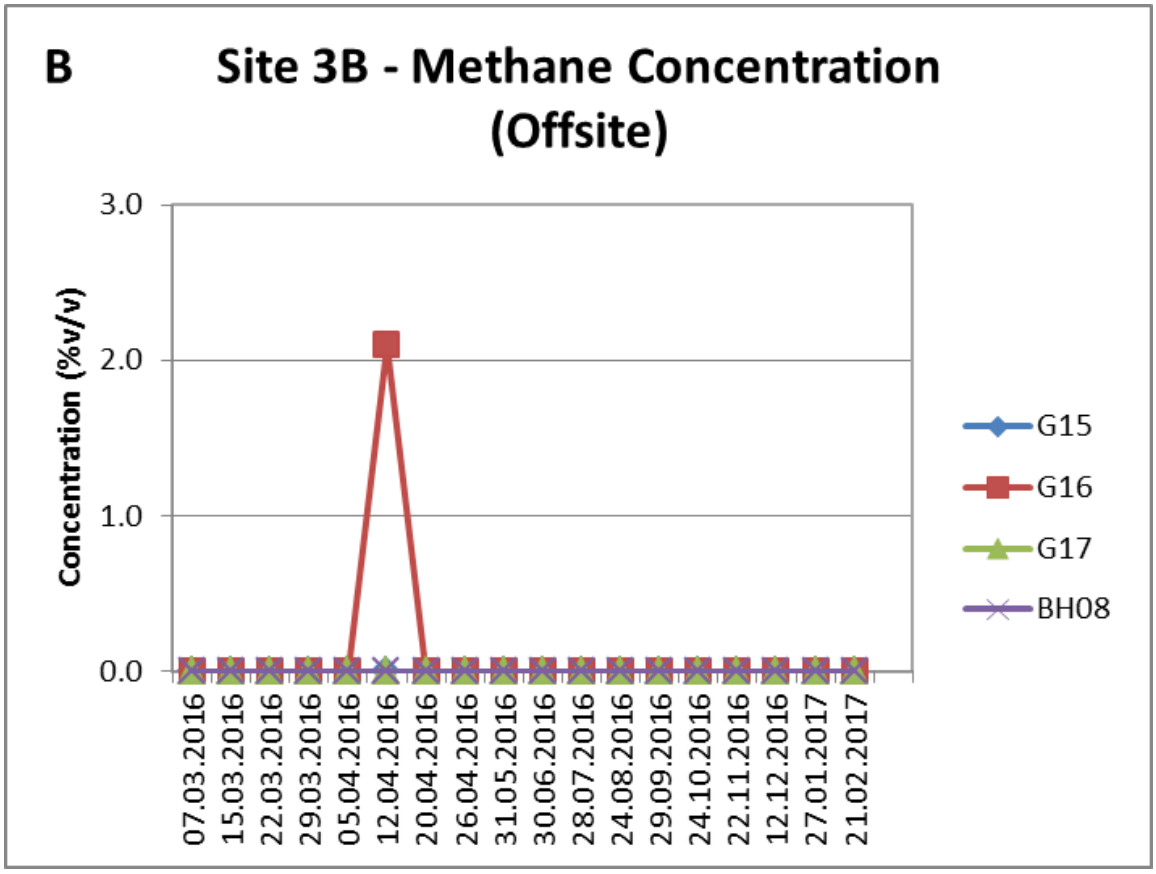
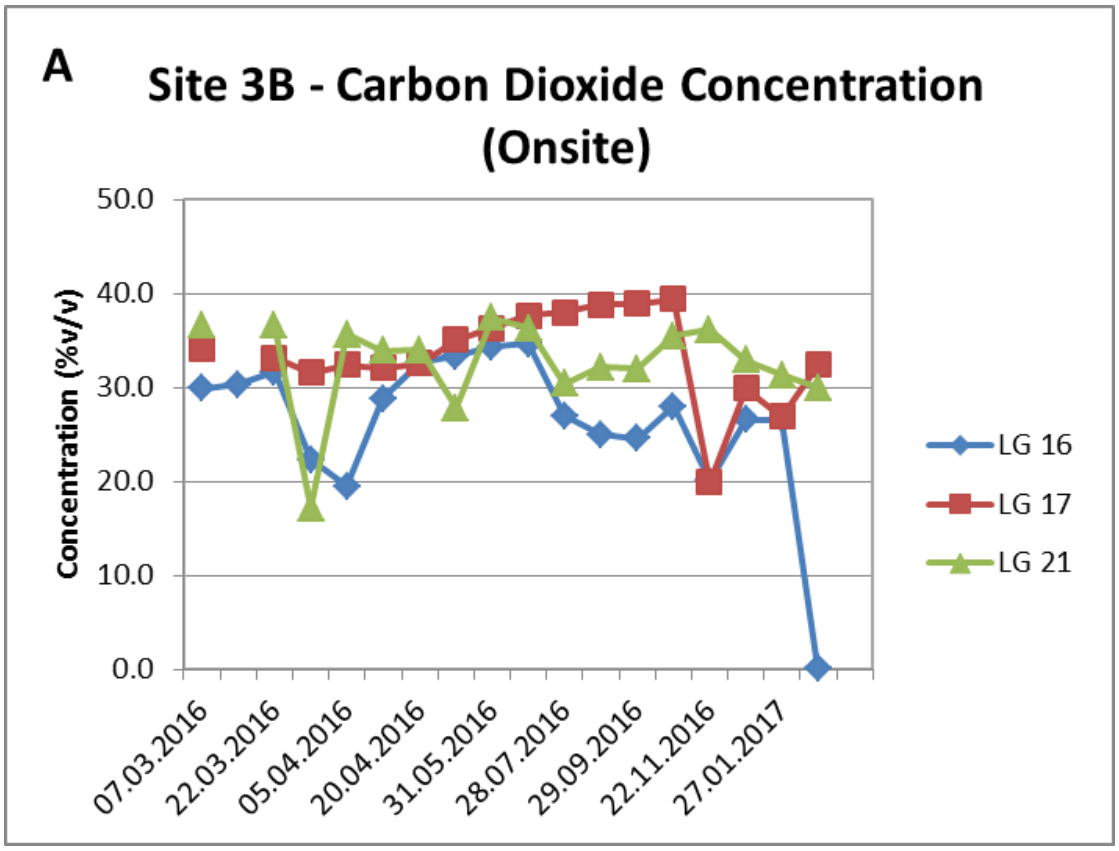
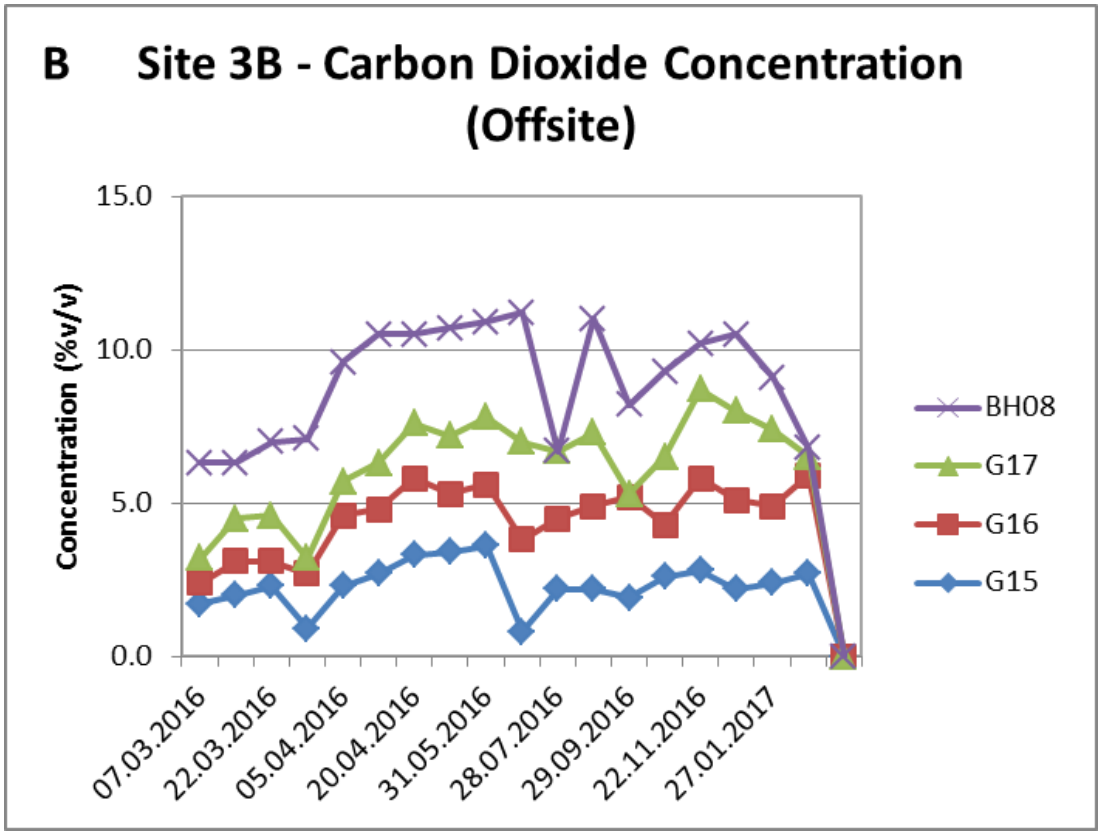


Chart 4.8 – Site 3B Carbon Dioxide Concentrations





Summary of Site 3B Gas Conditions Onsite

The gas monitoring data collected at onsite monitoring locations recorded consistently elevated methane concentrations ranging from 22.0% v/v to 73.1% v/v and carbon dioxide ranging from 17.2% v/v and 39.3% v/v. No measureable flow rate was recorded during several monitoring periods with peak reading of 3.3l/hr, 6.2l/hr and 2.5l/hr recorded at LG16, LG17 and LG21 respectively.

Summary of Site 3B Gas Conditions Offsite

The gas monitoring data collected at offsite monitoring locations recorded no methane detections with the exception of one monitoring period at G16 (2.1% v/v on the 12/4/2016). Carbon dioxide concentrations ranged from 0.5% v/v to 4.2% v/v. Flow rates are typically low, albeit variable ranging from -0.5 l/hr to 2.2 l/hr.

4.6.6.5 Site 3C

A total of six boreholes were monitored for gas at site 3C; three onsite boreholes comprising two combined gas/leachate boreholes and one historic borehole and three (3) offsite boreholes comprising two gas boreholes and one groundwater borehole.

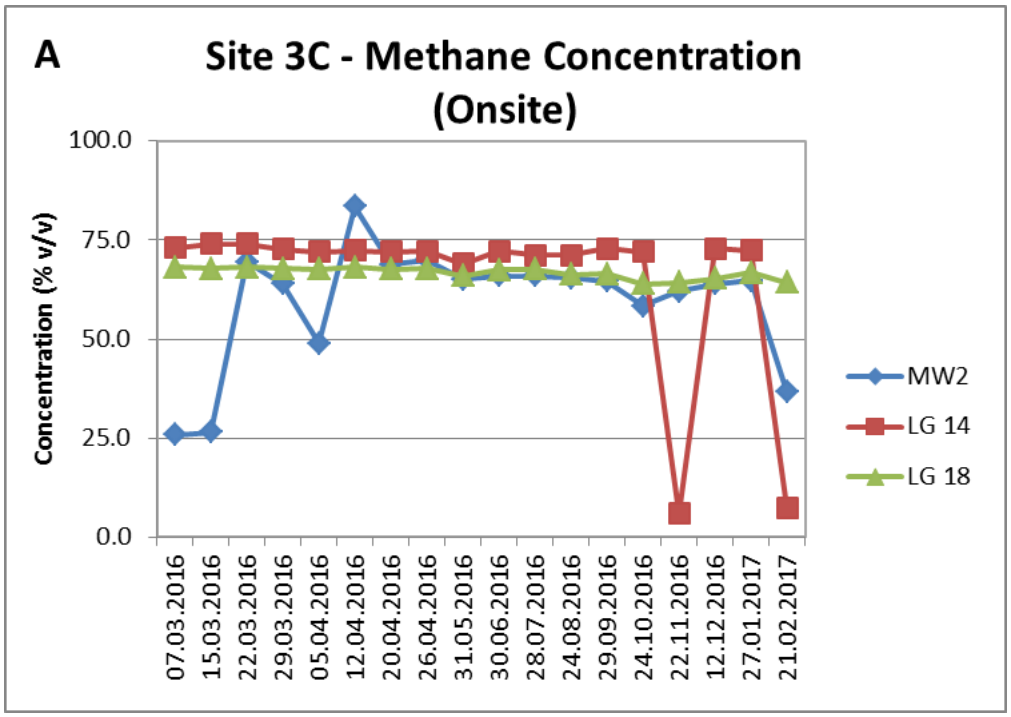
A summary of gas monitoring data is presented in **Table 4.39**.

Table 4.47 – Site 3C: Summary of Landfill Gas Monitoring Data – Onsite & Offsite

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow * (l/hr)	Water level**(mbgl)	Range of atmospheric pressure (mbar)
Site 3C							
Onsite							
MW2	In waste	18	25.8-83.5	7.3-37.2	-2.2 to 11.7~	3.31-4.34	983-1020
LG14	In waste	18	5.9-74.1	4.1-28.2	-0.1 to 1.9	9.11-10.07	983-1020
LG18	In waste	18	63.9-68.2	31.7-35.3	0.0 to 1.2	9.44-9.58	983-1020
Offsite							
G09	No	18	0.0-18.6	0-14.8	0 to 3.1	11.99-12.47	983-1020
G11	No	18	0.0 – 0.1	0-2.7	-0.1 to 1.2	9.64-9.99	983-1020
BH06	No	18	0.0-22.2	0.3-19.6	0 to 0.9	5.41-5.66	983-1020
~ single anomalously high reading of 11.7							

The gas monitoring data is presented graphically in Chart 4.9 and Chart 4.10.

Chart 4.9 – Site 3C Methane Concentrations



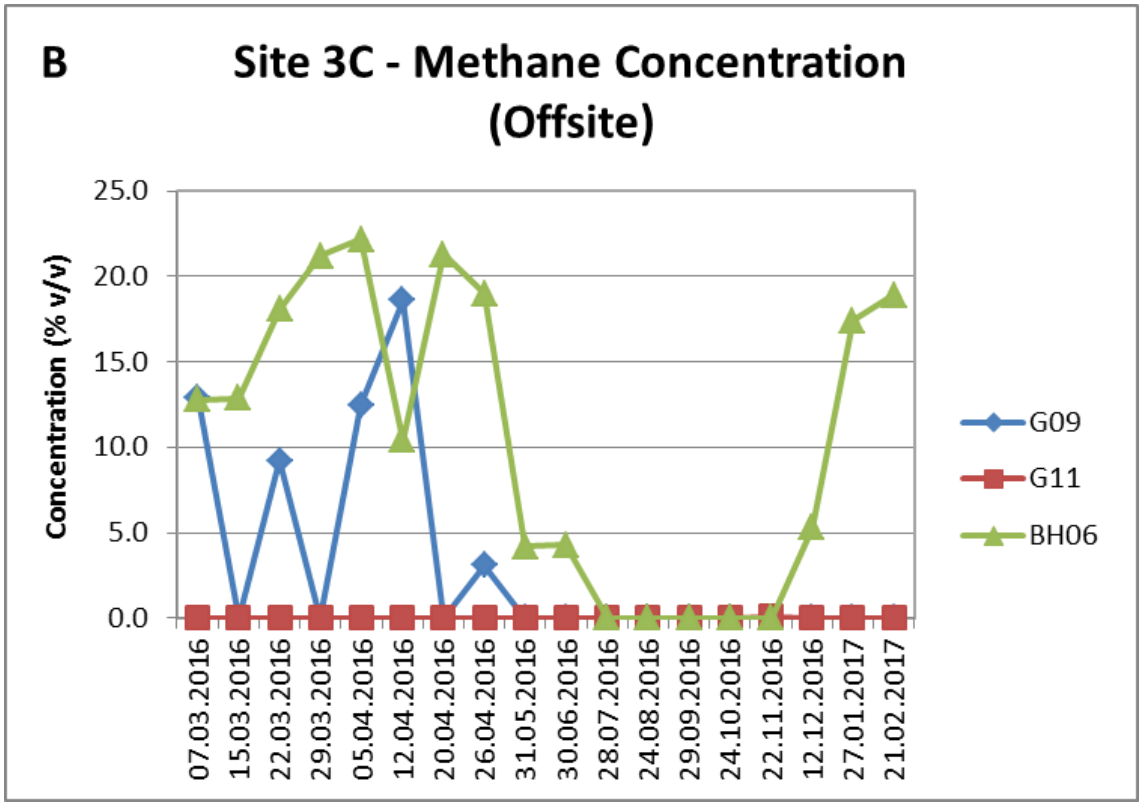
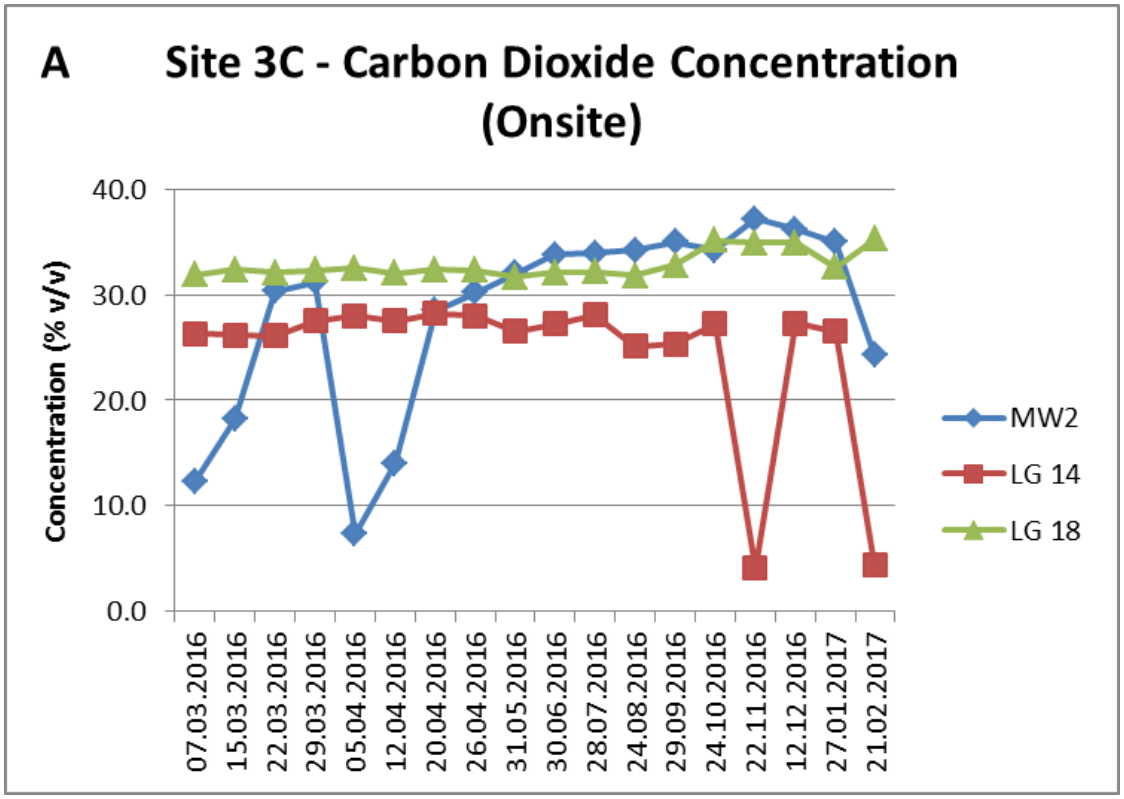
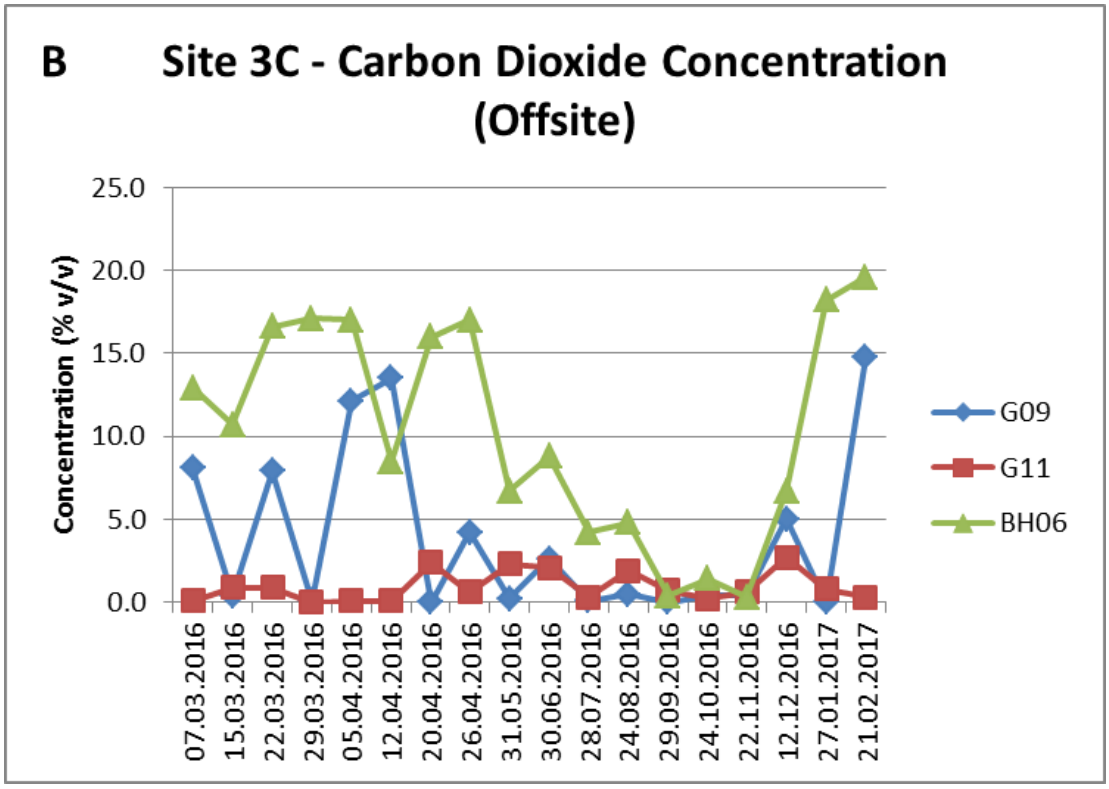


Chart 4.10- Site 3C Carbon Dioxide Concentrations





Summary of Site 3C Gas Conditions Onsite

The gas monitoring data collected from onsite monitoring locations recorded methane concentrations ranging from 5.9% v/v to 83.5% v/v with carbon dioxide concentrations ranging from 4.1% v/v to 37.2% v/v. Methane concentrations are typically stable with a concentration between 60% v/v and 75% v/v. Similarly the carbon dioxide concentrations typically exceeds 25%. Flow readings are typically low (i.e. below 2 L/hr) with the exception of 11.7l/hr recorded at MW2 on 12/04/2016. The elevated gas concentrations are consistent with an actively gassing municipal landfill.

Summary of Site 3C Gas Conditions Offsite

The monitoring of offsite monitoring locations recorded methane concentrations ranging from no detectable concentration to of 22.2% v/v and carbon dioxide concentrations ranging from no detectable concentration to 19.6% v/v. Methane concentrations show significant variability with absence of methane at all locations between July and November 2016. This variability is also seen with carbon dioxide, although non-zero concentrations are typically observed over this period. No measureable flow was recorded with the exception of 0.4l/hr in G09 and 0.3l/hr in BH06 on 05.04.2016.

G11 located to the west of the site did not record any detectable concentrations of methane for the duration of the monitoring period. G09 and BH06 are located to the east and south of the historic landfill however it should be noted that they are located in close proximity to the lateral extent of the waste body and not c.20m from the waste extent as proposed by best practice. Access was restricted within these locations due to ownership restrictions and minimisation of impact to local crops. Borehole logs for G09 and BH06 did not record the presence of any waste however these monitoring locations could be considered peripheral rather than offsite perimeter locations.

5 TIER 3 REFINEMENT OF CSM AND QUANTITATIVE RISK ASSESSMENT

5.1 REFINEMENT OF CONCEPTUAL SITE MODEL

Following the completion of the Tier 2 Investigation and Testing, a refined CSM was prepared for each site and is summarised in the cross sections provided in **Figure 20** to **23**, with the position of each conceptual cross section shown in **Figure 17**. The refined CSM is based on the Tier 1 information (i.e. regional geological and hydrogeological data from the GSI) and results of the site investigation and associated environmental monitoring (i.e. dataset for trial pits, boreholes, geophysical survey, quality data and groundwater levels).

5.1.1 Local Hydrogeological Setting

All five waste bodies are situated within a thick sequence of sand and gravel deposits that form the principal aquifer unit in the local area. Each waste body is overlain by a clay cap which is approximately 1 to 2m thick although its integrity is questioned following observations with respect to landfill gas emissions.

The sands and gravels are a glacial outwash deposits that comprise glaciofluvial and glaciolacustrine sediments formed as part of the Fassaroe Delta. The sediments are arranged in the typical delta sequence: topset gravels composed of up to 2m depth of horizontally bedded gravels on top; foreset gravels which are steeply dipping and well bedded deposited at the front of the delta; and bottomset, finer sediments of sands and silts, usually underlying the foresets and representing sediment that was originally deposited beyond the steep delta front on the sea floor. The thickness of the sand and gravel unit was not established during the drilling programme as it extended below the maximum reach of the drilling rig on site (35m below ground level). However, bedrock outcrop was noted in the river bed to the north of the site, the County Brook River (Fassaroe Stream) at an elevation of approximately 55mAOD.

The underlying bedrock consists of Ordovician Metasediments of the Maulin Bedrock Formation which are characteristically composed of dark blue-grey slate, phyllite & schist. The Maulin Formation is classified by the GSI as a locally important, moderately productive bedrock aquifer in local zones (Ll).

A significant depth of unsaturated sand and gravel deposits is characteristic of the areas surrounding each for the former landfill sites. The position of the waste mass with respect to groundwater levels is as follows:

- Site 1: Unsaturated sand and gravel deposits beneath waste mass;
- Site 2: Majority of waste body underlain by unsaturated sand and gravel deposits with the exception of most northerly parts of waste mass possibly intercept groundwater table;
- Site 3A: Majority of waste body underlain by unsaturated sand and gravel deposits with the exception of most northerly parts of waste mass possibly intercept groundwater table;
- Site 3B: Unsaturated sand and gravel deposits beneath waste mass;
- Site 3C: Base of the waste mass appears to intercept the top of the groundwater table across the majority of the site.

The unconsolidated sand and gravel deposits are principally composed of limestone from the Irish Midlands. The sand and gravel deposits form part of the Enniskerry gravel aquifer body, which is designated a locally important gravel aquifer with a WFD status of "Good".

The bedrock is characterised by a significantly lower transmissivity than the overlying sand and gravel deposits. It is therefore assumed that the contact bedrock constitutes the hydraulic base to the overlying granular sand and gravel aquifer system.

The groundwater flow regime at Fassaroe is that of a shallow, unconfined, largely granular aquifer system with groundwater flow directions generally reflecting the surface topography. A groundwater contour map for the local system is presented in **Figure 18**, based on water levels measured on the 29th of March 2016. This figure confirms that a water-table is present within the sand and gravel deposits, and groundwater flow direction at all sites is ultimately towards the County Brook River (Fassaroe Stream) to the north and northeast. The hydraulic gradient steepens towards the valleys and is flatter on the plateau. Groundwater underlying the site constitutes an important water environment receptor, although no private or public or private water supplies situated down-hydraulic gradient from the former landfill sites.

The nearest surface water receptor is the County Brook River (Fassaroe Stream) which cuts a steep gorge (up to 40m deep) through the gravel deposits. Flow in the river is estimated to be approximately 20L/s based on the river catchment area and proportional weighting from adjacent flow monitoring locations on the River Dargle. The river is a tributary of the River Dargle, which it joins approximately 1km downstream of the site and ultimately flows into the Irish Sea at Bray, a further 2km downstream.

The nearest sensitive site is the Ballyman Glen SAC (Site Code: 000713), adjacent to the County Brook River (Fassaroe Stream), selected for petrifying springs with tufa formation and alkaline fens. Lateral groundwater flow emerges as springs and/or seepages that feed the channels in which tufa deposition occurs and cross the alkaline fen. This confirms that the Ballyman Glen constitutes a Groundwater Dependant Terrestrial Ecosystems (GWDTE) under the WFD.

5.1.2 Current and Future Development of the Fassaroe Site

The general location and setting is characterised by one off housing developments in a predominantly agricultural setting. One off housing and commercial/agricultural buildings are located within the vicinity of Sites 2 and 3C. A sports ground and associated facilities are located in lands immediately to the east of Site 3B.

The five landfill sites are located within the area of Fassaroe, Bray, Co. Wicklow which is zoned for major new development under the Draft Bray Municipal District Local Area Plan 2018. The lands are zoned for residential high density (R-HD) new development with existing residential (RE), open space (OS1 and OS2), active open space (AOS), and neighbourhood centre (NC)[1].

It is anticipated that development of infrastructure would be undertaken outside of the landfill areas which would be incorporated into the overall development proposal as open space/amenity use.

[1] Bray Municipal District Local Area Plan 2017 Land Use Zoning Map, Map No. 2 DRAFT.

SITE INVESTIGATION CO-ORDINATES		
ID	X Co-ordinate	Y Co-ordinate
Surface Water Monitoring Locations		
SW1	724137.00	718407.00
SW2	723733.00	718594.00
SW3	723598.00	718560.00
SW4	722837.00	718475.00
SW5	722609.00	718667.00

SITE INVESTIGATION CO-ORDINATES		
ID	X Co-ordinate	Y Co-ordinate
Spring Locations		
Spring 1	724052.00	718436.00
Spring 2	723554.00	718552.00
Spring 3	723365.00	718567.00
Spring 4	723200.00	718486.00
Spring 5	723100.00	718489.00
Spring 6	723038.00	718488.00
Spring 7	722982.00	718476.00
Spring 8	722842.00	718471.00
Spring 9	722780.00	718489.00
Spring 10	722783.12	718446.41

LEGEND

- ESB Overhead (38 kv)
- ESB Overhead (110kv)
- ESB Overhead (220kv)
- ESB Overhead (400kv)
- ESB Overhead (LV)
- ESB Overhead (MV)
- ESB Underground (38kv)
- ESB Underground (MV & LV)
- ESB Underground (Spare)
- Extent of Waste
- Special Areas of Conservation (SAC's)
- Watermain

Site Investigation

- MW1 Existing Boreholes
- G01 Gas Monitoring Borehole
- LG01 Combined Gas/Leachate Monitoring Boreholes (Rotary)
- LG02 Combined Gas/Leachate Monitoring Boreholes (Cable Percussive)
- Combined Gas/Leachate Monitoring Boreholes (Cable Percussive with Rotary follow on)
- BH01 Combined Groundwater/Gas Monitoring Boreholes
- SW1 Surface Water Monitoring Location
- Spring 1 Spring Location
- SP1 Spring Sampling Location

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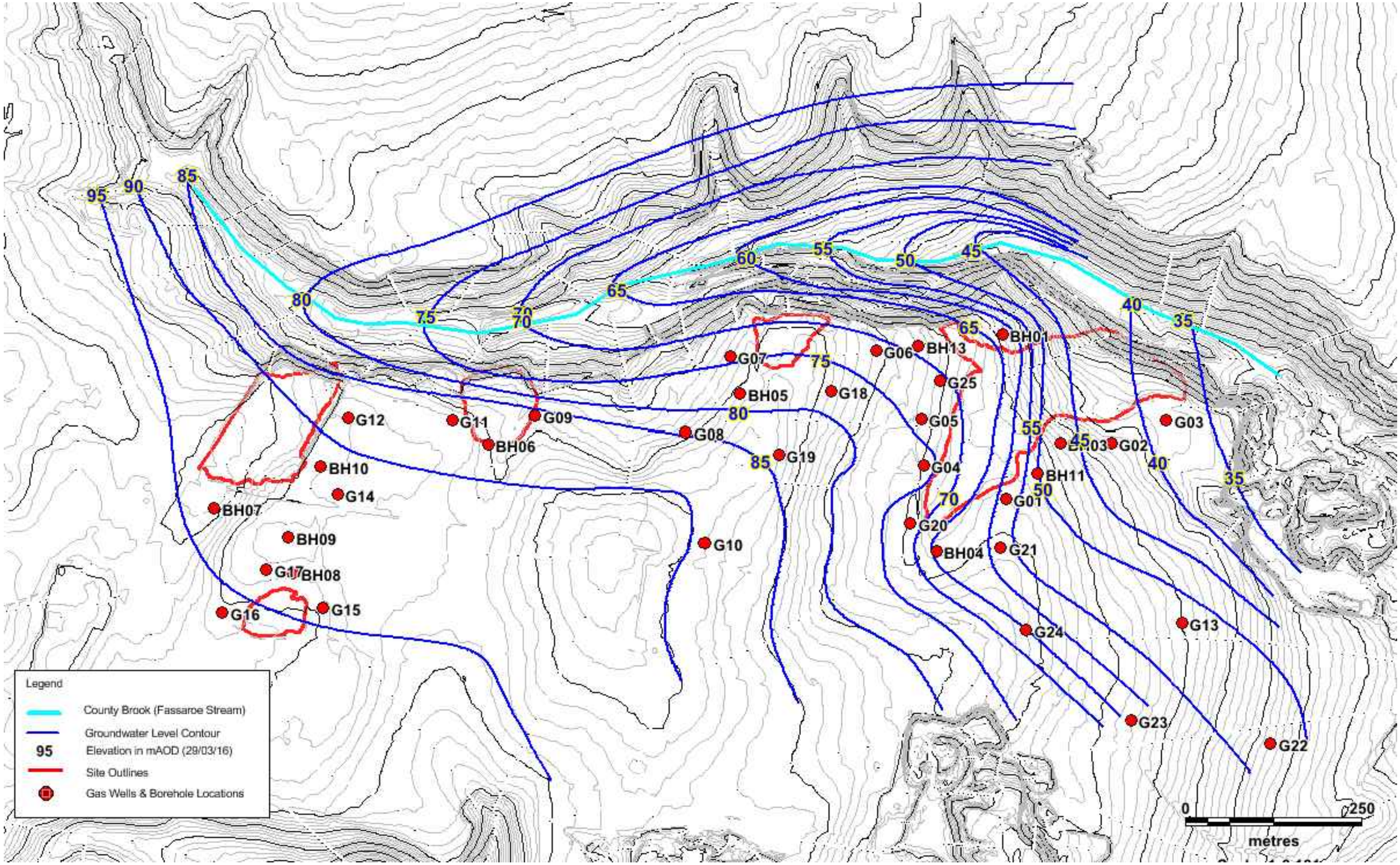
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Date	May 2016
Scale	1:2500 @ A1 1:5000 @ A3
Job No.	MDR1206

Project: **FASSAROE HISTORIC LANDFILL**

Title: PLAN SHOWING CROSS SECTION LOCATIONS SPRINGS, & MONITORING LOCATIONS

File Ref. MDR1206FG0017F02.dwg | Drg. No. Figure 17 | Rev. F02

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Project
FASSAROE HISTORIC LANDFILL

Title
GROUNDWATER CONTOUR MAP

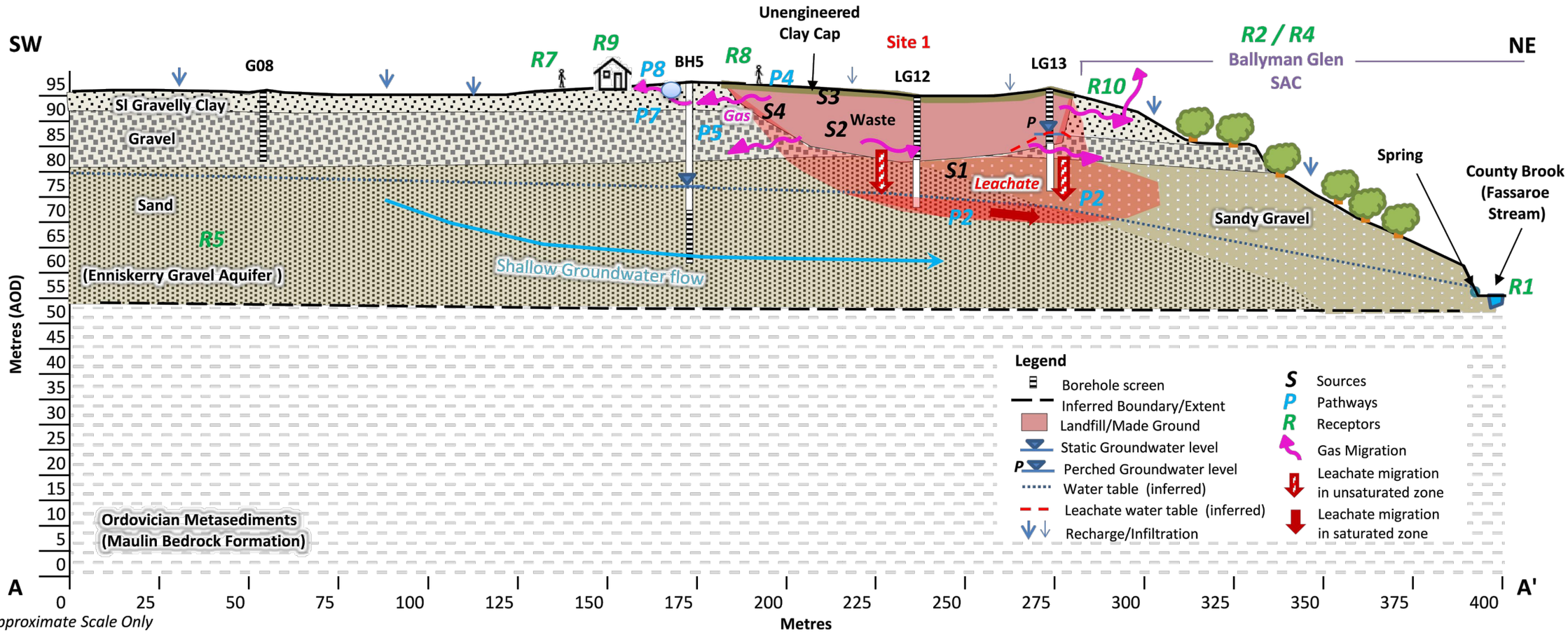
Job No.	File Ref.	Drg. No.	Rev.
MDR1206	MDR1206FG0018F02.dwg	Figure 18	F02

5.1.3 Site 1

The section (A-A') represented in **Figure 20** traverses the site from southwest to northeast. The section extends beyond the site boundary from the up-gradient boreholes G08 and BH5 to the County Brook River (Fassaroe Stream).

5.1.3.1 Source

The waste mass at Site 1 (Source S2) has been well defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The waste material is dominantly comprised of C&D waste with pockets of municipal waste. The maximum measured depth of waste is 14mbgl with an estimated area of 0.53 Ha. There may be a locally perched leachate towards the northern extent of the waste body (Source S1) as indicated by LG13.



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Project: **FASSAROE HISTORIC LANDFILL**

Title: CONCEPTUAL SITE MODEL SITE 1

File Ref.: MDR1206FG0020F02.dwg | Drg. No.: Figure 19 | Rev.: F02

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Based on lateral and vertical extent as defined by site investigations, an estimated 110,000 tonnes of waste is present at Site 1 (using a conversion factor for metres cubed to tonnes of 1.5 for inactive or inert waste (comprising sand, subsoil, concrete, bricks, fiberglass etc.)[2]).

WAC test analyses for samples from Site 1 recorded elevated concentration of pH, total organic carbon, antimony, total PCBs (7 congeners) and sulphate (see Section 4.7.1 for further details).

Geophysical survey results suggest that lower levels of the leachate plume have reached as far as 10 metres below the depth of waste at Site 1. Leachate samples from borehole LG11 highlighted the exceedances above the Groundwater Threshold Values (GTV) (S.I. 9 of 2010) and/or the Interim Guidelines Values (IGV) (EPA 2003) for several metals and major ions, as well as the detection of hydrocarbons and small number of trace organic compounds. The list of all contaminants of potential concern for the site is summarised in Section 6.1.3.

Analysis for the potential presence of Asbestos Containing Materials (ACMs) was completed at Site 1 with one fragment of asbestos cement encountered within the waste mass (Source S3).

See Section 6.1.2 for source contaminants from human health assessment.

Landfill gas (Source S4) was recorded at Site 1 methane concentrations up to 13.6% v/v and carbon dioxide concentrations up to 18.9% v/v.

5.1.3.2 Pathways

The waste mass at Site 1 is located above the water-table with an unsaturated zone thickness of over 5 m. The unsaturated sand and gravel deposits provide both a lateral (Pathway P5) and vertical migration pathway (Pathway P7) for landfill gas generated at the source.

The vertical pathway for leachate generation is driven by direct rainfall percolating through the waste body. The infiltrating water is considered likely to travel to the north-east through higher permeability horizons within the waste mass. Leachate then pools within the base of the waste mass in the north-eastern portion of Site 1 (LG13) from where it percolates into the underlying unsaturated and sand gravel deposits.

Upon reaching the water table, leachate mixes with groundwater in the sand and gravel aquifer. The saturated aquifer then provides both lateral and vertical (downward) migration pathways for leachate mixed with groundwater (Pathway P2). No evidence of free phase contamination has been identified during the works. The groundwater flow within the sand and gravel deposits is orientated in a north-easterly direction towards the County Brook River (Fassaroe Stream) and associated drainage system within the SAC.

Multiple springs and seepages have been mapped along the river valley. The spring flows are relatively small and often emerge as diffuse up-wellings which then coalesce downstream to form more defined riparian drains. Spring 2 (SP2) is situated in a position that is likely to be down-hydraulic gradient from Site 1. Spring 2 is characterised by clear water, tufa formation and high (mildly-alkaline) pH above 7.0 with little evidence of impact on chemical quality.

[2] S.I. No. 189/2015 – Waste Management (landfill Levy) Regulations 2015

There is considered to be a general absence of a formal surface water drainage system that directly connects Site 1 with the County Brook River (Fassaroe Stream) and the SAC in the river valley, hence Pathway P1 and Pathway P3 are not considered relevant to Site 1.

The existing 33" water main runs in a north south direction to the east of the waste infill area and could provide a potential pathway for landfill gas (Pathway P8).

The site currently comprises scrub and debris and is not in regular use therefore dermal contact, ingestion and inhalation pathways (Pathway P4) are considered unlikely.

5.1.3.3 Receptors

The receptors for Site 1 include: the County Brook River (Fassaroe Stream) (Receptor R1); the Ballyman Glen SAC (Receptor R4 / R2); the underlying sand and gravel aquifer system (Receptor R5); existing and future site users (Receptor R7); and existing, and any future off site buildings and structures (Receptor R9). No private or public groundwater supply sources are present down-hydraulic gradient from Site (Receptor R3 and R6).

5.1.4 Site 2

The section (B-B') represented in **Figure 21** traverses Site 2 from southwest to northeast. The section extends beyond the site boundary from the up-gradient borehole G20 to the County Brook River (Fassaroe Stream).

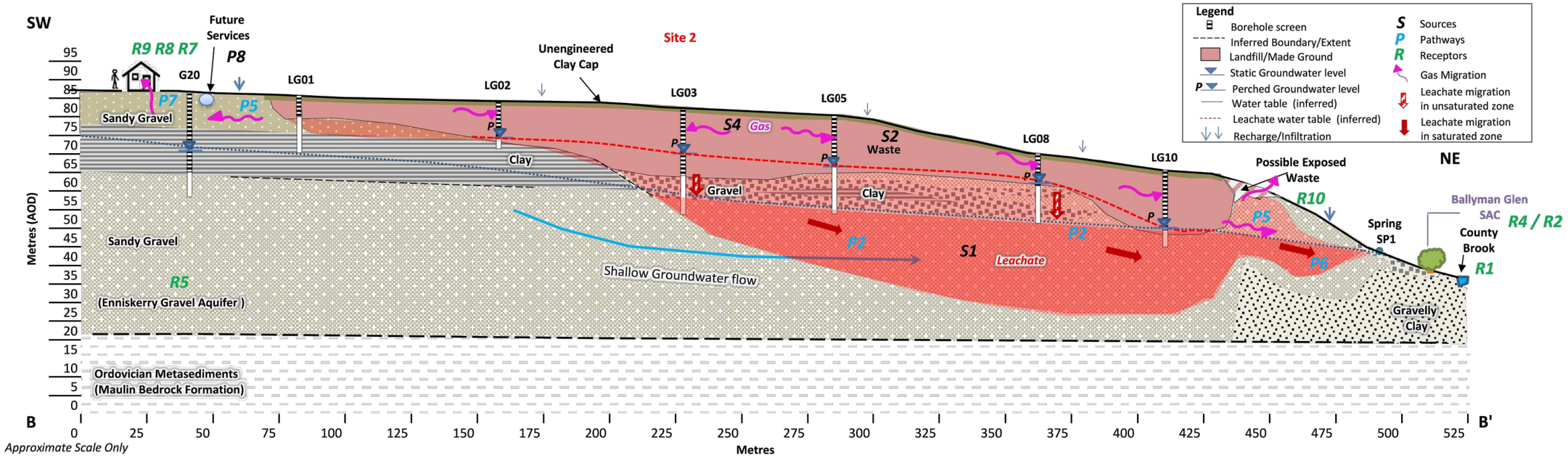
5.1.4.1 Source

The waste mass at Site 2 (Source S2) has been well defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The waste material is dominantly comprised of municipal waste with a maximum measured depth of 19mbgl and an estimated area of 4.5 Ha. An estimated c.340,000 tonnes of waste is present at Site 2 (based on a conversion factor for metres cubed to tonnes of 0.4 for compacted household waste[3]).

WAC test analyses from waste samples recorded exceedances of pH, TOC, antimony, sulphate, molybdenum and Total Dissolved Solids (TDS) (see Section 4.6.1 for further detail).

A discrete leachate body has been identified in the waste mass (e.g. LG03 and LG10) and geophysical survey results suggest that the leachate plume (Source S1) has reached as far as 40 metres below the depth of waste, particularly to the north-east at Site 2. Leachate samples taken at 5 leachate boreholes (LG01, LG03, LG7, LG09 and LG10) highlighted the exceedances above the GTVs and/ or the IGVs for several metals and major ions, as well as the detections of hydrocarbons and small number of trace organic compounds. The list of all contaminants of potential concern for the site is summarised in Section 6.1.3.

[3] S.I. No. 189/2015 – Waste Management (landfill Levy) Regulations 2015



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Project: **FASSAROE HISTORIC LANDFILL**

Title: CONCEPTUAL SITE MODEL SITE 2

File Ref. MDR1206FG0020F02.dwg | Drg. No. Figure 20 | Rev. F02

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See section 6.1.2 for soil exceedances from human health assessment. The monitoring dataset for landfill gas (Source S4) recorded methane concentrations ranging from no detections to 73.7% v/v and carbon dioxide concentrations ranging from no detection to 36.6% v/v with variable flow rates of between -6.2 l/hr to +7.6 l/hr.

5.1.4.2 Pathways

Most of the waste mass at Site 2 is located above the water-table with an unsaturated zone thickness of greater than 5m. The unsaturated sand and gravel deposits provide both lateral and vertical migration pathways via pore spaces for landfill gas generated at the site (Pathway P5 and Pathway P7 respectively).

The vertical pathway for leachate generation is driven by direct rainfall percolating through the waste body. A discrete leachate body has been identified in the waste mass (e.g. LG03 and LG10). The pathway for leachate migration is expected to be complex, as leachate will percolate through more permeable areas of the perching layer at the base of the waste mass, through the underlying unsaturated zone to the saturated sand gravel deposits at depth where it will mix with groundwater.

The low elevation of the waste body in the north of Site 2 suggests that leachate and groundwater may be in hydraulic continuity. This indicates a potential lateral pathway for soluble gases in groundwater (Pathway P6), although clay layers identified between the base of the waste and the deeper gravels may act as a confining layer causing the leachate to be perched above groundwater. It appears that the clay layers are largely absent to the north, with the leachate levels and groundwater head coincident as indicated by LG10. Leachate from the landfill site may also contain dissolved gases or may potentially degrade during migration to produce methane and carbon dioxide. Dissolved gas concentrations measured during Round 2 did identify elevated carbon dioxide (30 mg/l in BH1) but the absence of methane.

Upon reaching the water-table, the sand and gravel aquifer system provides both lateral and vertical migration pathways for leachate through groundwater (Pathway P2). The groundwater flow within the saturated sand and gravel aquifer is in a north-easterly direction towards the County Brook River (Fassaroe Stream) and SAC.

Multiple springs and seepages have been mapped along the river valley. Springs are often associated with tufa type deposition. Spring flows are relatively small and often occur as diffuse up-wellings which coalesce downstream to form a more defined channel. Ochre staining was observed in some springs situated in close proximity to Site 2, most notably Spring SP1. These springs represent the point of emergence from the groundwater pathway at surface and then discharge to the drainage system within the SAC that ultimately reaches Country Brook River (Fassaroe Stream). Spring 1 is characterised by the absence of tufa, ochre staining, sheening and elevated concentrations of certain contaminants of concern, principally in Round 1.

There is considered to be a general absence of a formal surface water drainage system that directly connects Site 1 with the County Brook River (Fassaroe Stream) and the SAC in the river valley, hence Pathway P1 and Pathway P3 are not considered relevant to Site 2.

Site 2 is currently in agricultural use and utilised for grazing. The site is therefore in use by animals, farmers and walkers. Potential pathways for dermal contact and inhalation are considered likely (Pathway P4). The proposed development proposes a road alignment through the southern margin

of Site 2 which may result in the potential development of additional pathways for landfill gas migration through the road structure and associated service/utility routings (Pathway P8).

5.1.4.3 Receptors

The receptors for Site 2 include: the County Brook River (Fassaroe Stream) (Receptor R1); the Ballyman Glen SAC (Receptor R4 / R2); the underlying sand and gravel aquifer (Receptor R5); current and future site users (Receptor R7); and existing and proposed offsite buildings and structures (Receptor R9). No private or public groundwater supply sources are present down-hydraulic gradient from Site (Receptor R3 and R6).

5.1.5 Site 3A

The section (C-C') represented in **Figure 22** traverses Sites 3A and 3B from south to north. The section extends beyond 3A site boundary through boreholes BH08 and BH09 and Site 3A up to the County Brook River (Fassaroe Stream).

5.1.5.1 Source

The waste mass at Site 3A (Source S2) has been defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The waste material is dominantly comprised of municipal waste, with a maximum measured depth of 16mbgl and an estimated area of 1.9Ha. An estimated c.120,000 tonnes of waste is present at Site 3A (based on a conversion factor for metres cubed to tonnes of 0.4 for compacted household waste[4]).

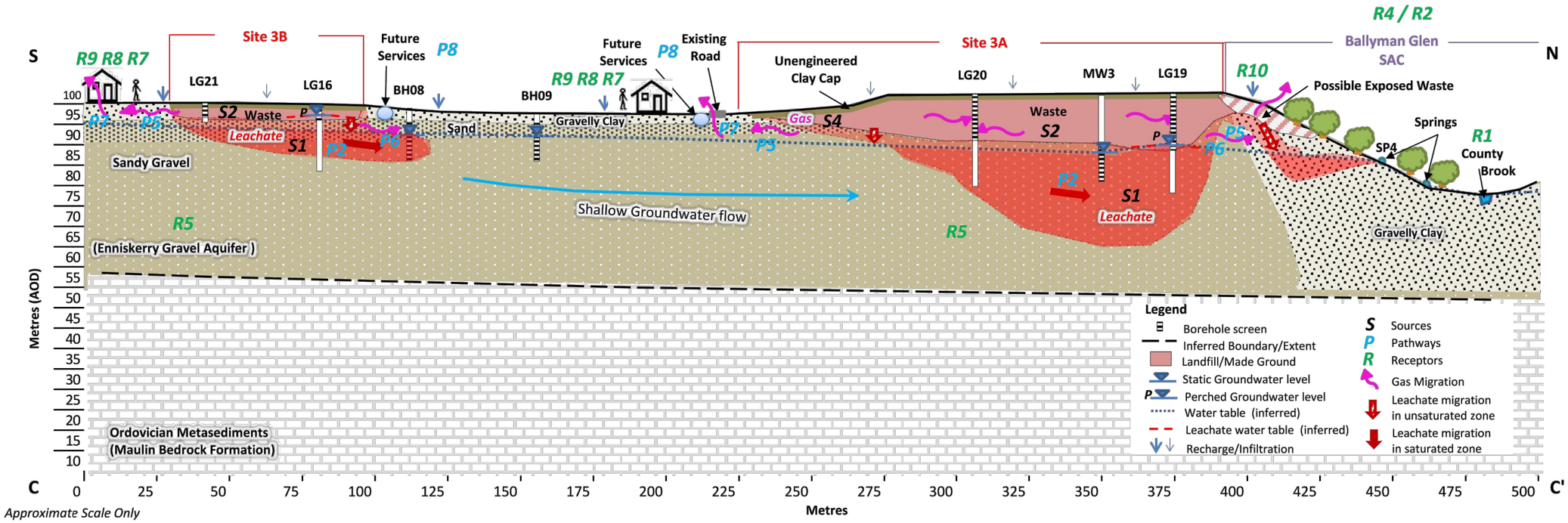
WAC test analyses recorded exceedances of pH, TOC, antimony, molybdenum and TPH (see Section 4.6.1 for further detail).

See Section 6.1.2 for soil exceedances from human health assessment.

The monitoring dataset for Landfill Gas for Site 3A (excluding MW3) identifies methane concentrations between 30 and 70 % v/v and carbon dioxide concentrations between 20 and 30% v/v. Flow rates are extremely variable, although high flow rates typically in excess of 30l/hr have been recorded at all in-waste boreholes. These results are considered to be consistent with a waste mass which is still degrading and producing large volumes of gas under pressure driven conditions (Source S4).

The waste body at Site 3A generally appears to be unsaturated with leachate restricted to the north of the site. This suggests the downward migration of leachate and mixing with groundwater at the water table. Geophysical survey results suggest that the leachate plume (Source S1) has reached as far as 20 metres below the depth of waste at Site 3A. Leachate samples taken at 3 leachate boreholes (MW4, LG15 and LG19) at Site 3A highlighted the exceedances above the GTVs and/ or IGVs for several metals and major ions, as well as the detections of hydrocarbons and several trace organic compounds. The list of all contaminants of potential concern for the site is summarised in Section 6.1.3.

[4] S.I. No. 189/2015 – Waste Management (landfill Levy) Regulations 2015



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Job No.	MDR1206

Project: **FASSAROE HISTORIC LANDFILL**

Title: CONCEPTUAL SITE MODEL SITES 3A & 3B

File Ref.	Drg. No.	Rev.
MDR1206FG0021F02.dwg	Figure 21	F02

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5.1.5.2 Pathways

The waste body at Site 3A generally appears to be unsaturated with leachate restricted to the north of the site. Groundwater appears to be located immediately beneath the landfill site, although a thin unsaturated zone may be present, with leachate mixing with groundwater at the water table. An unsaturated zone within the sand and gravel would provide both lateral and vertical migration pathways via pore spaces for the landfill gas generated at the site (Pathway P5 and P7). In the north of Site 3A, leachate and groundwater may be in hydraulic continuity. This indicates a potential lateral pathway for soluble gases in groundwater (Pathway P6). Dissolved gas analysis undertaken in Round 2 did not identify dissolved gases in groundwater although the dataset is limited (i.e. BH7, BH9 and BH10).

The vertical pathway for leachate generation is driven by the direct percolation of rainfall through the waste body. Infiltrating water is considered to travel northwards through the higher permeability sections of the waste mass. The leachate then pools within the base of the waste in the northern portion of Site 3A (LG19), and from there percolates into the underlying unsaturated sand and gravel deposits where it mixes with groundwater. Upon reaching the water-table, the sand and gravel aquifer provides both vertical (downward) and lateral migration pathway for leachate through groundwater (Pathway P2).

The general groundwater flow within the sand and gravel aquifer is to the north-easterly direction towards County Brook River (Fassaroe Stream) and the SAC. Multiple springs and seepages have been mapped along the river valley. The springs are often associated with tufa deposits. Spring flows are relatively small and often occur as diffuse up-wellings which coalesce downstream to form a more defined channel. Ochre staining was observed in some springs close to Site 3A, most notably Spring SP4 although spring SP4 is characterised by clear waters, low EC and tufa formation.

There is considered to be a general absence of a formal surface water drainage system that directly connects Site 3A with the County Brook River (Fassaroe Stream) and the SAC in the river valley, hence Pathway P1 and Pathway P3 are not considered relevant to Site 3A.

The site is currently not in use and generally comprises scrub therefore dermal contact, ingestion and inhalation pathways (Pathway P4) are considered unlikely, although waste is exposed in the north.

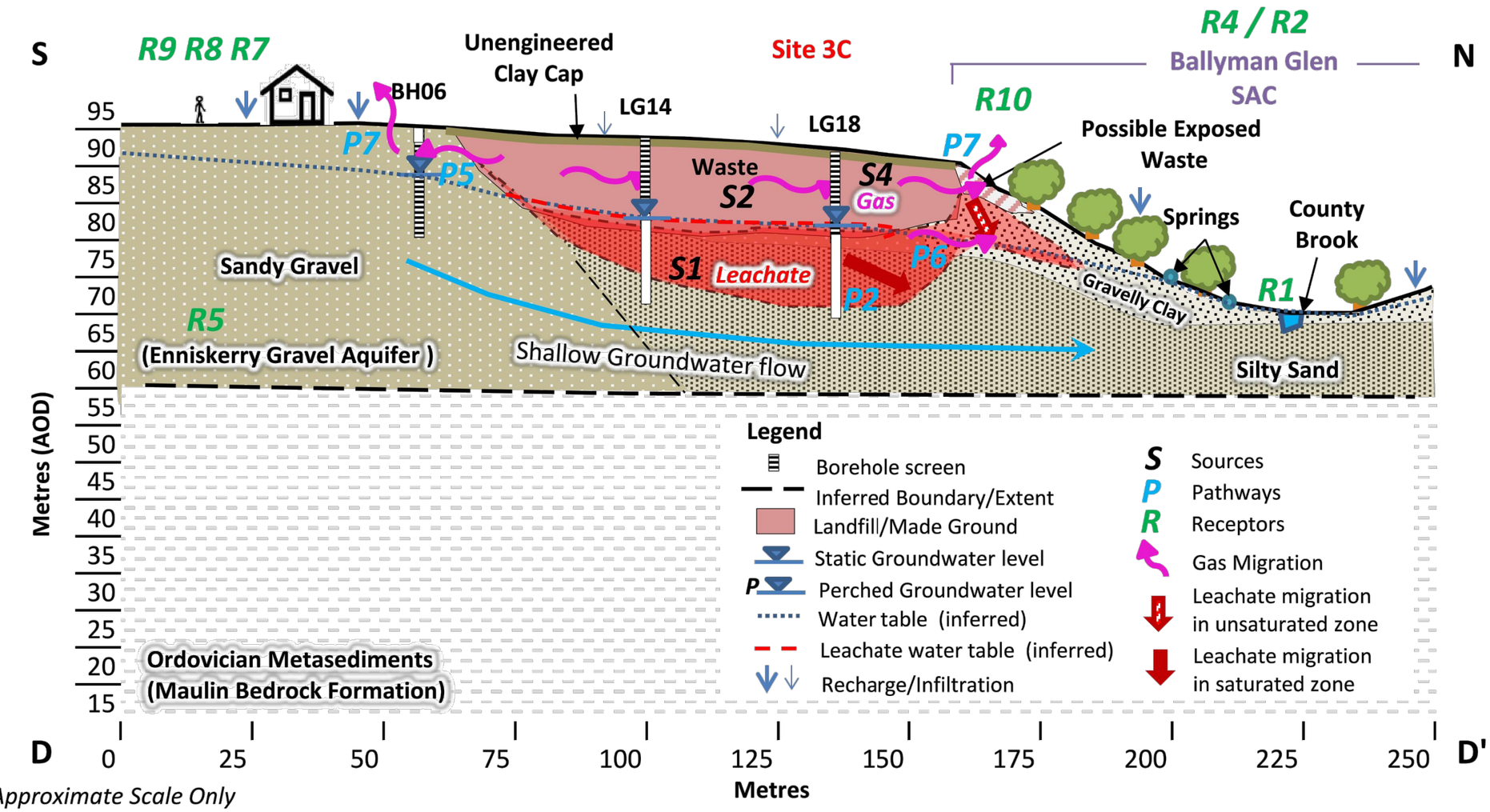
5.1.5.3 Receptors

The receptors for site 3A include: the County Brook River (Fassaroe Stream) (Receptor R1); the Ballyman Glen SAC (Receptor R4)/R2; the underlying sand and gravel aquifer (Receptor R5); current and future site users (Receptor R7): and offsite buildings and structures (Receptor R9). No private or public groundwater supply sources are present down-hydraulic gradient from Site (Receptor R3 and R6).

5.1.6 Site 3B

The conceptual site model for Site 3B is illustrated (as part of section C-C') in **Figure 22**.

5.1.6.1 Sources



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Project
FASSAROE HISTORIC LANDFILL

Title
CONCEPTUAL SITE MODEL
SITE 3C

File Ref.	Drg. No.	Rev.
MDR1206FG0022F02.dwg	Figure 22	F02

The waste mass at Site 3B (Source S2) has been well defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The relatively shallow waste material is dominantly comprised of municipal waste with a maximum measured depth of 4.9mbgl with an estimated area of 0.44Ha. An estimated c.8,500 tonnes of waste is present at Site 3B, based on a conversion factor for metres cubed to tonnes of 0.4 for compacted household waste[5].

WAC test analyses recorded exceedances of pH, TOC, antimony, molybdenum and TPH (see Section 4.6.1 for further detail). See Section 6.1.2 for soil exceedances from human health assessment.

Leachate is thought to be present within the base of the waste in the norther portion of Site 3B (LG16) (Source S1). Geophysical survey results suggest that the leachate plume has reached as far as 15 metres below the depth of waste at Site 3B. Leachate samples taken at LG17 highlighted the exceedances above the Groundwater Threshold Values (S.I. 9 of 2010) or the Interim Guidelines Values (EPA 2003) for several metals and major ions, as well as the detections of hydrocarbons and a small number of trace organic compounds. The list of all contaminants of potential concern for the site is summarised in Section 6.1.3.

The landfill gas monitoring dataset collected for onsite monitoring locations recorded consistently elevated methane concentrations ranging from 22.0% v/v to 73.1% v/v and carbon dioxide ranging from 17.2% v/v and 39.3% v/v (Source S4). No measureable flow rate was recorded during several monitoring periods with peak reading of 3.3l/hr, 6.2l/hr and 2.5l/hr recorded at LG16, LG17 and LG21 respectively.

5.1.6.2 Pathways

The groundwater table at Site 3B is located at shallow depth, however it appears that the waste body is perched above the water table. Some deeper portions of the waste body are expected to be saturated to the north, where groundwater is intercepted. The unsaturated sand and gravel deposits can provide both lateral and vertical migration pathways for generated landfill gas at the site (Pathway P5 and P7). The saturated waste located to the north of the site could result in the migration of dissolved gas in groundwater (Pathway P6).

The vertical pathway for leachate generation is driven by direct percolation of rainfall through the waste body. Infiltrating water is considered to travel northwards, via higher permeability horizons within the waste mass. The leachate may then pool within the base of the waste in the northern portion of Site 3B (LG16) from where it can percolate into the underlying unsaturated sand and gravel deposits. Upon reaching the water table and mixing with groundwater, the sand and gravel aquifer provides both lateral and vertical migration pathways for leachate through groundwater (Pathway P2).

The general groundwater flow within the sandy gravel deposits is in a north-easterly direction towards the County Brook River (Fassaroe Stream). Multiple springs and seepages have been mapped along the river valley. The springs and seepages are often associated with tufa deposits. Spring flows are relatively small and often occur as diffuse up-wellings which coalesce downstream to form more defined channels.

[5] S.I. No. 189/2015 – Waste Management (landfill Levy) Regulations 2015

There is considered to be a general absence of a formal surface water drainage system that directly connects the landfills with the County Brook River (Fassaroe Stream) and the SAC in the river valley, hence Pathway P1 and Pathway P3 are not considered relevant to Site 3B.

Site 3B is currently in agricultural use and utilised for grazing. The site is therefore in use by animals, farmers and walkers and is located adjacent to Enniskerry FC consequently the potential pathways for dermal contact and inhalation (Pathway P4) are considered likely.

5.1.6.3 Receptors

The receptors for both sites include: the County Brook River (Fassaroe Stream) (Receptor R1); the underlying sand and gravel aquifer (Receptor R5); existing and proposed site users (Receptor R7); adjacent site users (including adjacent football pitch) (Receptor R7); existing and any future offsite buildings and structures (Receptor R9). No private or public groundwater supply sources are present down-hydraulic gradient from Site (Receptor R3 and R6).

5.1.7 Site 3C

The section (D-D') represented in **Figure 23** traverses Site 3C from south to north. The section extends beyond the site boundary from the up-gradient boreholes BH06 to the County Brook River (Fassaroe Stream).

5.1.7.1 Source

The waste mass at Site 3C (Source S2) has been well defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The waste material is dominantly comprised of municipal waste with a maximum measured depth of 13mbgl and an estimated areal extent of 0.9 Ha. An estimated c. 47,000 tonnes of waste is present at Site 3C, based on a conversion factor for metres cubed to tonnes of 0.4 for compacted household waste[6].

WAC test analyses recorded exceedances of pH, TOC, antimony, molybdenum, TDS, lead, TPH, mercury, nickel, selenium and chloride (see Section 4.6.1 for further detail). See Section 6.1.2 for soil exceedances from human health assessment.

Geophysical survey results suggest the leachate plume (Source S1) has reached as far as 20 metres below the depth of waste at Site 3C. Leachate samples taken at 2 leachate boreholes (LG14 and MW2) highlighted the exceedances above the Groundwater Threshold Values (S.I. 9 of 2010) or the Interim Guidelines Values (EPA 2003) for several metals and major ions, as well as the detections of hydrocarbons and several trace organic compounds. The list of all contaminants of potential concern for the site is summarised in Section 6.1.3.

The monitoring dataset for Landfill Gas (Source S4) recorded methane concentrations ranging from 5.9% v/v to 83.5% v/v with carbon dioxide concentrations ranging from 4.1% v/v to 37.2% v/v. Methane concentrations typically stable with a concentration between 60% v/v and 75% v/v. Similarly the carbon dioxide concentration typically exceeds 25%. Flow readings are typically low (i.e. below 2 L/hr).

[6] S.I. No. 189/2015 – Waste Management (landfill Levy) Regulations 2015

5.1.7.2 Pathways

The base of the waste mass appears situated beneath the water table in the underlying sand and gravel aquifer. The saturated aquifer therefore provides both lateral and vertical migration pathways for leachate migration (Pathway P2) and dissolved gas through groundwater (Pathway P6). The general groundwater flow within the sandy gravel deposits is in a northeast direction towards the river. Surrounding unsaturated sands and gravel zone can provide both lateral and vertical migration pathways for generated landfill gas at the site (Pathway P5 and Pathway P7).

Multiple springs and seepages have been mapped along the river valley. The springs are often associated with tufa deposits. The spring flows are relatively small and often emerge as diffuse up-wellings which then coalesce downhill to form a more defined channel. Spring SP3 is situated down gradient of Site 3C ad is characterised by clear waters and tufa formation.

Site 3C is currently not in regular use and generally comprises scrub, therefore potential pathways for dermal contact and inhalation (Pathway P4) are considered unlikely however is should be noted that there are a number of buildings located immediately to the south of the site which are in use/occupied and the potential for gas migration to such should be considered further by the Local Authority.

There is considered to be a general absence of a formal surface water drainage system that directly connects Site 3C with the County Brook River (Fassaroe Stream) and the SAC in the river valley, hence Pathway P1 and Pathway P3 are not considered relevant to Site 3C.

5.1.7.3 Receptors

The receptors for Site 3C include: the County Brook River (Fassaroe Stream) (Receptor R1); the Ballyman Glen SAC (Receptor R4 / R2); the underlying sand and gravel aquifer (Receptor R5); existing and future site users and existing (including adjacent occupied properties) (Receptor R7); any future offsite buildings and structures (Receptor R9). No private or public groundwater supply sources are present down-hydraulic gradient from Site (Receptor R3 and R6).

5.2 REFINEMENT OF RISK SCREEENING & PRIORITISATION

A Tier 3 Refinement of Risk Screening exercise presented in Section 4 has been conducted for all sites to confirm the initial risk ranking assigned in the Risk Assessment Methodology Tier 1: Conceptual Site Model, Risk Screening and Prioritisation.

5.2.1 Revised Conceptual Site Model

The risk screening has been further developed based on the findings of the additional site investigation and testing and the subsequent refinement of the CSM. The revised site wide risk model (covering all 5 historic landfills) is based on the subdivisions of SPR linkages as set out in the initial CSM (Section 3.6). The CSM has been presented for the current Baseline Conditions defined on the site through Tier 2 investigation (**Table 5.1 – Revised Risk Site Wide Model (Baseline Conditions – No Development)Table 5.1**) and for baseline conditions with the Proposed Development (Table **5.2**). The site wide risk model takes account of the worst case for each SPR linkage.

Table 5.1 sets out the risk model, following detailed site investigations, for the 5 historic landfills for the existing pre-development scenario. **Table 5.2** details the risk model, following detailed site investigations, for future, post development, scenario with no mitigation measures in place.

Table 5.1 – Revised Risk Site Wide Model (Baseline Conditions – No Development)

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
S1	Leachate	P1	Vertical to groundwater then horizontally through possible surface water drainage channels into the river	R1	WFD Surface Water Body	None	Medium	No Risk	A formal Surface Water drainage system that directly connects the 5 landfill sites to the SAC and/or County Brook River has not been identified, pollutant linkage does not exist. Groundwater does emerges at the down-gradient springs which then form as riparian drains leading to the river and this is considered as part of pathway P2.
				R2	Surface Water Protected Area	None	Medium	No Risk	
		P2	Vertical & Horizontal via Groundwater	R3	Private Wells	None	Medium	No Risk	There are no known private wells along the leachate plumes (water main connection in the area)
				R4	Groundwater Dependent Terrestrial Ecosystem (GWDTE)	Highly Likely	Severe	High Risk	GWDTE present, location of alkaline fens and tufa sites identified by ecologists within the Ballyman Glen SAC. Sites are down-gradient of landfill Sites 1, 3A and 3C. Water quality at a number of the springs appears to have been affected by leachate migration from some of the landfill sites. Although not proven these effects may have had a direct effect on the tufa forming potential within these riparian streams.
				R5	Aquifer	Highly Likely	Medium	Moderate Risk	The underlying bedrock and gravel aquifers are at risk by direct connection
				R6	Public Supply Well	None	Mild	No Risk	There are no public water supply wells in the area.
				R1	Surface Water Body	Likely	Medium	Moderate Risk	The County Brook River (Fassaroe Stream) is at risk
		P3	Surface Water Drainage	R1	Surface Water Body	None	Medium	No Risk	There are no surface water drainage channels in the area, however at Site 2 there is seepage from exposed waste at collapsed river bank observed at one down-gradient location
				R2	Surface Water Protected Area	None	Medium	No Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
S2	Waste	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	Sites 1, 3A and 3C are currently not in use. Currently minimal clay cap in place.
				R8	Construction Workers	Unlikely/Low Likelihood	Minor	Very Low Risk	Sites 1, 3A and 3C are currently not in use. Currently minimal clay cap in place.
S3	ACM	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Current and Future Site Users	Unlikely	Severe	Low/ Moderate Risk	Shallow soil sampling recorded a single detection of ACM in Site 1 – no detections were recorded at the remaining sites.
				R8	Construction Workers	Unlikely	Severe	Low/Moderate Risk	Shallow soil sampling recorded a single detection of ACM in Site 1 – no detections were recorded at the remaining sites.
S4	Landfill Gas	P5	Lateral Migration Subsoil	R7	Current and Future Site Users	Low Likelihood	Mild	Low Risk	Monitoring indicates that all sites are actively gassing. Offsite gas monitoring completed. The age, extent, volume and composition of waste is known. Potential for ingress to existing buildings and structures. Potentially, landfill gas migration could occur into existing adjacent buildings through cracks within the floor slab construction and/or around service/utility routes. Risks associated with gas migration into existing buildings should be considered further by the Local Authority.
				R8	Construction Workers	Likely	Severe	High Risk	
				R9	Adjacent Buildings and Structures	Low Likelihood/Likely	Severe	Moderate/ High Risk	
				R10	Non Designated Land	Low Likelihood/Likely	Minor	Very Low/Low Risk	
S4	Landfill Gas	P6	Lateral Migration Groundwater	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	Landfill gas known to be present onsite. Offsite gas monitoring completed.
				R8	Construction	Unlikely/Low	Severe	Low/Modera	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
					Workers	Likelihood		te Risk	Age, extent, volume and composition of waste.
				R9	Adjacent Buildings and Structures	Unlikely/Low Likelihood	Severe	Low / Moderate Risk	Groundwater and leachate levels established
S4	Landfill Gas	P7	Vertical Migration Subsoil	R7	Current and Future Site Users	Low Likelihood	Mild	Low Risk	Existing clay cap c.1-2m . The lack of an engineered cap will enable vertical migration of gas and atmospheric dispersion and dilution at surface.
				R8	Construction Workers	Likely	Severe	High Risk	Landfill gas known to be present onsite however no credible dataset available. No offsite monitoring completed. Age, extent, volume and composition of waste known.
				R9	Adjacent Buildings and Structures	Low Likelihood/Likely	Severe	Moderate/High Risk	Water level and effect on gassing regime known. Potential for ingress to existing buildings and structures.
				R10	Non Designated Land	Likely	Minor	Very Low /Low Risk	Vegetation die back noted.
S4	Landfill Gas	P8	Existing & Proposed Services Routes	R9	Adjacent Buildings and Structures	Low Likelihood/Likely	Severe	Low/Moderate Risk	Offsite gas monitoring known to have been completed.

Table 5.2 – Revised Risk Site Wide Model (Baseline Conditions with Development)

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
S1	Leachate	P1	Vertical to groundwater then horizontally through possible surface water drainage channels into the river	R1	Surface Water Body	None	Medium	No Risk	No change to this SPR linkage as a result of the proposed development.
				R2	Surface Water Protected Area	None	Medium	No risk	
		P2	Vertical & Horizontal via Groundwater	R3	Private Wells	Unlikely	Medium	Low Risk	There are no known private wells along the leachate plumes (water main connection in the area). No change following development.
				R4	GWDTE	Highly Likely	Severe	High Risk	No change to SPR linkage with proposed development. Tufa springs still impacted by leachate.
				R5	Aquifer	Likely	Medium	Moderate Risk	The underlying bedrock and gravel aquifers are at risk by direct connection.
				R6	Public Supply Well	None	Mild	No Risk	There are no public water supply wells in the area.
				R1	Surface Water Body	Likely	Medium	Moderate Risk	The County Brook River (Fassaroe Stream) is at risk
		P3	Surface Water Drainage	R1	Surface Water Body	Unlikely	Medium	Low Risk	There are no surface water drainage channels in the area, however at Site 2 there is seepage from exposed waste at collapsed river bank observed at one down-gradient location. The proposed development will route normal rainfall events from the housing and roads areas to soakaways as such there will be no substantial change in runoff. Excess inflow from storm events greater than 1 in 5year event will be discharge directly to surface
				R2	Surface Water Protected Area	Unlikely	Medium	Low Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
									water via attenuation ponds with not potential for contamination from the waste body. As such there are no material change to these SPR linkages as a result of the proposed development.
S2	Waste	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	No change to SPR linkage with proposed development Sites 1, 3A and 3C are currently not in use. Currently minimal clay cap in place.
				R8	Construction Workers	Low Likelihood	Minor	Very Low Risk	Risk to construction workers during excavations should be mitigated by the use of appropriate PPE
S3	ACM	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Current and Future Site Users	Unlikely	Severe	Low/Moderate Risk	No change to SPR linkage with proposed development. Shallow soil sampling recorded a single detection of ACM in Site 1 – no detections were recorded at the remaining sites.
				R8	Construction Workers	Unlikely	Severe	Low/Moderate Risk	No change to SPR linkage with proposed development. Shallow soil sampling recorded a single detection of ACM in Site 1 – not detections were recorded at the remaining sites. Risk to construction workers during excavations should be mitigated by the use of appropriate PPE
S4	Landfill Gas	P5	Lateral Migration Subsoil	R7	Current and Future Site Users	Likely	Mild	Moderate Risk	Monitoring indicates that all sites are actively gassing. Offsite gas monitoring completed. Age, extent, volume and composition of waste known.
				R8	Construction Workers	Likely	Severe	High Risk	
				R9	Adjacent Buildings	Likely	Severe	High Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
					and Structures				Potential for exposure to construction workers during excavations. The installation of hardstand as part of the proposed development may promote off site lateral gas migration. Potential for ingress to existing and proposed buildings and structures. Potentially, landfill gas migration could occur into existing adjacent buildings through cracks within the floor slab construction and/or around service/utility routes. If the proposed development does not proceed risks associated with gas migration into existing buildings should be considered further by the Local Authority.
				R10	Non-designated Land	Low Likelihood/Likely	Minor	Very Low/Low Risk	
S4	Landfill Gas	P6	Lateral Migration Groundwater	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	Landfill gas known to be present onsite. Offsite gas monitoring completed. Age, extent, volume and composition of waste. Groundwater and leachate levels established
				R8	Construction Workers	Unlikely/Low Likelihood	Severe	Low/ Moderate Risk	
				R9	Adjacent Buildings and Structures	Low Likelihood	Severe	Moderate Risk	
S4	Landfill Gas	P7	Vertical Migration Subsoil	R7	Current and Future Site Users	Low Likelihood	Mild	Low Risk	Existing clay cap c.1-2m . The lack of an engineered cap will enable vertical migration of gas and atmospheric dispersion and dilution at surface. No buildings proposed to be constructed on waste bodies. Landfill gas known to be present onsite however no credible dataset available. No
				R8	Construction Workers	Likely	Severe	High Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
				R9	Adjacent Buildings and Structures	Likely	Severe	High Risk	offsite monitoring completed. Age, extent, volume and composition of waste known. Water level and effect on gassing regime known. Potential for exposure to construction workers during excavations. Potential for ingress to existing and proposed buildings and structures. Vegetation die back noted.
				R10	Vegetation Stresses/Ecology	Likely	Minor	Very Low/Low Risk	
S4	Landfill Gas	P8	Existing & Proposed Services Routes	R9	Adjacent Buildings and Structures	Likely	Severe	Moderate Risk	Offsite gas monitoring known to have been completed. No buildings proposed to be constructed on waste bodies.

5.2.2 Revised Risk Classification

In light of the results of the Tier 2 investigation and the highest risk pollutant linkages identified in the updated CSM presented in **Table 5.1** the original risk classification has not been updated. Tier 3 Quantified Risk Assessments have however been undertaken to evaluate the risk associated with key pollutant linkages identified. -

6 TIER 3 QUANTITATIVE RISK ASSESSMENT

6.1 GENERIC QUANTIFIED RISK ASSESSMENT (GQRA)

6.1.1 Landfill Gas

The Department of the Environment published a document '*Protection of New Buildings and Occupants from Landfill Gas'* in 1994. This document outlines the high level requirements for landfill gas assessment and guidelines that should be considered.

The guidelines include a recommendation that *houses with private gardens should not be erected within 50m of any landfill site where the concentration of methane exceeds one per cent (1%) by volume or where the concentrations of carbon dioxide exceeds one-half per cent (0.5%) by volume or where the landfill still has the potential to produce large quantities of gas*. This recommendation is not based on a risk assessment approach.

It is now considered that this document is out of date, although it is noted that it has not been withdrawn and is still referenced as a guidance document. It has been superseded by CIRIA Report C665 which represents the current best practice guidance in relation to ground gas assessment. It should be noted that this document does not make any reference to minimum offset distances for developments. The purpose of the risk assessment based approach is to determine the appropriate mitigation measures to appropriately deal with the risk posed by the gas.

CIRIA Report C665 proposes a holistic approach to gas risk assessment, taking account of the following factors:

- Nature of source and migration pathway;
- Borehole flow rate and surface emission rate;
- Frequency and distribution of elevated gas concentrations;
- Nature of any future development; and
- Confidence and reliability of results.

In accordance with Section 8.1.2 of CIRIA C665 for closed landfill sites and Made Ground

> *The risk assessment approach discussed in Section 8.2 can be adopted to screen potential risks or classify the ranges of measured gas concentrations and emission rates. This will determine the type of protective measures in buildings, calculate the vent trench dimensions, or determine that development is not suitable for the location.*

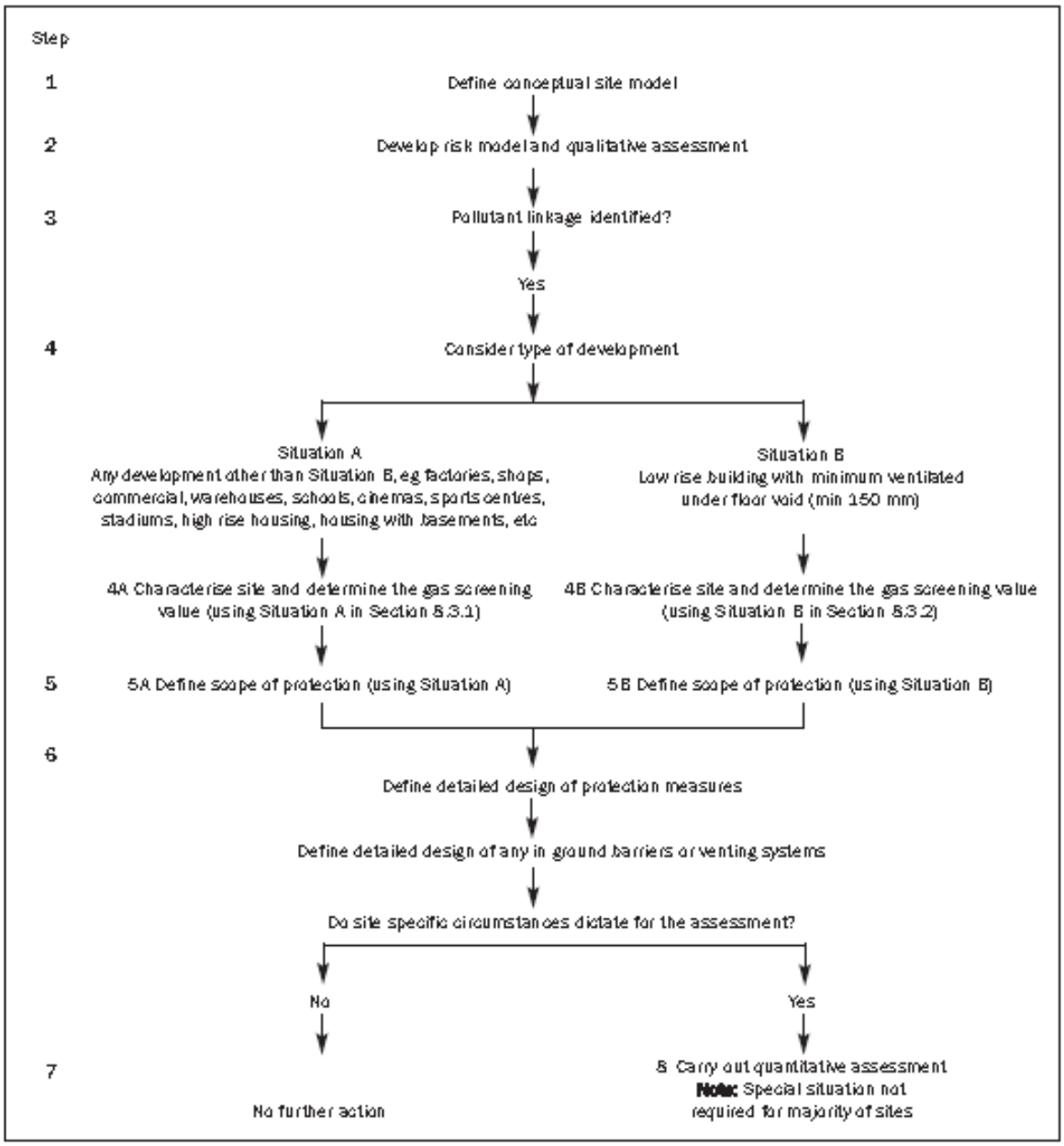


Figure 23 Risk Assessment Process for Methane and Carbon Dioxide (from CIRIA C665)

6.1.1.1 Gas Sources and Migration Pathways

The main gas source is considered to be the waste within each of the five historic landfills Site 1, 2, 3A, 3B and 3C. As detailed in **Table 5.1 and Table 5.2** there are several pathways for the gas to migrate;

- Lateral migration subsoil
- Lateral migration groundwater
- Vertical migration subsoil
- Existing and proposed services routes

Production phases of typical landfill gas is described in the 1997 EPA Report gas production and divided into 4 phases, Phase I is aerobic with phases II – IV anaerobic. Table 3.1 details the data from the EPA Section 22 Register. This dates the end date for site 2 as 1991 and sites 3B and 3C as 1995. There are no known records detailing the end dates for site 1 and site 3A. Given the waste is over 20 years old with a low to moderate flow production, this suggests the gas production is in the later stages of degradation and in line with Phase IV.

The source and pathways for each site are discussed below.

Site 1

As discussed in section 5.1.2 the waste material within site 1 is dominantly C&D waste with pockets of municipal waste with a maximum depth of waste of 14mbgl.

The waste is located above the water-table with an unsaturated zone thickness of over 5m. These unsaturated unconsolidated sands and gravel deposits are considered to represent the primary gas migration pathway, providing both lateral and vertical migration pathways for landfill gas. Gas migration may also occur at depth within the bedrock deposits, but this is considered a secondary pathway given its depth, permeability and position with respect to the groundwater table. As the waste is located above the water-table it is considered a secondary pathway as dissolved gas could travel laterally through groundwater. Migration of dissolved gases (due to the saturation limit) would be considered a secondary gas migration pathway. This will be further assessed following completion of additional rounds of gas and environmental monitoring.

Available records do not show the presence of existing services within or in close proximity to site 1, however the proposed development may include services within or near site 1 and they will need to be considered as potential pathways for gas.

Site 2

The waste material for site 2 is dominantly municipal with a maximum measured depth of 19mbgl.

Following the site investigations and as detailed in section 5.1.3 the majority of the waste body is located above the water-table within an unsaturated zone with a thickness of greater than 5m. The unsaturated sands and gravel deposits provide both a lateral and vertical migration pathway for gas via the pore spaces.

The majority of the waste is located above the water table, however, the lowest levels of the waste body are saturated and may possibly be in hydraulic connection with the underlying water-table. This could result in a potential pathway for soluble gases in the groundwater.

Site 3A

For site 3A the waste material is dominantly comprised of municipal waste with a maximum measured depth of 16mbgl.

As detailed in section 5.1.4 the waste body at site 3A appears to be mainly unsaturated with only a minor depth of leachate head to the north of the site. The groundwater elevation is considered to be located directly underneath the site but there may be a marginal unsaturated zone between the two. The unsaturated sands and gravel zone can provide both lateral and vertical migration pathways via pore spaces for generated landfill gas at the site.

Based on current records of existing services at site 3A the only known services are overhead and therefore do not create a pathway for the landfill gas to travel. This phase of the proposed development does not envisage any services to be constructed at site 3A therefore this is not considered to be a viable pathway at this time. However should future development be considered at this site a further assessment is recommended.

Site 3B

The waste material at site 3B is relatively shallow and is comprises mainly municipal waste with a maximum measured depth of 4.9mbgl.

The water-table is relatively shallow but it would appear the waste body is perched above the water-table. Some deeper portions of the waste body are saturated to the north. This would suggest dissolved landfill gas could migrate laterally through the groundwater. This will be further assessed following the completion of the additional gas and environmental monitoring.

The unsaturated sands and gravel zone can provide both lateral and vertical migration pathways for landfill gas.

Current records do not show any existing services present at site 3B.

Site 3C

The waste material in site 3C is dominantly municipal waste with a maximum depth of 13mbgl. The base of the waste would appear to be saturated and in direct connection with the watertable in the underlying sand and gravel deposits providing both lateral and vertical pathways for dissolved gas through groundwater.

Based on current records there are no known services at site 3C and there is currently no proposed development within this area but should a development be proposed the potential for migration of gas through proposed services should be assessed.

West of Site 2 and east of the existing water main, the geophysical report discussed in Section 4.3.1 shows pockets of waste along the water main line.

6.1.1.2 Production Phases of Typical Landfill Gas

Based on the 1997 EPA Report gas production is divided into 4 phases, Phase I is aerobic with phases II – IV anaerobic. **Table 3.1** details the data from the EPA Section 22 Register. This dates the end date for Site 2 as 1991 and Sites 3B and 3C as 1995. There are no known records detailing the end dates for site 1 and site 3A. Given the waste is over 20 years old with a low to moderate flow production, this suggests the gas production is in the later stages of degradation and in line with Phase IV.

6.1.1.3 Hydrogen Sulphide and Carbon Monoxide

A review of the hydrogen sulphide and carbon monoxide results were also completed for each site. A summary of the dataset is presented in Table 6.1.

Table 6.1 - Summary of Hydrogen Sulphide and Carbon Monoxide Monitoring Results

Location	Count of H2S	Max of H2S (ppm)	Count of CO	Max of CO (Ppm)
Site 1				
		Offsite		
BH05	17	0	17	0
G06	18	0	18	0
G07	18	0	18	0
G08	18	0.013	18	0
G10	18	0	18	0
G18	18	0	18	0
G19	18	0	18	0
		Onsite		
LG 11	18	0	18	10
LG 12	18	0	18	0
LG 13	18	0	18	0
Site 2				
		Offsite		
BH01	18	0	18	0
BH03	18	0	18	0
BH04	18	0	18	0
BH11	18	0	18	0
BH13	18	0	18	0
G01	18	0	18	0
G02	18	0	18	0

Location	Count of H2S	Max of H2S (ppm)	Count of CO	Max of CO (Ppm)
G03	18	0	18	0
G04	18	0	17	0
G05	17	0	17	0
G13	18	0	18	0
G20	18	0	18	0
G21	18	0	18	0
G22	18	0	18	0
G23	18	0	18	0
G24	18	0	18	0
G25	18	0	18	0
Onsite				
LG 01	17	0	17	0
LG 02	18	0	18	0
LG 03	18	0	18	0
LG 04	17	50	17	10
LG 05	18	0	18	0
LG 06	18	0	18	0
LG 07	18	0	18	10
LG 08	18	0	18	14
LG 09	18	0	18	0
LG 10	18	0	18	0
Site 3A				
Offsite				
BH07	18	0	18	0
BH09	18	0	18	0
BH10	18	0	18	0
G12	18	0	18	0
G14	18	0	18	0
Onsite				
LG 15	18	0	18	10
LG 19	18	30	18	0
LG 20	18	87	18	10
MW3 (25 dia. Pipe)	18	25	18	0
MW3 (50 dia. Pipe)	17	0	16	0
MW4	18	40	18	0
Site 3B				
Offsite				
BH08	18	0	18	0
G15	18	0	18	0
G16	18	0	18	0
G17	18	0	18	0
Onsite				
LG 16	18	0	18	32
LG 17	17	0	17	10
LG 21	17	0	17	0
Site 3C				
Offsite				
BH06	18	0	18	0
G09	18	0	18	0
G11	18	0	18	10
Onsite				
LG 14	18	50	18	0
LG 18	18	40	18	0
MW2	18	210	18	0

Full details of hydrogen sulphide and carbon monoxide monitoring are in Appendix J.

6.1.1.4 Borehole flow rate

A review of the borehole flow rates results is presented in Table 6.2.

Table 6.2 - Summary of Flow Monitoring Results (peak and steady)

Location	Number of Flow measurement (Peak)	Max of Flow Measurement (Peak) (l/hour)	Number of Flow measurement (Steady)	Max of Flow Measurement (Steady) (l/hour)
Site 1				
Offsite				
BH05	16	9	17	9
G06	18	6.6	18	3.5
G07	18	7.1	18	6.9
G08	17	6.5	18	6.3
G10	16	3.4	18	3.1
G18	16	0.4	18	0.3
G19	17	1.2	18	0.6
Onsite				
LG 11	16	0.4	18	0
LG 12	16	2.8	18	0.7
LG 13	16	4	18	0
Site 2				
Offsite				
BH01	16	3.6	18	3.4
BH03	17	10.2	18	10.2
BH04	17	11.4	18	10.8
BH11	17	7.5	18	7.2
BH13	17	5.2	18	4.7
G01	15	3.9	18	3.8
G02	18	3.9	18	5
G03	17	5.4	18	4.7
G04	18	0.4	18	0.1
G05	16	6.5	17	6.3
G13	18	6.7	18	6.4
G20	16	13.8	18	13.6
G21	16	6.5	18	5.8
G22	17	20	18	19.8
G23	17	3.5	18	3.4
G24	17	11	18	10.5
G25	17	9.3	18	9
Onsite				
LG 01	17	3.1	17	2.5

Location	Number of Flow measurement (Peak)	Max of Flow Measurement (Peak) (l/hour)	Number of Flow measurement (Steady)	Max of Flow Measurement (Steady) (l/hour)
LG 02	17	7.4	18	7
LG 03	17	5.4	18	4.3
LG 04	16	10.8	17	7.6
LG 05	18	7.1	18	7
LG 06	17	7.3	18	3.3
LG 07	18	3.9	18	3.9
LG 08	18	4.9	18	4.6
LG 09	18	7.8	18	6
LG 10	18	5.5	18	4.8
Site 3A				
Offsite				
BH07	17	5.9	18	1.6
BH09	17	2.2	18	1.6
BH10	17	4.2	18	1.6
G12	17	1.9	18	1.4
G14	16	4	18	1.3
Onsite				
LG 15	18	6.4	18	5.8
LG 19	18	45.6	18	45
LG 20	18	26.7	18	26.5
MW3 (25 dia. Pipe)	13	1.6	10	1.5
MW3 (50 dia. Pipe)	16	5	16	4.9
MW4	18	44.8	18	43.5
Site 3B				
Offsite				
BH08	16	3.7	18	1.4
G15	16	3.1	18	1.3
G16	16	0.3	18	0.1
G17	16	2.2	18	2.2
Onsite				
LG 16	18	4.3	18	3.3
LG 17	16	6.6	16	6.2
LG 21	16	3.1	16	2.5
Site 3C				
Offsite				
BH06	16	3.4	18	0.9
G09	17	4	18	3.1
G11	16	3.4	18	1.2
Onsite				
LG 14	18	2.8	18	1.9
LG 18	18	3.7	18	1.2

Location	Number of Flow measurement (Peak)	Max of Flow Measurement (Peak) (l/hour)	Number of Flow measurement (Steady)	Max of Flow Measurement (Steady) (l/hour)
MW2	16	19.5	17	11.7

Full details of flow rates are in Appendix J.

6.1.1.5 Nature of the Proposed Development

Whilst the detailed layout has yet to be confirmed, any future development will comprise a mixed commercial and residential development. It is anticipated that no buildings would be located within the landfill areas and these would be developed instead as open space/amenity.

6.1.1.6 Confidence and Reliability of Results

It should be noted that the gas risk assessment is based upon eighteen rounds of monitoring and provides an initial indication of gas risks only. The monitoring period covers a wide range in weather conditions and atmospheric pressure. The current dataset complies with minimum monitoring requirement stated by CIRIA C665 guidance, in excess of 10 rounds although it could be extended to 24 months due to very high generation potential and high sensitivity of development.

6.1.1.7 Gas Risk Assessment

Any future development will include mixed use development including low rise housing. Given the proposed mixed use of the development the Wilson and Card has been utilised for Situation A and the NHBC traffic light classification has also been used for low rise residential development (Situation B)[7].

6.1.1.8 Wilson and Card Methodology

As detailed in CIRIA C665 the Wilson and Card method is used for all development types except those in Situation B. This method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flow for methane and carbon dioxide. The limiting borehole gas volume flow is renamed as the gas screening value (GSV).

Gas screening value (litres/hour) = max borehole flow rate (l/hr) x max gas concentration (%) / 100.

Table 6.3 presents the Gas Screening Value calculation carried out for both methane and carbon dioxide. The maximum steady flow rate has been used and the worst case screening value between methane and carbon dioxide is adopted for the classification.

[7] Low rise residential development is considered to be a non flat/apartment development consisting of one to three stories in height.

Table 6.3 - Gas Screening Value Calculation (Wilson and Card Methodology)

Location	Max of Flow (Peak)	Max of CH4 (%)	Max of CO2 (%)	Gas Screening Value	Class
Site 1					
Onsite	0.7	13.6	18.9	0.13	CS2
Offsite	9	23.9	8.1	2.15	CS3
Site 2					
Onsite	7.6	73.7	36.6	5.60	CS4
Offsite	19.8	55.7	25.5	11.03	CS4
Site 3A					
Onsite	45	71.7	37	32.27	CS5
Offsite	1.6	0	3.2	0.05	CS1
Site 3B					
Onsite	6.2	73.1	39.4	4.53	CS4
Offsite	2.2	0	4.2	0.09	CS2
Site 3C					
Onsite	11.7	83.5	37.2	9.77	CS3
Offsite	3.1	22.2	19.6	0.69	CS2

6.1.1.9 NHBC Traffic Light System

The NHBC have developed a characterisation system that is similar to the Wilson and Card system, but is specific to low-rise housing development with a clear ventilated underfloor void. This is a risk-based approach that is designed to allow an identification of gas protection for low-rise housing developments by comparing the measured gas emission rates to generic "traffic lights" scenarios. The traffic lights include "typical maximum concentrations" and are provided for initial screening purposes and risk-based gas screening values (GSVs) for consideration in situations where the typical maximum concentrations are exceeded.

This method is carried out for both methane and carbon dioxide.

It should be noted that the method used to develop the GSV thresholds in Table 8.7 of CIRIA C665 is based on a number of assumptions regarding the proposed structures. For the purpose of this assessment it is assumed the low rise development for the site is as per CIRIA guidance

Following the completion of the Wilson and Card screening it was decided to complete NHBC traffic light system for all sites due to the potential of low rise housing in the proposed development.

Using table 8.7 from *CIRIA C665 Assessing risks posed by hazardous ground gases to buildings* along with peak methane, carbon dioxide and GSV (calculated using Modified Wilson and Card), the following tables detail the Traffic Light Classification for all sites.

Table 6.4 – Traffic Light Classification - Methane

Site Number	Position	Peak methane	GSV (l/hr)	Traffic Light

		(% v/v)		Classification
1	Onsite	13.60	0.10	Green
	Offsite	23.90	2.15	Red
2	Onsite	73.70	5.60	Red
	Offsite	55.70	11.03	Red
3A	Onsite	71.70	32.27	Red
	Offsite	0.00	0.00	Green
3B	Onsite	73.10	4.53	Red
	Offsite	0.00	0.00	Green
3C	Onsite	83.50	9.77	Red
	Offsite	22.20	0.69	Amber2

Table 6.5 – Traffic Light Classification – Carbon Dioxide

Site Number		Peak carbon dioxide (% v/v)	GSV (l/hr)	Traffic Light Classification
1	Onsite	18.90	0.13	Green
	Offsite	8.10	0.73	Green
2	Onsite	36.60	2.78	Amber2
	Offsite	25.50	5.05	Amber2
3A	Onsite	37.00	16.65	Red
	Offsite	3.20	0.05	Green
3B	Onsite	39.40	2.44	Amber2
	Offsite	4.20	0.09	Green
3C	Onsite	37.20	4.35	Red
	Offsite	19.60	0.61	Green

6.1.1.10 Proposed Protection Measures

Wilson and Card

In accordance with Table 8.6 of CIRIA C665 the typical scope of gas protection measures proposed are presented for each site area in **Table 6.6** for the characteristic situation for each site using the Wilson and Card method.

Table 6.6 – Proposed Protection Measures – Wilson and Card

Characteristic Situation	Site Area	No. of levels of protection	Gas Protection Measures (Situation B)
CS1	Site 3A - offsite	None	No special precautions
CS2	Site 1 onsite Site 3B offsite Site 3C offsite	2	a. Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM^2 and underfloor venting b. Beam and block or pre-cast concrete and 2000g DPM/ reinforced gas membrane and underfloor venting. All joints and penetrations sealed.
CS3	Site 1 offsite	2	All types of floor slabs as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space.
CS4	Site 2 onsite & offsite Site 3B onsite Site 3C onsite	3	All types of floor slabs as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space
CS5	Site 3A onsite	4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressured underfloor sub-space, oversite capping and in-ground ventilating layer and in-ground venting wells or barriers
CS6		5	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design

Whilst CIRIA C665 sets out typical gas protection measures this guidance has been superseded with respects to the detailed design of gas protection measures. The detailed gas protection system shall be designed in accordance with relevant guidance, including but not limited to:

- BS 8485:2015 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BSI, 2015);
- Protecting development from methane (CIRIA, 1995); and
- Assessing risks posed by hazardous ground gases to buildings (CIRIA. 2007).

Where these standards conflict, the most up to date relevant guidance will be applied.

Traffic Light System

Based on the traffic light classification for each site for low rise housing development only, the scope of protections measures as defined in Box 8.4 of CIRIA C665 are presented in **Table 6.7**.

Table 6.7 – Proposed Protection Measures – Traffic Light System

Traffic light classification	Site Number	Protection measures required
Green	Site 3A offsite Site 3B offsite	Negligible gas regime identified and gas protection measures are not considered necessary
Amber 1		Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414 (Johnson, 2001). Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Site 1 onsite	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414 (Johnson, 2001). Membranes should always be fitted by a specialist contractor. As with amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	Site 1 Offsite Site 2 onsite & offsite Site 3A onsite Site 3B onsite Site 3C onsite & offsite	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further gas risk assessment and/ or possible remedial migration measures to reduce and/or remove the source of gas.

As set out above, detailed gas protection system shall be designed in accordance with relevant guidance, including but not limited to:

- BS 8485:2015 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BSI, 2015);
- Protecting development from methane (CIRIA, 1995); and
- Assessing risks posed by hazardous ground gases to buildings (CIRIA. 2007).

Where these standards conflict, the most up to date relevant guidance will be applied.

6.1.1.11 Summary of Gas Risk Assessment

The Fassaroe Historic Landfill sites lie within the area of Fassaroe, Bray, Co. Wicklow which is zoned for major new development under the Draft Bray Municipal District Local Area Plan 2018. The lands are zoned for residential high density (R-HD) new development with existing residential (RE), open space (OS1 and OS2), active open space (AOS), and neighbourhood centre (NC).

A review of the gas regime at the site (based on the currently available information) suggests that the main gas generation at the site is the waste within the landfills. The main pathway for gas migration from the waste materials is considered to be through the permeable superficial deposits, with limited contributions through groundwater and the deeper bedrock deposits which are considered to be of a lower permeability.

Following the completion of the Wilson & Card and the Traffic Light assessments the proposed protection measured for each site are detailed in **Table 6.6**and **Table 6.7**. Protection measures will need to include gas barriers to prevent migration of gases from the landfills where further monitoring cannot dismiss the risk from gas within the proposed development areas.

We would recommend that a gas management strategy is developed for the site, taking account of the available data and any future development layout. This strategy should identify the gas protection measures that can be installed to limit gas migration from the landfills and the protection measures that will be required to properties, supported by relevant appraisal / assessment. This strategy will need review and update once the further information is available.

6.1.2 Human Health Risk Assessment

6.1.2.1 Introduction

This section assesses the risk to human health as a result of soil contamination identified at the site. Data confirming the contamination status of soils at the site has been derived from multiple stages of investigation, the most recent and comprehensive data being provided by the ground investigation undertaken by RPS in 2015. The assessment is constrained to the extents of the known landfills (5 no.) and considers the available data and compares it against relevant screening criteria. A tabulated summary of the results is provided within *Appendix K.*

6.1.2.2 Risk Assessment Methodology

The assessment of risks posed to human health by the presence of soil contaminants is based upon the guidelines outlined in CLR11 (*DEFRA & EA, 2004*), which provides a framework for risk assessment and follows the tiered process, with each subsequent tier involving a higher degree of input into the assessment should risks above tolerable levels be identified within the previous tier. This approach is outlined below.

6.1.2.3 Tier 1 – Qualitative Risk Assessment

This stage qualitatively identifies each of the Source-Pathway-Receptor components that are present on site, which forms the basis of the risk assessment approach. The Tier 1 assessment is presented within the Preliminary Risk Assessment in Section 3.5.

6.1.2.4 Tier 2 – Generic Quantitative Risk Assessment (GQRA)

The Tier 2 risk assessment aims to identify contaminants of concern and their spatial distribution and requires benchmarks against which to compare the concentrations of soil contaminants. This requires the comparison of contaminant concentrations with a relevant standard.

There are a number of standards available that may be adopted, although none provide a complete up to date list of screening criteria. Consideration has been given to the following standards when selecting a set of screening criteria:

Soil Guideline Values (SGV 2009) published by the UK Environment Agency

- Category 4 Screening Levels (C4SLs), published by CL:AIRE 2014, CL:AIRE SP1010 Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, September 2014 (DEFRA in 2014); and
- Suitable 4 Use Levels (S4ULs), Published by LQM, 2015. Land Quality Management Ltd, the LQM/CIEH S4ULs for Human Health Risk Assessment (LQM in 2015) ;

The standard selected should take consideration of the purpose of the assessment. This assessment is being undertaken in support of a planning application and on this basis the following standards shall be applied for the stated contaminants:

- Suitable 4 Use Levels (S4ULs), for all contaminants for which there are published values;
- Category 4 Screening Levels (C4SLs), for lead; and
- Generic Assessment Criteria (GAC) developed by Contaminated Land: Application in Real Environments (CL:AIRE), 2010. Soil Generic Assessment Criteria for Human Health Risk Assessment (CL:AIRE) for where there are no S4ULs or C4SLs available.

Where asbestos has been identified as a Contaminant of Concern (CoC) this has also been considered. In the absence of a screening criteria the Laboratory Limit of Detection (LLoD) has been used as a screening criteria.

6.1.2.5 Application of Screening Criteria

A comparison with the selected criteria provides the risk assessor with an indication as to whether a particular contaminant may pose a risk to human health and whether additional assessment is required. A site specific appraisal is required to establish the statistical basis on which the contaminant concentrations should be assessed and compared against the standards. This appraisal should consider the following:

- The nature and cause each contaminant at the site;
- If the contamination is likely to be present in 'hotspots' or is likely to be distributed horizontally and / or vertically within the site;
- The suitability of the data set for statistical treatment; and
- The site use and layout (existing or proposed depending on the purpose of the assessment).

A consideration of the above allows the assessor to consider the most appropriate statistical treatment of the data to allow comparison with the selected standard, including the use of:

- Maximum values;
- Segregation of data by lithology;
- Ninety-fifth percentile Upper Confidence Levels (95% UCL) and outliers; and

- Averaging areas.

Table 6.8 presents the selected approach for the site together with a justification for the selected approach.

Table 6.8 – Summary of Selected Statistical Approach

Contaminant	Data Treatment Option			
	Maximum Value or 95% UCL and outliers	Segregation of Data by Lithology	Averaging Areas	Justification
Inorganic Contaminants	Maximum Value and 95% UCL and outliers if required	Yes	Yes	Data derived from 5 different landfills which are geographically distinctive. Capping and landfilled materials are considered to represent different contamination 'sources' and therefore the results have been separated as such for the assessments. For these reasons, for the most part, the datasets are too small for the calculation of the 95% UCL value and maximum values have been compared against screening criteria. If an exceedance of screening criteria is observed, where datasets are large enough, 95% UCL statistical analysis has been undertaken.
PAH and TPH	Maximum Value and 95% UCL and outliers if required	Yes	Yes	Data derived from 5 different landfills which are geographically distinctive. Capping and landfilled materials are considered to represent different contamination 'sources' and therefore the results have been separated as such for the assessments. For these reasons, for the most part, the datasets are too small for the calculation of the 95% UCL value and maximum values have been compared against screening criteria. If an exceedance of screening criteria is observed, where datasets are large enough, 95% UCL statistical analysis has been undertaken.
VOCs	Maximum Value	Yes	N/A	Significant majority of laboratory analysis results below the laboratory detection limit, so statistical analysis is not required.

6.1.2.6 Tier 2 – Generic Quantitative Risk Assessment

The following sections provide a summary of the findings of the risk assessment for the capping and landfilled materials within each of the five landfills.

6.1.2.7 Inorganic Contaminants

Capping Materials

Tables 1 and 3 of *Appendix K* summarise the results of the laboratory analysis for inorganic contaminants encountered within soils within the capping layer within Sites 1, 2, 3A, 3B and 3C, and compares them with the relevant screening values for a public open space (parks) end use.

Comparison with the screening criteria identifies that concentrations of inorganic contaminants within the capping materials are low and that the identified concentrations lie below the relevant

screening criteria. On this basis it is considered that the identified concentrations of inorganic contaminants within the capping layer within each of the 5 landfills are unlikely to pose an unacceptable risk to human health for a future public open space (parks) end use.

Landfill Materials

Tables 2, 4, 5, 6 and 7 of *Appendix K* summarise the results of the laboratory analysis for inorganic contaminants encountered within the landfill materials within Sites 1, 2, 3A, 3B and 3C and compares them with the relevant screening values for a public open space (parks) end use.

Comparison with the screening criteria identifies that the concentrations of inorganic contaminants within the landfill materials are generally low and in the majority of cases lie below the relevant screening criteria. The exception to this is lead within Site 2, where a concentration of 4,955 mg/kg was recorded within the landfill materials within trial pit TP6 (excavated during a previous ground investigation) lying above the screening value of 1,300 mg/kg. Statistical analysis of the dataset has derived a 95% UCL of 1,903.07 mg/kg for lead, again lying above the screening criteria. The statistical analysis indicates 5 statistical lead outliers to be present, however due to the likely heterogeneous nature of landfilled materials, it is considered that these outliers cannot be excluded from the statistical dataset.

On this basis therefore, it is considered that identified concentrations of lead within the landfill materials in Site 2 may present an unacceptable risk to human health for a future public open space (parks) end use.

6.1.2.8 Total Petroleum Hydrocarbons (TPH) and BTEX Compounds

Capping Materials

Tables 1 and 3 of *Appendix K* summarise the results of the laboratory analysis for TPH / BTEX soil analysis contaminants encountered within soils in the capping materials in Sites 1, 2, 3A, 3B and 3C and compares them with the relevant screening values for a public open space (parks) end use.

Comparison with the screening criteria identifies that the concentrations of TPH / BTEX within the capping materials are low and that all determinants lie below the relevant screening criteria. On this basis therefore it is considered that the identified concentrations of TPH / BTEX contaminants within the capping layer within each of the 5 landfills are unlikely to pose an unacceptable risk to human health for a future public open space (parks) end use.

Landfill Materials

Tables 2, 4, 5, 6 and 7 of *Appendix K* summarise the results of the laboratory analysis for TPH / BTEX soil analysis contaminants encountered within soils in the landfill materials in Sites 1, 2, 3A, 3B and 3C and compares them with the relevant screening values for a public open space (parks) end use.

Comparison with the screening criteria identifies that the concentrations of TPH / BTEX within the landfill materials are low and that all determinants lie below the relevant screening criteria. On this basis therefore it is considered that identified concentrations of TPH / BTEX contaminants within the

landfill materials within each of the 5 landfills are unlikely to pose an unacceptable risk to human health for a future public open space (parks) end use.

6.1.2.9 Polycyclic Aromatic Hydrocarbons (PAH)

Capping Materials

Tables 1 and 3 of *Appendix K* summarise the results of the laboratory analysis for PAH contaminants encountered within soils in the capping materials in Sites 1, 2, 3A, 3B and 3C and compares them with the relevant screening values for a public open space (parks) end use.

Comparison with the screening criteria identifies that concentrations of PAH within the capping materials are low and generally lie below the relevant screening criteria. The exception to this is dibenzo(ah)anthracene within Site 2, where a concentration of 1.2 mg/kg was encountered within borehole LG10, marginally exceeding the screening criteria of 1.1 mg/kg. Only 1 sample from this material was analysed for the presence of PAHs and therefore no statistical analysis of the dataset can be undertaken.

On this basis it is considered that dibenzo(ah)anthracene within the capping material within Site 2 may pose an unacceptable risk to human health for a future public open space (parks) end use.

Landfill Materials

Tables 2, 4, 5, 6 and 7 of *Appendix K* summarise the results of the laboratory analysis for PAH contaminants encountered within soils in the landfill materials in Sites 1, 2, 3A, 3B and 3C and compares them with the relevant screening values for a public open space (parks) end use.

Comparison with the screening criteria identifies that the concentrations of PAH within the landfill materials are low with a small number of exceedances of the relevant screening criteria:

- Benzo(b)fluoranthene within Site 1, within borehole LG13, with a concentration of 19 mg/kg exceeding the screening criteria of 13 mg/kg;
- Benzo(a)pyrene within Site 1, within borehole LG13, with a concentration of 15 mg/kg exceeding the screening criteria of 11 mg/kg;
- Dibenzo(ah)anthracene within Site 1, within borehole LG11, with a concentration of 1.9 mg/kg exceeding the screening criteria of 1.1 mg/kg; and
- Dibenzo(ah)anthracene within Site 2, within borehole LG04, with a concentration of 2.9 mg/kg exceeding the screening criteria of 1.1 mg/kg.

Statistical analysis of the dataset has shown that the 95% UCL for the majority of these contaminants lie marginally above the respective screening criteria, the exception being benzo(a)pyrene within Site 1. The statistical analysis indicates a number of statistical outliers to be present for each of the PAH contaminants, however due to the likely heterogeneous nature of landfilled materials, it is considered that these outliers cannot be excluded from the statistical dataset.

On this basis therefore it is considered that identified concentrations of PAH within the landfill materials in Sites 1 and 2 may potentially pose an unacceptable risk to human health for a future public open space (parks) end use.

6.1.2.10 Other organic compounds [Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), and Phenols]

Tables 1 to 7 within *Appendix* K summarise the results of the laboratory results for VOC, SVOC and phenol analysis, where encountered above the laboratory detection limit and compares them with CL:AIRE GACs for a residential without plant uptake end use scenario.

VOCs, SVOCs and Phenols were encountered at generally low concentrations, predominantly lying below the laboratory detection limit, with no concentrations exceeding the appropriate screening values, where such values exist. On this basis therefore it is considered that identified concentrations of VOCs, SVOCs and Phenols are unlikely to pose a risk to human health.

6.1.2.11 Asbestos

A total of 53 soil samples obtained from the capping and landfill materials were analysed for the presence of asbestos during the recent ground investigation undertaken by RPS.

Asbestos was identified above the laboratory limit of detection within 1 of the 53 samples, where asbestos cement containing amosite and chrysotile was encountered within the landfill materials in Site 1 (TP13 at 2.5 mbgl). The presence of asbestos within the landfill materials is, in general, unlikely to pose a risk to future site users given that an informal capping layer is present over these materials. Where this capping layer is compromised a risk may be present.

In Sites 2 and 3B, where asbestos might be expected to be present, if the exposed landfill faces are not suitably capped, there is a risk that future site users may be exposed to the asbestos contamination.

6.1.2.12 Summary of Risks to Human Health

Future Site Users

The Tier 2 human health risk assessment has identified that contaminant concentrations are generally below the selected screening criteria for a public open space (parks) use.

The risk assessment has identified elevated concentrations of PAHs within the landfill materials in Site 1, elevated concentrations of lead and PAHs within the landfill materials in Site 2 and elevated concentrations of PAH within the capping materials in Site 2. In addition, asbestos containing materials have been encountered at 1 location within the landfill materials in Site 1.

Despite the presence of elevated concentrations of contaminants and the presence of asbestos within the landfilled materials, it is not considered that future site users are likely to be exposed to the contamination due to the depth at which the contamination is present (>1.0 m). With regard to the PAH contamination within the capping materials within Site 2, additional sampling may be

considered to further determine levels of contamination within these materials. Should a clean cap be placed at this location however, this would likely mitigate risks to future site users by preventing exposure to the contamination.

A suitable capping layer should also be constructed in any faces where landfill materials in Sites 2 and 3B are exposed as a result of any future development, to mitigate potential risks to site end users in these areas.

Where site levels are altered, the findings of this risk assessment will require review.

Construction Workers

The human health risk assessment outlined within this section is designed to assess potential long term contamination risks to future site users and as such is not suitable to assess potential, short term, risks to construction workers future development may be proposed in Sites 2 and 3B.

It is considered however that the concentrations of contaminants identified during the ground investigation are unlikely to constitute a risk to construction workers during the development on Sites 2 and 3B where appropriate measures are adopted. Due to the heterogeneous nature of landfilled materials however, there is a possibility that asbestos and areas of gross contamination may be present and a suitable watching brief should be employed during construction for any such contamination. In addition, suitable hygiene and welfare facilities and PPE should be provided in accordance with the requirements of the Safety, Health and Welfare at Work (General Application) Regulations 2007, Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010 amendments and the Safety Health and Welfare at Work (Construction) Regulations 2013 to manage potential risks to construction workers. Appropriate procedures should also be in place to remediate any such contamination encountered during construction in line with the Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010 amendments and the Safety Health and Welfare at Work (Construction) Regulations 2013.

6.1.3 Water Environment Generic Quantified Risk Assessment

The EPA provide guidance on the management of contaminated land sites (EPA 2013) which outlines the requirement for a GQRA, that utilise Generic Assessment Criteria (GAC) to identify pollutant (SPR) linkages for which a Detailed Quantified Risk Assessment (DQRA) should be undertaken.

The GACs adopted for this assessment are those recommended by the EPA. The EPA recommend that values for screening of the impact on groundwater may come from several sources, including the European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. no. 9 of 2010), the EPA's Groundwater Threshold Values (GTVs), the EPA's Interim Guideline Values (IGVs) or relevant Environmental Quality Standards (EQSs), when considering a surface water receptor. For the purpose of the DQRA presented herein the groundwater quality dataset has been compared with the Schedule 5 GTVs presented in the Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (Statutory Instruments No. 366 of 2016) which update / supersede the Schedule 5 GTV's presented in Environmental Objectives (Groundwater) Regulations 2010 (SI No. 9, 2010). The groundwater quality results are compared to all three sets of GACs, and the surface water is only compared to the surface water annual average EQS.

The results of the GQRA provides a list of contaminants/chemicals of potential concern (COPC), in soil, groundwater or surface water, that will be required to be taken forward for DQRA.

6.1.3.1 Aquifer Receptor - *Gravel Aquifer (Receptor R5)*

Analytical results and the results of the screening exercise are presented in Appendix G & H.

The main contaminants of concern (which exceed statutory and guideline threshold values) in the leachate generated from the waste body within the sand and gravel aquifer at each Site are summarised in Section 4.6.2 Leachate Assessment. A summary of that assessment showing the parameters where the leachate concentration exceeded the GAC is presented in **Table 5.26** below.

Table 6.9 – Summary of Leachate Concentrations above GACs

Parameter	Site 1	Site 2	3A	3B	3C
**Denotes a leachate sample from the site exceeded the relevant GAC for this parameter*					
Aluminium	*	*	*	*	*
Ammoniacal Nitrogen	*	*	*	*	*
Arsenic	*	*	*	*	*
Barium	*	*	*	*	*
Boron		*	*	*	*
Cadmium	*		*		*
Calcium	*		*	*	*
Chloride	*	*	*	*	*
Chromium		*	*	*	*
Copper	*	*	*	*	*
Cyanide	*				
Electrical Conductivity		*	*	*	*
Iron	*	*	*	*	*
Lead	*	*	*	*	*
Manganese	*	*	*	*	*
Mercury		*			
Nickel	*	*	*	*	*
Ortho-phosphate	*	*	*	*	*
Potassium	*	*	*	*	*
Sulphate	*				
Sodium		*	*	*	*
Total Dissolved Solids	*	*	*	*	*
Zinc	*	*	*	*	*
TPH	*	*	*	*	*
Benzene			*	*	*
Benzo (a) pyrene	*				

Parameter	Site 1	Site 2	3A	3B	3C
**Denotes a leachate sample from the site exceeded the relevant GAC for this parameter*					
Benzo (b) fluoranthene	*				
Ethyl Benzene			*		
Fluoranthene	*				
m&p-Xylene			*		
MTBE			*		
Naphthalene	*	*	*		*
Phenol			*	*	*
Total PAHs	*	*	*	*	*
Toluene			*	*	
Trans-1,2-dichloroethene			*		
Vinyl Chloride			*	*	

A number of other organic compounds (including 2,4-diethyphenol, 3&4-methylphenol, 3,5-diemthyphenol and various PAHS) have also been identified in leachate although no appropriate water assessment criteria are available.

A number of the contaminants of concern as listed in **Table 6.9** are considered to be leachate marker parameters considering their particularly high concentration within the leachate body in each landfill, the common absence or low background concentrations in groundwater / surface water, particularly where the parameters are characterised by conservative / recalcitrant behaviour during transport in the subsurface. For the purpose of this assessment leachate marker parameters include ammoniacal nitrogen, chloride, the heavy metal arsenic and petroleum hydrocarbons.

The results of geophysical surveys confirm the presence of a leachate plume beneath the landfill sites.

Groundwater samples taken down-gradient of the waste bodies confirm: elevated levels of ammoniacal nitrogen (e.g. at Site 2); a number of heavy metals down-gradient of Sites 2, 3A and 3B, although trace organics remain below LoD. There are no down-gradient groundwater boreholes at Site 1 or 3C however based on observations of leachate quality and the similarly of the hydrogeological environment to the other sites and the evidence from the geophysical surveys it is reasonable to assume the presence of a contamination plume moving down-gradient.

Up-gradient groundwater samples have also shown elevated levels of ammonia (at Site 1) and heavy metals at all sites. This may indicate there is significant infiltration through the leachate and that that a perched leachate head at the up-gradient perimeter of the waste-body is affecting the groundwater quality up-gradient of the site possibly causing localised mounding of the water-table leading to the plume dispersing out from the site. There are no direct up-gradient boreholes at Site 3B. Elevated levels of ammonia and heavy metals, in up-gradient and down-gradient boreholes, indicate groundwater quality beneath all sites has been impacted by the historic landfilling of waste at Fassaroe.

Table 6.10 – Summary of Leachate Markers Parameters for Site 2

Parameter (units)	Leachate Dataset		Groundwater Dataset		Spring Dataset	
	Location	Concentration*	Location~	Concentration*	Location ~	Concentration*
Ammoniacal Nitrogen (mg/l)	LG01 LG03 LG07 LG09 LG10	14.7 – x – x 286 – 270 – x 475 – 310 – 335 439 – 280 – 374 496 – 330 – 67	G20 (u/g) BH1 (d/g)	0.07 – 0.93 - < 0.94 – 2 - x	SP1	25.7 – 18 - <
Chloride (mg/l)	LG01 LG03 LG07 LG09 LG10	25 – x – x 483 – 780 – x 968 – 1100 – 592 866 – 1000 – 705 1190 – 1300 – 115	G20 (u/g) BH1 (d/g)	20.6 – 46 – 6.6 23.3 – 21 - x	SP1	109 – 120 – <
Arsenic (ug/l)	LG01 LG03 LG07 LG09 LG10	77 – x – x 18 – 8.9 – x 205 – 10 – 92 390 – 9.7 – 45 47 – 14 - 17	G20 (u/g) BH1 (d/g)	16 – < - < 29 - < - x	SP1	709 - < - <
TPH (C6-C40) (mg/l)	LG01 LG03 LG07 LG09 LG10	0.143 – x –x 0.286 – 0.310 – x 1.38 - < - x 0.258 - < - x 0.256 – 0.390 - x	G20 (u/g) BH1 (d/g)	< - < < - < - x	SP1	0.047 - < - x

** Data is presented for Round 1 – Round 2 – Round 3; x denotes no sample taken; < denotes below Limit of Detection*
~ u/g denotes up-gradient; d/g denotes down-gradient of landfill site.

The concentration of key leachate marker parameters is summarised in Table 6.10 and Table 6.11 for Site 2 and Site 3A respectively. Data for those sites is presented as they include groundwater monitoring locations that are situated down-gradient or lateral to the landfill site and down-gradient springs. It is evident from the dataset presented that off-site groundwater quality does not demonstrate a large impact from leachate. This may relate to dilution with groundwater or the limitations of the monitoring network considering: the highly elevated concentrations; the evidence of plume development identified from the site geophysics; the absence of down-gradient monitoring locations (due to stability / access constraints); and potential for a greater impact observed on certain (but not all) springs, most notably spring SP1 situated down gradient from landfill Site 2.

Table 6.11 – Summary of Leachate Markers Parameters for Site 3A

Parameter (unit)	Leachate Dataset		Groundwater Dataset		Spring Dataset	
	Location	Concentration*	Location~	Concentration*	Location~	Concentration*
Ammoniacal Nitrogen (mg/l)	LG15 LG19 MW4	81.7 – 100 -157 620 – 540 – 33.8 454 – 590 - 337	BH7 (u/g) BH9 (u/g) BH10 (lat)	< - 0.86 - < < - 3.5 - < < - 14 - <	SP4 SP5	5.8 – 4.1 - < < - 0.075 - <
Chloride (mg/l)	LG15 LG19 MW4	76.9 – 190 – 1070 1400 – 1700 – 47.8 631 – 1100 - 549	BH7 (u/g) BH9 (u/g) BH10 (lat	nm - 28 – 20.5 16.2 – 23 – 12.9 26.1 – 31 – 24.3	SP4 SP5	37.8 – 63 – 70.5 34 – 49 - x
Arsenic (ug/l)	LG15 LG19 MW4	202 – 11 – 187 56 – 73 – 30 64 – 19 - 64	BH7 (u/g) BH9 (u/g) BH10 (lat	18 - < - 49 24 - < - 32 33 – 1.5 - 24	SP4 SP5	127 - < - 15 < - < - x
TPH (C6-C40) (mg/l)	LG15 LG19 MW4	0.783 – 0.64 – x 3.15 – 0.75 – x 0.796 – 1.6 - x	BH7 (u/g) BH9 (u/g) BH10 (lat	< - < - x < - < - x < - < - x	SP4 SP5	< - < - x < - < - x

** Data is presented for Round 1 – Round 2 – Round 3; x denotes no sample taken; < denotes below Limit of Detection*
~ u/g denotes up-gradient; d/g denotes down-gradient of landfill site; nm denotes not measured.

6.1.3.2 Surface Water Receptor

County Brook River (Fassaroe Stream) (Receptor R1)

Surface water concentrations were compared to Environmental Quality Standards (EQS) protective of Freshwater bodies from the Environmental Objectives (Surface Waters) (Amendment) Regulations 2015 (S.I. No. 386 of 2015). These standards are considered to be the most appropriate generic assessment criteria for assessing the risk to surface water courses.

The main contaminants of concern (exceeding EQS) in the County Brook River (Fassaroe Stream) are summarised in Section 4.6.5 Surface Water and include BOD, chromium, copper, lead, nickel and some trace organics. Ammoniacal nitrogen was not identified in surface water at concentrations above the EQS in Round 1. In subsequent rounds ammoniacal nitrogen has been identified at concentrations above the LoD although observed concentrations do not routinely exceed the EQS at any location, with concentrations typically approaching the EQS where present.

Surface water quality exceedances correspond primarily to sampling location SW3 (upstream of Site 1), SW4 (close to Site 3A) and SW5 (up-gradient of all sites). Similarly, detection of hydrocarbons is observed at SW3, SW4 and SW5 and were restricted to Round 1. Surface water quality exceedances above EQS's at SW5 are indicative of contributions from other up-gradient contaminant sources.

There are no exceedances observed at SW1 and SW2, suggesting that Sites 2 has less of an impact on the County Brook River (Fassaroe Stream) than the other sites.

The surface water quality results demonstrate that the landfill sites are likely have the potential of affecting water quality within the County Brook River (Fassaroe Stream), although a measurable and reproducible effect is not evident and any small effects are mitigated by the dilution capacity within the drainage system and main river itself.

Springs (Receptor R4)

Small spring flows were encountered along the river valley, emerging as diffuse up-wellings which coalesce downstream to form a more defined channel that ultimately discharge into the County Brook River (Fassaroe Stream). The spring water is derived from groundwater within the up-gradient sand and gravel aquifer and supports the designated features of the Ballyman Glen SAC. For the purpose of the GQRA the water quality dataset for the five spring samples analysed, identified as being down-gradient of Site 1, 2, 3A and 3B, were compared to Environmental Quality Standards (EQS) protective of Freshwater bodies from the Environmental Objectives (Surface Waters) (Amendment) Regulations 2015 (S.I. No. 386 of 2015), reflecting the fact that spring discharges travel a short distance before discharging to the river. These standards are considered to be the most appropriate generic assessment criteria for assessing the risk to surface water courses.

The main contaminants of concern (which exceed EQS) at all five springs are summarised in Section 4.6.5 Surface Water include BOD, ammoniacal nitrogen and a number of heavy metals including arsenic, chromium and lead.

A summary of the water quality observed at springs considered to be located down-gradient of specific landfill site is presented in **Table 6.10** and **Table 6.11**. These tables present data for the key leachate marker parameters. An impact on water quality was observed in SP1, down-gradient of Site 2, with most EQS exceedances and the highest concentrations of heavy metals and ammonia. Furthermore, SP1 is the only spring sampling location where hydrocarbons and di-n-Butylphthalate where detected, albeit the latter is only marginally above the detection limit. SP4, down-gradient of Site 3A shows exceedances above EQS for arsenic, BOD and ammonia and SP2, down-gradient of Site 1 shows exceedances above EQS for lead, zinc and BOD.

It should be noted that a potential impact on water quality was also observed in SP3, down-gradient of Site 3C where exceedance above the EQS for cadmium, chromium, copper, lead, zinc and BOD are observed, although ammoniacal nitrogen and chloride remain low.

There is no detection of any other trace organic contaminants or hydrocarbons contaminants in the spring water samples with the exception of SP1 (Site 2).

It is therefore possible that concentration of trace organics and hydrocarbons in the River at SW3, SW4 and SW5 are derived from up-gradient contaminant sources such as runoff from the Ballyman Road. Elevated concentrations of BOD and heavy metals are likely to originate from the waste bodies assessed in this report.

Analysis of down-gradient spring water quality confirms that the County Brook River (Fassaroe Stream) has been impacted by the landfilling of waste at Fassaroe, although systematic effects are not clear in all monitoring rounds. It is notable that potential effects at the springs are typically greater than seen in the groundwater samples obtained from the monitoring network.

Tufa Springs & Alkaline Fen (GWDTE within the SAC) (Receptor R2)

Two out of five down-gradient springs (SP1 and SP4) show visual evidence of ochre staining, while the remainder of springs show the presence of tufa (calcite) deposits. The results of environmental monitoring completed to date do not provide a clear or reproducible relationship between the

contamination status of the springs, the measured field parameters and the visual observations for individual springs sampled. The monitoring dataset does identify a measurable effect on spring water quality that can be attributed to the leachate migration from the landfill sites although any associated effect on the surface watercourse is less clear and mitigated by attenuation within the drainage system and surface water course associated with the SAC. Although direct effects have been observed it is not known whether these effects have peaked or are stable, or declining. However, the age of the landfill (typically filling in the early 1990s or earlier), the rapid transport expected along the short pathway in the sand and gravel (between the landfill sites and springs within the SAC), and gas dataset showing highly methanogenic albeit generally stable conditions would suggest that effects on the SAC should have established themselves.

The evidence collected to date demonstrates that the five landfill sites have the potential to affect conditions with the Alkaline Fen of the Ballyman Glen SAC and associated watercourse. It is possible that this affect could have a localised impact on tufa forming potential within a small number of the streams situated downstream of affected springs and the quality within therein. The ecological appraisal of the SAC will determine the extent and significance of any measurable and visual effects on the designated features of the Ballyman Glen SAC (i.e. tufa forming potential and alkaline fens).

6.2 DETAILED QUANTIFIED WATER ENVIRONMENT RISK ASSESSMENT

A Detailed Quantitative Risk Assessment (DQRA) has been undertaken to quantify the potential significance of the soil and groundwater contamination upon the quality of the water environment and to allow the likely effect any proposed remediation options to be evaluated.

The UK Environment Agency has developed a methodology for deriving site-specific remedial objectives for contaminated soils and/or groundwater to protect the aquatic environment (EA Remedial Targets Methodology (RTM): Hydrogeological Risk Assessment for Contaminated Land, 2006). The RTM approach consists of up to four levels of assessment which progressively follow the pathway from the contaminant source to the receptor. A Remedial Target Criteria (or RTC) that defines the maximum source concentration required to meet a specified water quality criterion (or “target concentration”) is derived at each level. The RTCs become less stringent at the progressive levels of assessment as additional processes of attenuation are considered (e.g. physical dispersion, retardation and biodegradation) which affect contaminant concentrations along the pollutant linkage from the source to the receptor.

A DQRA has been carried out individually for each of the landfill sites using the RTM and Worksheet (Release 3.2, issued January 2013). The assessment has been completed for the principal leachate marker parameter of ammoniacal nitrogen. Ammoniacal nitrogen has been selected as it is a contaminant of concern that occurs at high concentrations in leachate with a site-wide average concentration of c. 300 mg/l. Ammoniacal Nitrogen therefore has the greatest magnitude of exceedance with the target concentration used for the down gradient water environment receptor (e.g. 0.065 mg/l surface water annual average EQS). The highest concentrations of ammonaical nitrogen were typically measured in Round 1 (c. 370 mg/l) with a decreasing site-wide average concentration measured with each subsequent round. Ammoniacal nitrogen has been identified in groundwater and spring water samples.

The models have been developed based on site-specific data collated during the Tier 2 site investigation to reflect the updated Tier 3 CSM developed for each of the five landfill sites. Where site-specific data is unavailable suitably conservative generic data has been adopted.

The Tier 2 intrusive investigation works and associated environmental monitoring have demonstrated that two possible models for the setting individual landfill may apply:

- A perched landfill system, characterised by a perched leachate body that migrates from the waste mass to the underlying sand and gravel aquifer, although the depth of unsaturated zone is often small or absent; or

- Sub water-table landfill where leachate levels and groundwater levels are similar, suggesting leachate quality reflects that of shallow groundwater quality at the water-table.

Landfill Site 1 and Site 3B seem to be representative of a perched system, whereas Site 3C and the north area of Site 2 seem more consistent with the sub water table system. The conditions at Site 3A are more uncertain.

To reflect the potential difference in conceptual settings a number of different RTM assessment levels have been used for the DQRA presented herein. A Soil Level 3 Assessment has been undertaken to represent perched landfill system (Model 1). This assessment considers the effect of dilution at the water table through mixing with laterally flowing groundwater in the saturated aquifer and subsequent attenuation (by physical dispersion) during lateral transport in the saturated aquifer.

A Groundwater Level 3 Assessment has been used to consider possible sub-water table landfill scenarios (Model 2). This model does not include the effect of dilution with groundwater at the water table and therefore represents a very conservative approach for assessing risk to environmental receptors, as it assumes leachate concentrations are indicative of groundwater contaminations. Clearly any RTCs derived from Model 2 are considerably lower than derived through Model 1.

For the purpose of deriving RTCs, appropriate water quality criteria (target concentrations) are required for the receptors affected. The receptors considered as part of the DQRA and a discussion of relevant standards is given below in the order of increasing distance from the identified source:

Receptor R5: Groundwater in the sand and gravel aquifer – Plume development and observed effects principally on lateral and up-gradient monitoring locations confirm the impact of leachate on groundwater. Furthermore the presence of at least partially saturated waste at a number of the landfill sites, confirms direct effects on the shallow groundwater in localised areas. As this groundwater body constitutes a locally important aquifer unit Schedule 5 Groundwater Threshold Values (GTV) (as presented in the Environmental Objectives (Groundwater) (Amendment) Regulations 2016) have been used as target concentrations for the derivation of RTCs and for comparison of predicted concentrations beneath the landfill sites.

However, as the groundwater body affected by leachate is of limited aerial extent and occurs in an area unlikely to be exploited for water supply, it is risk to the Ballyman Glen SAC and County Brook River (Fassaroe Stream) that is the principal focus of the DQRA presented herein.

Receptor R4: Ballyman Glen SAC GWDTE – The designated features of the SAC include tufa forming streams situated downstream from springs and / or groundwater seepages and the alkaline fen communities within the SAC. The process of tufa formation is strongly dependent on the pH and

carbonate inventory of the stream water, which is in turn dependent on the carbonate chemistry of groundwater from limestone gravel aquifer. Tufa formation is also dependent on the quantitative flow in those streams hence the groundwater discharge thereto. Other characteristics of water quality - such as the total chemical load (i.e. TSS) or effect of specific contaminants - may have an effect on the tufa forming potential although the nature of these effects and sensitivity of tufa formation to them is not known. The ecological communities that form the Alkaline Fen of the SAC may have quality requirements for the groundwater discharging in those areas. Water quality standards are not available for determination of risk and/or effect on the designated features of the SAC, however, predicted concentrations at the springs / seepages do provide an indication of likely level of impact that could be encountered at this receptor (R4).

Receptor R1: County Brook River (Fassaroe Stream) – The County Brook River is a WFD surface water body. Environmental Quality Standards (EQS) protective of Freshwater bodies as presented in Environmental Objectives (Surface Waters) (Amendment) Regulations 2015 (S.I. No. 386 of 2015) are therefore used for determining risk to the water course. The evaluation is risk for the County Brook River is determined after the effect of dilution within the river channel and assuming a baseline quality characterised by the non-detection of the modelled contaminant of concern, i.e. ammoniacal nitrogen.

The Groundwater Level 3 Assessment also allows the concentration of the modelled contaminant to be calculated at the down gradient receptor. By using the groundwater dilution factor at the water table calculated in the Soil Assessment (Level 2) and the calculated dilution factor associated with Q95 flow in the County Brook River (Receptor 1) it is possible to calculate predicted concentration at three key points within the system for Model 1 and Model 2: 1) Diluted concentrations in groundwater beneath the landfill; 2) Concentration at the point of groundwater emergence (i.e. springs in the SAC); and 3) Diluted concentration in the surface water receptor, at the Q95 (low) flow. These predicted concentrations allow the CSM and field observation to be evaluated with respect to the models of landfill setting.

The Remedial Targets Worksheets for each site are included as Appendix L.

6.2.1 Input Parameters

6.2.1.1 Site Characteristics

The main inputs for each site are summarised in **Table 6.12** .

Table 6.12 – Input Parameters for the Remedial Targets Worksheet Model

Site Name	Site 1	Site 2	Site 3a	Site 3b	Site 3c	Source
Landfill surface area (ha)	0.72	4.21	2.65	0.66	0.87	Site Mapping / Geophysics
Thickness of saturated gravel aquifer (m)	22	30	30	35	25	Conceptual Site Model
Hydraulic conductivity of gravel aquifer, K (m/d)	10	10	10	10	10	Literature / Local Experience
Hydraulic gradient across landfill site, i (-)	0.10	0.15	0.05	0.02	0.12	Water-table Map
Groundwater flow through gravel aquifer under the site (m^3/d)	744	5916	1267	126	893	Calculated using Darcy's Law (W, K and i)
Maximum depth of waste (mbgl)	14	19	16	5	13	Drilling / Geophysics
Width of waste body along groundwater flow path, W (m)	60	135	106	65	60	Site Mapping / Geophysics
Length of waste body along groundwater flow path, L (m)	115	340	219	85	113	Site Mapping / Geophysics
Distance to river along flow path (m)	107	160	96	400	90	Site Mapping / Geophysics
Q95 River Flow (L/s)	27	30	23	23	23	EPA Hydronet Data Extrapolation

6.2.1.2 Contaminants of Concern

The contaminant of concern that has been modelled for each site is ammoniacal nitrogen. Ammoniacal nitrogen is selected as the leachate concentrations were many orders of magnitude higher than the regulatory thresholds for the receptors and ammonia was at elevated concentrations at both groundwater and surface water receptors.

6.2.1.3 Target Concentrations

The target concentrations for groundwater (R5) and surface water (R1) receptors are based on current statutory threshold values. The GTV for ammonia is 0.175mg/l (Groundwater Regulations S.I. No. 366 of 2016) and the surface water annual average EQS for ammonia is 0.065mg/l (Surface Water Regulation S.I. No 386 of 2015).

6.2.1.4 Infiltration

The current infiltration at each of the sites is taken as the GSI recharge rate for the area of 575mm/yr. The actual infiltration rate may be lower due to the presence of the landfill capping on site. However the caps are not considered to be impervious as there appears to be landfill gas venting diffusely through the cap and the drainage and vegetative indicators are not typical of an impervious layer. This recharge rate is therefore considered to be conservative.

6.2.1.5 Biodegradation

The attenuation of ammoniacal nitrogen in soils and groundwater has received considerable attention in scientific literature, most notably Report NC/02/49 (NGWCLC, 2003) and Buss et al., 2004. The attenuation and biodegradation of reduced nitrogen are expected to occur in the subsurface. Biodegradation typically occurs by nitrification (biological oxidation) and is not therefore expected in anaerobic conditions. In oxidising conditions the half-life for ammonium in groundwater within a sand-gravel is expected to be 1 to 6 years.

Although variable the oxidation-reduction potential measured in groundwater (in Rounds 1, 2 and 3) and at springs (Round 3) is only occasionally negative, implying oxidising hydrochemical conditions prevail. However, as the dataset set is limited for down gradient monitoring locations the DQRA has not allowed for degradation of ammonia in the unsaturated or saturated zones, assuming reducing conditions predominate. Significant degradation of ammonia can occur but this will be site specific and no such data is available to date for each site. As such ammoniacal nitrogen concentrations are attenuated in the DQRA by dilution at the water table and / or physical dispersion during flow through the saturated aquifer.

6.2.1.6 Time Since Contamination Entered Groundwater

The time when contamination entered the groundwater is estimated at 20 years, approximately the same time when waste landfilling at Site 2 ceased. However the model has been run for steady state conditions and is therefore independent of the age / maturity of the waste mass.

6.2.2 Modelling Results and Discussion

The RTM Worksheet is used to calculate RTCs for Groundwater (Level 3) (i.e. Receptor 4) and for Surface Water (Level 4 that includes dilution within the watercourse) (Receptor 1). The RTCs generated for both receptors are then compared to average source concentration for each site (Round 1 to round 3) to determine whether the contaminant source (of ammonia) would result in the target concentration being exceeded at the receptor (gravel aquifer and County Brook River (Fassaroe Stream)).

Ammonia source concentrations are taken from leachate quality results. Where more than one leachate results for the same waste body an average ammonia concentration value is used. Other quality parameters (e.g. heavy metals) have not been included in the Remedial Targets Worksheet Model, however with considerably higher concentrations in waste leachate and the water environment, ammonia is considered as the worst case scenario for the DQRA.

The results for the DQRA based on current site conditions are summarised in **Table 6.13**. Red text denotes where the average ammonia leachate concentration is in excess of the RTC calculated for groundwater or surface water.

Table 6.13 – DQRA Model Results for Baseline Conditions

Model Parameter / Output	Unit	Site 1		Site 2		Site 3A		Site 3B		Site 3C		Comment
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Ammoniacal Nitrogen Concentration in Leachate	mg/l	20.5		306		366		567		203		Average concentration over three monitoring rounds
Infiltration Rate	mm/yr	575	575	575	575	575	575	575	575	575	575	GSI Recharge Rate
Thickness of Mixing Zone	m	12.4	12.4	29.8*	29.8*	23.9	23.9	9.66	9.66	12.11	12.11	Calculated in RTM
Groundwater flow under site	m3/d	744	744	5916	5916	1267	1267	126	126	893	893	Darcy's Law, using width and mixing zone thickness.
Seepage Rate to Groundwater	m3/d	11.3	11.3	66.3	66.3	41.7	41.7	10.4	10.4	13.7	13.7	Calculated
Calculated Factors												
Dilution Factor (in groundwater)[1]	-	69.4	NA	85.3	NA	35.7	NA	15.5	NA	82.9	NA	RTM Soil Level 2
Attenuation Factor (In saturated aquifer)[2]	-	1.06 - 1.3		1.003		1.000 - 1.006		5.61 - 10.82		1.021 - 1.175		RTM Soil Level 3 - RTM Groundwater Level 3
Dilution Factor for mixing in Watercourse	-	206	206	39	39	48	48	191	191	145	145	Based on Q95 flow and seepage rate to groundwater calculated above
Predicted Concentrations (For Source Concentrations CL)												
(R5) Groundwater beneath landfill site[3]	mg/l	0.30	20.5	3.59	306	10.25	366	36.6	567	2.4	203	Based on Leachate Concentration and dilution factor for Model 1 or Leachate Concentration (Model 2)
(R4) Groundwater at point of Spring / SAC emergence[4]	mg/l	0.23	15.72	3.58	305	10.20	364	3.4	52.4	2.08	173.7	RTM Groundwater Level 3 using calculated concentration in groundwater following mixing for model 1 or leachate concentration for Model 2
(R1) River (County Brook River)	mg/l	0.0011	0.076	0.092	7.81	0.21	7.65	0.018	0.27	0.014	1.20	Based on modelled concentration at R4 and dilution factor for watercourse / river (County Brook River).
Remediation Target Criteria (Red denotes where average leachate concentration exceeds RTC)												
RTC for Groundwater[5]	mg/l	12.1	NA	14.9	NA	2.3	NA	2.7	NA	14.5	NA	RTM Soil Level 2 RTC. Based on GTV of 0.175 mg/l
RTC for EQS at Spring / SAC[6]	*mg/l*	*4.783*	*0.085*	*5.561*	*0.065*	*2.320*	*0.065*	*5.638*	*0.703*	*5.503*	*0.076*	*RTM Soil Level 2 RTC (Model 1) / RTM Groundwater level 3 (Model 2)*

RTC for Surface Watercourse with dilution EQS (County Brook River)[7]	mg/l	983.7	17.4	217.3	2.5	110.4	3.1	1077.5	134.4	797.9	11.1	Based on surface water EQS of 0.065mg/l.

1 Dilution factor, Df, as calculated in RTM for mixing at water table beneath landfill sites. RTM Level 2 Soils. NA denotes Not Applicable for Model 2
2 Attenuation factor, Af, as calculated in RTM for saturated groundwater pathway (Range represents the AF calculated for the Level 3 Soil and Level 3 Groundwater models)
3 Predicted concentration in groundwater based on the Df and leachate source concentration (C_L / Df); NA denotes Not Applicable as not calculated for Model 2 which assumes leachate / groundwater are the same.
4 Calculated concentration in groundwater at spring / SAC. Result calculated in RTM for Level 3 Groundwater. Model 1 uses a groundwater concentration calculated using the Df presented in the table. Model 2 uses the leachate concentration CL directly
5 RTC for groundwater calculated on the basis of the target concentration set at the groundwater GTV of 0.175mg/l
6 NA denotes Not Applicable - In the absence of water quality criteria applicable to SAC. no RTC has been calculated for the SAC / Spring (See Text)
7 RTC for surface water calculated on the basis of the EQS for surface waters of 0.065 mg/l. Includes dilution within the River.
* Saturated thickness reduced as plume to deep

Table 6.13 demonstrates that ammoniacal nitrogen concentrations identified in leachate at all five sites at Fassaroe exceed the groundwater RTC under current conditions, therefore impacting the underlying gravel aquifer. The predicted concentration of ammoniacal nitrogen at the spring exceeds the EQS for surface water for both models. Dilution within the down-gradient surface watercourse river (County Brook River) provides a significant capacity to reduce concentrations. Despite the dilution capacity of the surface water, ammoniacal nitrogen concentrations exceed the RTC for all sites for Model 2 and for Site 2 and Site 3A for Model 1.

The low attenuation factor in groundwater calculated for all sites clearly demonstrate the limited capacity that mechanical dispersion in the saturated aquifer has for attenuating the concentration of ammoniacal nitrogen over the short pathway to the Ballyman Glen SAC applicable to each site. In the absence of any biodegradation with the aquifer, the principal mechanism for the attenuation of ammoniacal nitrogen in leachate is through mixing with groundwater at the water table. It is therefore notable that the predicted concentrations at the springs / SAC that result from Model 2 (based on leachate concentrations applied to groundwater) appear to be significantly greater than the actual concentration measured at the 5 springs monitored. The results suggest that for most sites that mixing at the water table (Model 1) is occurring and is crucial for limiting water quality effects observed at the SAC.

Field measurements of oxidation-reduction potentially suggest that biodegradation by nitrification may occur in the saturated aquifer down-gradient of the landfill sites. However this process has not been included in the model for conservatism and in light of the short residence time in the aquifer implied by the RTM model. As such the effects on water quality predicted by either model in **Table 6.13** represent worst-case outcomes.

In summary the results seem to support the following:

- The potential for a significant impact on groundwater beneath the historical landfills (Receptor R5);
- Measurable effects on water quality at springs / SAC (Receptor 4), the magnitude of which is dependent on the degree of mixing at the water table and is likely to be variable depending on the nature of pollutant linkage connecting the leachate source to the springs; and
- Significant dilution capacity within the watercourse (Receptor R1) that can attenuate water quality effects if there is significant dilution through mixing at the water table.

7 REMEDIATION OPTIONS APPRAISAL

7.1 INTRODUCTION

This section presents a Remedial Options Appraisal (ROA) undertaken in accordance with CLR 11, in light of the findings of the Tier 2 and Tier 3 assessment previously described. The ROA, in the first instance, identifies the feasible remedial options. Following identification of the feasible options a detailed evaluation is undertaken to identify the most appropriate option. The ROA includes the following:

- Summary of effects associated the 5 landfill sites with respect to water environment receptors, human health and associated with landfill gas generation;
- Identification of remedial options; and
- High level appraisal of each option identified.

7.2 SUMMARY OF EFFECTS

7.2.1 Water Environment

Geophysical surveys have identified leachate plume development at all sites. Elevated concentrations of ammonia and heavy metals have been identified in up-gradient and down-gradient boreholes and are consistent with a direct effect of leachate on groundwater quality beneath all sites. This confirms the impact on groundwater by the historic landfilling of waste at Fassaroe. The magnitude of the observed impact on groundwater quality is typically small considering the hydrogeological setting and leachate quality identified on the sites, which may reflect dilution at the water table and/or limitations in the monitoring network that result from constraints on the installation of down-gradient monitoring boreholes.

The water quality dataset for springs within Ballyman Glen SAC that are situated down-gradient of the landfill sites highlights water quality impacts associated with leachate at a number of monitoring points. These effects are not observed at all springs with only two out of the five springs monitored showing visual evidence of ochre staining and/or possible sheening (i.e. SP1 and SP4). The remaining springs are typically characterised by clear waters and the build-up of tufa deposits, consistent with the discharge of calcareous, mildly alkaline waters from the sand and gravel aquifer. These observations are consistent with the outcome of the DQRA which demonstrates that the detailed setting of each landfill site will control the magnitude of effects on groundwater dependent receptors (i.e. springs).

The water quality dataset confirms the impact of leachate on the springs, with elevated concentration of ammoniacal nitrogen, chloride, some heavy metals and occasional organic compounds (most notably at Spring SP1 and Spring SP4). In Round 1 the springs characterised by the absence of tufa formation were associated with spring water of low pH and elevated concentrations of contaminants associated with leachate. However this relationship was not reproduced in subsequent monitoring rounds, with no systematic variability observed with pH, contamination status and tufa formation.

The groundwater and spring water quality dataset suggests that the landfill sites do have the potential to affect water quality within the County Brook River (Fassaroe Stream), although the

magnitude of the effect is strongly mitigated by the dilution capacity within the river. This outcome is supported by the DQRA.

The results of the first monitoring round did identify exceedances principally at sample locations SW3, SW4 and SW5. Similarly, hydrocarbons were also detected in SW3, SW4 and SW5 in Round 1. Surface water quality exceedances above EQSs at SW5 is indicative of contributions from other up-gradient contaminant sources. In Round 1 there are no exceedances observed at SW1 and SW2, suggesting that Sites 2 does not have a measurable effect on water quality in County Brook River (Fassaroe Stream) despite the leachate quality observed on the site and water quality observed at Spring 1. Despite the observations in Round 1, the water quality dataset did not generally exceed relevant EQSs at any location in the two subsequent monitoring rounds.

In summary, the landfill sites do have the potential to affect surface water quality within the County Brook river (Fassaroe Stream) although water quality effects are not routinely observed, are largely restricted to upstream sections when they occur and are observed at locations situated at positions situated upstream of the landfill sites. These observations are consistent with the continued WFD Status of the County Brook Stream, which is classified as 'good'.

A DQRA was undertaken for each landfill site for ammoniacal nitrogen, one of the principal contaminants of concern associated with leachate on the sites. The DQRA confirms that that all five sites have the potential to impact the underlying sand and gravel aquifer and potentially the County Brook River (Fassaroe Stream) although dilution in that water course is likely to be unaffected if dilution through mixing at the water table is a significant process. The monitoring works undertaken on the site demonstrate that the actual impact on down-gradient groundwater quality reduces significantly over relatively short distances of 20 to 50m, as indicated by down-gradient borehole and spring water quality. This reduction in concentrations highlights the dilution and natural attenuation capacity along the groundwater pathway. The significant flow in the County Brook River (Fassaroe Stream) also provides dilution to the potential impact on surface water quality, and for the case of ammonia concentrations, reduces the concentrations in the river below laboratory detection limit.

The evidence collected to date demonstrates that the five landfill sites have the potential to affect conditions with the alkaline fen of the Ballyman Glen SAC and its associated watercourse. It is possible that this affect could have a localised impact on tufa forming potential and water quality within a small number of the streams situated downstream of affected springs. The ecological appraisal of the SAC will determine the extent and significance of any measurable effects on the designated features of the Ballyman Glen SAC (i.e. tufa forming potential and alkaline fens).

7.2.2 Landfill Gas

A review of the gas regime at the site (based on the currently available information) suggests that the main source of gas generation at the site is the waste within the landfills. The main pathway for gas migration from the waste materials is considered to be through the permeable superficial deposits, with limited contributions through dissolved gas in groundwater. The deeper bedrock is not considered to be a significant gas migration pathway owing to its depth and low permeability.

An initial review of methane and carbon dioxide concentrations within and outside the waste mass typically identifies lower concentrations outside the waste mass than within. The decrease in gas concentrations is more pronounced for methane than for carbon dioxide indicating that methane

may be venting vertically through the landfill cap and natural deposits. There are a small number of occasions where higher concentrations of recorded gases are present outside the recorded areas of the waste mass. It is considered that these may be related to preferential pathways. These locations require further consideration. The current data does not suggest a link between groundwater levels and gas flow rates.

Following the completion of the Wilson & Card and the NHBC Traffic Light assessments the proposed protection measures for each site are detailed in **Table 6.6** and **Table 6.7**. Protection measures will need to include gas barriers to prevent migration of gases from the landfills where further monitoring cannot dismiss the risk from gas within the proposed development areas.

7.2.3 Human Health

The Tier 2 human health risk assessment has identified that contaminant concentrations are generally below the selected screening criteria for a public open space (parks) use.

The risk assessment has identified elevated concentrations of PAHs within the landfill materials in Site 1, elevated concentrations of lead and PAHs within the landfill materials in Site 2 and elevated concentrations of PAH within the capping materials in Site 2. In addition, asbestos containing materials have been encountered at 1 location within the landfill materials in Site 1.

Despite the presence of elevated concentrations of contaminants and the presence of asbestos within the landfilled materials, it is not considered that future site users are likely to be exposed to the contamination due to the depth at which the contamination is present (>1.0 m). With regard to the PAH contamination within the capping materials within Site 2, additional sampling may be considered to further determine levels of contamination within these materials. Should a clean cap be placed to mitigate potential ground gas risks and / or risks to the water environment at this location, this would likely mitigate risks to future site users by preventing exposure to the contamination.

7.3 IDENTIFICATION OF FEASIBLE REMEDIAL OPTIONS

Remediation is required at the site to mitigate potential risks to the water environment (where an unacceptable level of impact is demonstrated through the ecological appraisal) and human health in relation to the waste mass at each of the landfill sites and associated leachate / landfill gas generation. The proposed remedial options shall conform to the requirements of Chapter 7 (remediation Techniques) of the EPA Code of Practice. The remediation options proposed shall enable the known or predicted effects to be eliminated or reduced relative to baseline conditions.

The pollutant linkages potentially requiring remediation are summarised in the revised CSM presented in **Table 5.1** and **Table 5.2** and include:

- Leachate Source – Groundwater Receptor (Moderate Risk);
- Leachate Source – Groundwater Pathway – GWTDE Receptor (High Risk);
- Leachate Source – Groundwater Pathway – Surface Water Body Receptor (Moderate Risk);
- Landfill Gas Source – Lateral / vertical migration Pathway – Existing and Future Site User Receptor (Moderate Risk) and

- Landfill Gas Source – Lateral / vertical migration – Future Construction Workers Receptor (High Risk).
- Waste (PAHs and certain metals) – Existing and Future Site Users (Low / Moderate Risk)
- Waste (Asbestos) - Existing and Future Site User Receptor (Low / Moderate Risk)

The proposed ROA shall consider approaches to mitigate the magnitude of effects associated with these pollutant linkages. In addition at specific sites there remains a moderate risk in association with landfill gas migration along existing subsurface infrastructure and the potential for Asbestos Containing Material (ACM).

The factors and associated criteria that will be used to evaluate the remedial options to achieve the remedial objectives with respect to the site specific conditions and constraints are summarised in **Table 7.1**.

Table 7.1 - Remedial Option Selection Criteria

Factor	Criteria
Effectiveness	Performance with respect to reducing the respective pollutants to levels that are acceptable or breaking pathways. Therefore options that are not suitable for the particular physical and chemical characteristics of the site are not considered any further.
Timescale	Remediation techniques that require a significant period of time to successfully meet the remedial objectives are not considered suitable for this site given the proposed development timetable.
Cost	Only remedial options that fulfil the remedial objectives within an acceptable cost bracket have been considered any further. The appraisal of cost is based on small treatment volumes that are anticipated to be presented, and therefore remedial approaches with significant set up/mobilisation cost are not considered suitable for the site.
Durability	All remedial options must be long lasting and minimise the potential for residual impacts to become apparent as the requirement for further remedial works post development of the site is unacceptable.
Commercial Availability	There are many remediation technologies that have been used within the UK, however only a limited number of these are commercially available in the UK.
Track Record	Only remedial options with a proven track record in the UK have been selected. Options with no or poor UK track records may impact on other factors in this table such as effectiveness, timescale and cost.
Environmental Impact	Some remedial options have not been selected because of the likely environmental impacts. Examples include energy and material requirements.
Compatibility	The risk assessment has identified a number of pollutant linkages that may require different remediation techniques to successfully meet the remedial objectives. Therefore all remedial options must be compatible with each other as well as the proposed development scheme.
Permissions	Some remedial options will require forms of waste management licences and potentially other forms of licensing such as discharge consents etc. The form of licence may influence the selection of the remediation technique because of the likely timescales required for applications and the cost of application.
Site Constraints	The site conditions may limit the likely effectiveness of a given remedial technique due to issues such as access, available space and ground conditions.

7.4 OPTIONS APPRAISAL

In considering potential remedial options, account must be taken of the contamination related objectives and constraints. Monitored Natural Attenuation (MNA) has not been considered as part of the ROA in light of the observed impacts on groundwater and groundwater dependent receptors identified during the Tier 2 investigations however monitoring is likely to form part of any remediation programme ultimately delivered on the site.

Table 7.2 – Remediation Options Appraisal

Remediation Options		
Source	Treatment Options	Suitability
Waste & Leachate (Associated with former landfill sites)	Civil Engineering (Excavate and Disposal at Landfill)	Effectiveness: High. Removes all contamination. Unclear if sufficient landfill space to receive waste generated.Disposal options are limited (may have to be exported) as 625,500 tonnes which would not have been accounted for in Regional Waste Management Plans Timescales: Quick assuming sufficient landfill space to receive waste requiring disposal. Cost: Extremely high cost considering total volume of waste to be removed from landfill sites and leachate management / disposal that would be required. Durability: Permanent. Commercial Availability: Widely availed. Track record: Proven track record. Environmental Impact: Short term impacts could be large considering the depth of the waste mass to be removed, the proximity to the Ballyman Glen SAC and stability issues identified during site works; Temporary exposure of waste mass by removal of existing landfill cap could mobilise leachate to groundwater and associated receptors in short term; Leachate management and extraction required during excavation which is likely to complex and difficult; Requires haulage and will lead to loss of landfill void as well as requirement to import fill materials to backfill voids created; Release of noxious odours and gases, potential to attract pests (birds, flies, rodents), and the generation of dust and other nuisances including wind-blown litter. Compatibility: Will address all contamination pollutant linkages including human health. Permissions: Planning and waste authorisations Site Constraints: Access to areas may be difficult with large plant. Practicalities of excavating 625,500 tonnes of waste, to significant depths (up to 20m), lying directly adjacent to a steep densely-wooded river valley and Special Area of Conservation (SAC), would be extremely difficult with significant environmental impact; Deep excavations required that would require backfilling. Given the large volumes of waste involved (625,500 tonnes), this increases the handling and transport requirements thereby increasing the short term potential for pollution.
	Engineered Low Permeability Landfill Cap. (Likely to be integrated with other gas management measures for human health	Effectiveness: Moderate. Will reduce leachate generation on each landfill site, whilst minimising disruption to quantitative groundwater flow within the aquifer, thereby reducing impacts on receptors situated down-hydraulic gradient from landfill sites. Complies with waste minimisation and sustainability principles. Timescales: Very quick. Cost: Low (construction cost and any upgrade). Durability: Long-term. May potentially require upgrade / replacement

Remediation Options		
	associated with future development – see below)	Commercial Availability: Widely availed. Track record: Proven track record. Environmental Impact: Minimises disturbance of contaminated material and associated risks. Small reduction in water balance for local sand and gravel aquifer system, hence reduction of groundwater through flow to the SAC and County Brook River. Minimises risk to site workers and the public. Compatibility: Would address all gas issues if integrated with comprehensive gas management measures for any future development. Will reduce impacts on groundwater dependent receptors, but may not eliminate effects thereon. Would reduce impacts on groundwater. Would mitigate risk to human health associated with waste mass and/or cap materials. Permissions: Planning and waste authorisations Site Constraints: Few Constraints.
	Impermeable Barriers / Cut off walls (full isolation of landfill sites likely to be required)	Effectiveness: Low. Extensive barrier system would be required (possibly full isolation) considering proximity to SAC, This would require deep barriers possibly keyed into bedrock and leachate management to prevent breakout of landfill site would be required to eliminate risk on water quality at SAC and County Brook River. Timescales: Quick. Cost: Moderate. Durability: Long-term / permanent. Commercial Availability: Widely availed. Track record: Proven track record, but not necessarily in this setting. Environmental Impact: Significant effect on groundwater through flow in aquifer hence discharge to the SAC and water levels therein. Leachate breakout could affect groundwater water quality in the SAC and associated watercourses. Compatibility: Not designed to manage gas risk. Does not mitigate human health risks associated with waste mass and/or cap materials. Permissions: Planning and waste authorisations Site Constraints: Stability issues may prevent practical installation of deep barriers.
	Permeable Reactive Barriers	Effectiveness: Moderate if can be constructed to appropriate depth. Could require replacement. Should be feasible to manage key contaminants of concern. Timescales: Quick subject to access. Cost: Moderate. Could require replacement Durability: Long-term. Commercial Availability: Widely availed. Track record: Proven track record, but not necessarily in this setting. Environmental Impact: Minimal effect on groundwater through flow to the SAC and associated groundwater receptors. .

Remediation Options		
		Compatibility: Not designed to manage gas risk. Does not mitigate human health risks associated with waste mass and/or cap materials. Permissions: None required. Site Constraints: Stability issues may prevent useful installation of deep barriers.
Leachate (Associated with former landfill sites)	Pump and Dispose	Effectiveness: Will significantly reduce leachate generation and loss to groundwater. May help to reduce landfill gas generation; Timescales: Open-ended, long-term until waste mass no longer produces significant leachate; Cost: High construction and operation costs; Durability: Should reduce effects on groundwater and associated groundwater dependent receptors, but requires operational system at all times. Commercial Availability: Widely availed. Track record: Proven track record. Environmental Impact: Significant quantity of leachate disposal required either off-site or using onsite treatment plant. Compatibility: Unclear if it will address gas risk. Will reduce but not eliminate impacts on groundwater; will reduce but may not eliminate effects on groundwater dependant receptors. Does not mitigate human health risks associated with waste mass and/or cap materials. Permissions: Planning and waste authorisations. Site Constraints: Access to areas may be difficult with large plant.
	Pump and Treat	Effectiveness: Will significantly reduce leachate generation and loss to groundwater. Should reduce landfill gas generation; Timescales: Open-ended, long-term until waste mass no longer produces significant leachate; Cost: High construction and operation costs; Durability: Should reduce effects on groundwater and associated groundwater dependent receptors, but requires operational system at all times. Commercial Availability: Widely availed. Track record: Proven track record. Environmental Impact: Significant quantity of leachate disposal required either off-site or using onsite treatment plant. Compatibility: Unclear if it will address gas risk. Will reduce but not eliminate impacts on groundwater; will reduce but may not eliminate effects on groundwater dependant receptors. Does not mitigate human health risks associated with waste mass and/or cap materials. Permissions: Planning and waste authorisations. Construction of permanent treatment-plant would be required. Site Constraints: Access to areas may be difficult with large plant.

Remediation Options		
Contaminated Groundwater (Leachate contaminants of concern most notably ammoniacal nitrogen, heavy metals and some organic compounds)	Pump and Dispose	Effectiveness: Would reduce potential for contaminated groundwater to affect SAC. Does not change leachate generation and impacts on groundwater around the landfill sites. Timescales: Long-term open-ended pump and dispose system would be required. Cost: High construction and operational costs expected as significant groundwater removal would be required. Durability: Should reduce effects on groundwater receptors but would require operational system in the long term which would require renewal / upgrade. Commercial Availability: Widely availed. Track record: Proven track record. Environmental Impact: Large volume of water will require disposal; Pumping induced drawdowns would significantly alter groundwater flow system, significantly reduce groundwater through flow to the SAC / Country Brook River and could result in drying of the fen at the margins. Compatibility: Only addresses water quality impact observed on the SAC and Country Brook River. Does not address landfill gas issues; Does not address impacts on groundwater beneath / around the landfill sites. Does not mitigate human health risks associated with waste mass and/or cap materials. Permissions: None required. Site Constraints: requires down-gradient borehole network to be installed at all site. Access to required areas will be extremely problematic for heavy plant required..
	Pump and Treat	Timescales: Long-term open-ended pumping and treatment would be required. Cost: High construction and operational costs expected as significant groundwater removal would be required. On-site treatment for ammoniacal nitrogen, heavy metals and organics may be costly. Pipeline to treatment plant would be required. Durability: Should reduce effects on groundwater receptors but would require operational system in the long term which would require renewal / upgrade. Commercial Availability: Widely availed. Track record: Proven track record. Environmental Impact: Large volume of water will require disposal; Pumping induced drawdowns would significantly alter groundwater flow system, significantly reduce groundwater through flow to the SAC / Country Brook River and could result in drying of the fen at the margins. Compatibility: Only addresses water quality impact observed on the SAC and Country Brook River. Does not address landfill gas issues; Does not address impacts on groundwater beneath / around the landfill sites. Does not mitigate human health risks associated with waste mass and/or cap materials. Permissions: Planning and waste authorisations. Construction of permanent treatment-plant would be required. Site Constraints: requires down-gradient borehole network to be installed at all site. Access to required areas will be extremely problematic for heavy plant required.

Remediation Options		
Landfill Gas	Engineered Low Permeability Landfill Cap and / or Gas Protection Measures for Land-use (As designed by Gas Risk assessment)	Effectiveness: High. Will manage gas risk on site Timescales: Quick. Cost: Moderate. Gas protection measures dependent on complexity but gas risk is significant on the site Durability: Long-term. May potentially require upgrade / replacement Commercial Availability: Widely availed. Track record: Proven track record. Environmental Impact: Risk to current and future users should be managed, Reduced leachate generation hence impact on groundwater and groundwater dependent receptors shall also be reduced (see above). Small reduction of quantitative groundwater through flow to the SAC and County Brook River expected. Compatibility: Will reduce magnitude of effects associated with groundwater and groundwater dependent receptors. Will manage human health risks associated with waste mass and/or cap materials. Permissions: Planning and waste authorisations. Site Constraints: Few Constraints.
Asbestos	Civil Engineering (Excavate and Disposal at landfill)	Effectiveness: Removes contamination. Timescales: Relatively quick where asbestos has been waste has been located and quantified Cost: Cost effective for small volumes anticipated at the site. However, extremely expensive relative to other treatment options Durability: Permanent. Commercial Availability: Widely availed. Track record: Proven track record. Environmental Impact: Extensive mitigation measures required to prevent exposure to site workers and the public. Release of noxious odours and gases, potential to attract pests (birds, flies, rodents), and the generation of dust and other nuisances including wind-blown litter. Required haulage and will lead to loss of landfill void as well as requirement to import fill materials to backfill voids created. Short term dust and odour nuisance may be created during works. Compatibility: Addresses all contaminant sources at site (accepting that impacted perched groundwater is removed as part of the process) so no compatibility issues. Permissions: Planning and waste authorisations. Site Constraints: Access to areas may be difficult with large plant.

7.5 SELECTED REMEDIAL OPTION

On the basis of the remedial options appraisal outlined in **Table 7.2** the following options appear to be most suited to addressing the pollutant linkages identified on the Fassaroe site:

- Waste Removal;
- Engineered Low Permeability Landfill Cap and Gas Protection Measures for Land-use;
- Permeable Reactive Barriers; and
- Gas Protection Measures.

7.5.1 Waste Removal

Complete removal of the waste mass would remove the contamination source hence severe all pollutant linkages identified in the **Table 5.1**. However there would be significant issues associated with this approach;

- **Excavation:** Based on the site investigations undertaken as part of the ERA, the volume of waste present across the five sites is estimated to be 625,500 tonnes. The below ground depths to which waste has been landfilled were found approximately to range from 13 to 19mbgl for four of the sites with Site 3B having a depth of approximately 5mbgl. Excavation and replacement of the waste would lead to the removal of the source of environmental pollution and thereby eliminate the potential for future environmental liabilities. However, the practicalities of excavating this volume of waste, to the depths outlined above, lying directly adjacent to a steep densely-wooded river valley and SAC, would be extremely difficult and could result in significant impacts on the SAC considering the short pathway to the environmental receptors. Excavating aged waste can cause the release of noxious odours and gases, the potential to attract pests (birds, flies, rodents), and the generation of dust and other nuisances including wind-blown litter. In addition, any excavated waste would need to be replaced with clean soil material in order to reinstate the areas. Significant traffic movements would be required in order to excavate/ replace the required volume of material from/ to the site with the potential to significantly impact on local communities over several years.
- **Disposal:** The disposal of approximately 625,500 tonnes of waste would present major difficulties particularly given the current waste management challenges in Ireland with regard to suitably licensed facilities and their remaining landfill capacity. It is likely that the excavated waste would have to be hauled considerable distances for landfill, pre-treatment or to be exported. The EPA reported residual waste capacity in Irish landfills to be “critically low” in ‘Ireland’s Environment 2016 - An Assessment’ (EPA, November 2016). Furthermore, emergency measures were exercised by the EPA in 2016 with the re-opening of Knockharley and Ballynagran Landfills due to the serious risk of environmental pollution occurring as a result of disposal options not being available to manage residual waste nationally. The requirement to dispose of a further 625,500 tonnes of waste material, which has not been accounted for any of the Regional Waste Management Plans, would constitute a major issue in this regard. The environmental impacts associated with the loading and haulage of this volume of waste to licenced facilities capable of accepting this volume of material would be considerable, as would the length of time required to do so given the piecemeal controlled management that would be required. To put this into context, the licensed capacity of Ballynagran landfill, Co. Wicklow in recent years was 175,000 tonnes per year, versus potentially 625,500 tonnes of waste in Sites 1, 2, 3A, 3B and 3C at Fassaroe.

- **Cost:** The cost of excavating approximately 625,500 tonnes of waste and disposing elsewhere is a consideration also. Assuming a gate fee of €120 per tonne (exluding landfill levy), the costs alone of disposal would be in excess of €28 million. On top of this the costs of excavation, haulage and environmental management of the sites during the excavation and replacement with clean material would run into further multi-millions. The Eastern - Midlands Region Waste Management Plan 2015 – 2021 states that local authorities are "committed to targeting and addressing the highest risk sites as soon as possible and subject to funding being made available". However, obtaining funding at the scale required for the excavation and disposal of the entirety of the waste bodies at the Fassaroe sites when more feasible, environmentally sustainable and cost effective remedial measures can be implemented would be difficult to justify.

7.5.2 Engineered Low Permeability Landfill Cap

The capping of a landfill with a low permeability barrier is an accepted method for reducing leachate generation on landfill sites. A capping option is considered viable on the historical landfill sites, would be cost effective and would be a low impact approach that will mitigate human health risks associated with asbestos and PAHs in soils and will result in a net betterment to the water environment by improving water quality without significant reducing groundwater flow to the Ballyman Glen SAC. Furthermore an engineered low permeability cap would also enable landfill gas management measures for any future development of the site.

To evaluate the potential betterment that the capping of the each landfill site may have the water environment, the DQRA for baseline conditions presented in **Table 6.13** was updated for all sites assuming they are capped in accordance with EPA Landfill Guidelines.

For the post-development scenario a reduced infiltration rate of 67mm/yr for all sites has been used. This is based on the assumption that a remediation strategy will be put in place capping the landfills, using the EPA landfill design for non-hazardous landfill (EPA Landfill Manuals Landfill Design, 2000; Page 96). This designs uses a compacted mineral cap layer of a minimum 0.6m thickness having a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s. The estimated infiltration rate is equal to the average effective rainfall through this compacted mineral layer. Thus the RTM model was modified to reflect the reduced infiltration rate that would result.

The results for the updated DQRA based on a capped scenario are summarised in **Table 7.3**.

Table 7.3 – DQRA Model Results for Engineered Low Permeability Cap

Model Parameter / Output	Unit	Site 1		Site 2		Site 3A		Site 3B		Site 3C		Comment
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Ammoniacal Nitrogen Concentration in Leachate	mg/l	20.5		306		366		567		203		Average concentration over three monitoring rounds
Infiltration Rate	mm/yr	67	67	67	67	67	67	67	67	67	67	See text
Thickness of Mixing Zone	m	12.4	12.4	29.8*	29.8*	23.9	23.9	9.66	9.66	12.11	12.11	Calculated in RTM
Groundwater flow under site	m3/d	744	744	5916	5916	1267	1267	126	126	893	893	Darcy's Law, using width and mixing zone thickness.
Seepage Rate to Groundwater	m3/d	1.3	1.3	7.7	7.7	4.9	4.9	1.2	1.2	1.6	1.6	Calculated
Calculated Factors												
Dilution Factor (in groundwater)[1]	-	578.5	NA	722.0	NA	290.3	NA	117.3	NA	693.8	NA	RTM Soil Level 2
Attenuation Factor (In saturated aquifer)[2]	-	1.06 - 1.3		1.003		1.000 - 1.006		5.61 - 10.82		1.021 - 1.175		RTM Soil Level 3 - RTM Groundwater Level 3
Dilution Factor for mixing in Watercourse	-	1765	1765	335	335	409	409	1640	1640	1244	1244	Based on Q95 flow and seepage rate to groundwater calculated above
Predicted Concentrations (For Source Concentrations CL)												
(R5) Groundwater beneath landfill site[3]	mg/l	0.035	20.5	0.42	306	1.26	366	4.83	567	0.293	203	Based on Leachate Concentration and dilution factor for Model 1 or Leachate Concentration (Model 2)
(R4) Groundwater at point of Spring / SAC emergence[4]	mg/l	0.027	15.72	0.423	305	1.254	364	0.45	52.4	0.25	173.7	RTM Groundwater Level 3 using calculated concentration in groundwater following mixing for model 1 or leachate concentration for Model 2
(R1) River (County Brook River)	mg/l	0.00002	0.0089	0.0013	0.91	0.0031	0.891	0.0003	0.032	0.0002	0.139	Based on modelled concentration at R4 and dilution factor for watercourse / river (County Brook River).
Remediation Target Criteria (Red denotes where average leachate concentration exceeds RTC)												
RTC for Groundwater[5]	mg/l	101.2	NA	126.7	NA	50.8	NA	20.5	NA	121.4	NA	RTM Soil Level 2 RTC. Based on GTV of 0.175 mg/l
RTC for EQS at Spring / SAC[6]	*mg/l*	*107*	*0.085*	*47.1*	*0.065*	*18.9*	*0.065*	*45.2*	*0.703*	*46.1*	*0.076*	*RTM Soil Level 2 RTC (Model 1) / RTM Groundwater level 3 (Model 2)*

RTC for Surface Watercourse with dilution EQS (County Brook River)[7]	mg/l	189655	149.6	15787	21.9	7708	26.7	74206	1153.6	57341	95.0	Based on surface water EQS of 0.065mg/l.

Table 7.3 also highlights the exceedance in average ammonia leachate concentration above the Groundwater or Surface Water RTC in red. The results confirm that a substantial improvement in water quality can be expected as the result of capping, particularly for Model 1 where dilution at the water table is the principal mechanism of attenuation as expected at the majority of landfill sites.

The new capping system will reduce the infiltration of rainwater through the waste and therefore reduce the volume of leachate entering the underlying aquifer and ultimately the stream. The reduced recharge to the aquifer as a result of the capping layers has the potential to impact on the hydrology of the down-gradient tufa springs. It is estimated the recharge within the spring groundwater catchment could reduce by up to 7% as a result of the capping. This could lead to a drop in groundwater levels and/or a drop in groundwater flow to the springs. The impact is mitigated by the expected improvement in groundwater quality which will lead to the potential for improved tufa depositions rates or new tufa deposits.

Where the runoff from the capping layer can be reintroduced to groundwater, such that it does not re-saturate the waste and is sufficiently far enough up gradient from the springs to allow the hydrochemistry to equilibrate with the in-situ groundwater, this will mitigate the potential reduction in groundwater recharge the impact on the spring hydrology.

Landfill Gas Management

A gas management strategy should for any future development be developed for the site having regard to its proposed mixed residential and commercial zoning. This strategy should identify the gas protection measures that can be installed to limit gas migration from the landfills and the protection measures that will be required to properties, supported by relevant appraisal / assessment. This strategy will need review and update once the further information is available, but shall be based on gas protection measures outlined in Section 4.6.6 in order to protect human health in relation to ground gases associated with the landfill site.

Human Health

A clean cap should be placed to mitigate potential ground gas risks and / or risks to the water environment at this location however this would likely mitigate risks to future site users by preventing exposure to the contamination.

It is considered however that the concentrations of contaminants identified during the ground investigation are unlikely to constitute a risk to construction workers during any future development where appropriate measures are adopted. Due to the heterogeneous nature of landfilled materials however, there is a possibility that asbestos and areas of gross contamination may be present and a suitable watching brief should be employed during construction for any such contamination. In addition, suitable hygiene and welfare facilities and PPE should be provided in accordance with the requirements of the Safety, Health and Welfare at Work (General Application) Regulations 2007, Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010 amendments and the Safety Health and Welfare at Work (Construction) Regulations 2013 to manage potential risks to construction workers. Appropriate procedures should also be in place to remediate any such contamination encountered during construction in line with the Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010 amendments and the Safety Health and Welfare at Work (Construction) Regulations 2013.

The capping system will comprise engineering and restoration layers. The details of the restoration layers must be consistent with the proposed after use of the facility. The main objectives of the capping system are to:

- Minimise infiltration of water and maximise run off;
- Promote surface drainage and maximise run off;
- Control gas migration; and
- Provide a physical separation between waste and plant and animal life

The proposed capping system is in accordance with the EPA Landfills Manuals – Landfill Site Design. The capping system should consist of at a minimum the following:

- Top soil (150 – 300mm) and subsoil of at least 1m total thickness;
- Drainage layer of 0.5m thickness having a minimum hydraulic conductivity of 1x10-4m/s
- Compacted mineral layer of a minimum 0.6m thickness having a hydraulic conductivity of less than or equal to 1x10-9m/s or a geosynthetic material (e.g. GCL) or similar that provides equivalent protection; and
- A gas collection layer of natural material (minimum 0.3m) or a geosynthetic layer.

Consideration should be given to the inclusion of a flexible membrane liner in the capping system.

7.5.3 Permeable Reactive Barriers

The high level ROA suggests that permeable reactive barriers may potentially address the water quality risk to the Ballyman Glen SAC and associated watercourse, without reducing the quantitative groundwater flow within the aquifer to the SAC. However, site constraints suggest that the feasibility of construction of such a barrier may be questionable considering the stability issues identified along the northern boundary of the majority of landfill sites and the proximity to the river valley and boundary of the Ballyman Glen SAC. The feasibility of such a system needs further consideration and design.

7.5.4 Final Conceptual Site Model

A final CSM has been produced for the Fassaroe site a based on the implementation of engineered capping and gas management system, with associated gas protection measures for the potential future development of the site. The final post-development CSM is provided in *Table 7.4*.

Table 7.4 – Revised Risk Site Wide Model with Engineered Cap and Gas Mitigation Measures

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
S1	Leachate	P1	Vertical to groundwater then horizontally through possible surface water drainage channels into the river	R1	WFD Surface Water Body	None	Medium	No Risk	The mitigation measures include capping of landfill Sites and will significantly reduce the vertical movement of rainwater through the waste and therefore significantly reduce leachate generation.
				R2	Surface Water Protected Area	None	Medium	No Risk	
		P2	Vertical & Horizontal via Groundwater	R3	Private Wells	None	Medium	No Risk	There are no known private wells along the leachate plumes (water main connection in the area)
				R4	Groundwater Dependent Terrestrial Ecosystem (GWDTE)	Likely	Medium	Moderate Risk	Landfill capping will reduce the risk from High to Moderate as a result of reduced leachate generation. Some leachate discharge will still occur as some of the waste is located beneath the water-table elevation and there will be a limited amount of seepage through the capping. Impacts on springs / SAC will be greatest where conditions most closely reflect model 2 (leachate concentrations reflecting groundwater concentrations at water table)
				R5	Aquifer	Likely	Medium	Moderate Risk	The reduced leachate generation will significantly reduce the risk to the underlying aquifer.
				R6	Public Supply Well	None	Mild	No Risk	There are no public water supply wells in the area.
				R1	Surface Water Body	Unlikely	Mild	Very Low Risk	The capping of the landfill sites will reduce the leachate generation and the risk to the County Brook River (Fassaroe Stream) from moderate to low risk
		P3	SW Drainage	R1	Surface Water Body	None	Medium	No Risk	The drainage from the landfills will be directed

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
				R2	Surface Water Protected Area	None	Medium	No Risk	to a dedicated surface water drainage and attenuation system. As such the runoff will not come in contact with the waste the SPR link age is broken.
S2	Waste	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Future Site Users	None	Mild	No Risk	Sites 1, 3A and 3C are currently not in use. Currently minimal clay cap in place. The provision of an engineered cap would address human health direct contact pathways
				R8	Construction Workers	Unlikely/Low Likelihood	Minor	Very Low Risk	Risk to construction workers during excavations should be mitigated by the use of appropriate PPE
S3	ACM	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Future Site Users	None	Severe	No Risk	Shallow soil sampling recorded a single detection of ACM in Site 1 – not detections were recorded at the remaining sites. The provision of an engineered cap would severe link for human health direct contact pathways
				R8	Construction Workers	Unlikely	Severe	Low/Moderate Risk	Shallow soil sampling recorded a single detection of ACM in Site 1 – not detections were recorded at the remaining sites. Risk to construction workers during excavations should be mitigated by the use of appropriate PPE
S4	Landfill Gas	P5	Lateral Migration Subsoil	R7	Future Site Users	Unlikely	Mild	Very Low Risk	Monitoring indicates that all sites are actively gassing. Offsite gas monitoring completed. Age, extent, volume and composition of waste known. Potential for exposure to construction workers during excavations.
				R8	Construction Workers	Likely	Severe	High Risk	
				R9	Adjacent Buildings and Structures	Unlikely	Severe	Moderate	
				R10	Non Designated	Low Likelihood	Minor	Very Low Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
					Land				The installation of an engineered cap and hardstand as part of the proposed development may promote off site lateral gas migration. Potential for ingress to existing and proposed buildings and structures. As part of any future development, any new buildings adjacent to site to be constructed with full gas protection measures. Potentially, landfill gas migration could occur into existing adjacent buildings through cracks within the floor slab construction and/or around service/utility routes. If future development does not proceed risks associated with gas migration into existing buildings should be considered further by the Local Authority.
S4	Landfill Gas	P6	Lateral Migration Groundwater	R7	Future Site Users	Unlikely	Mild	Very Low Risk	Landfill gas known to be present onsite. Offsite gas monitoring completed. Age, extent, volume and composition of waste. Groundwater and leachate levels established
				R8	Construction Workers	Unlikely/Low Likelihood	Severe	Low/Moderate Risk	
				R9	Adjacent Buildings and Structures	Unlikely	Severe	Low Risk	
S4	Landfill Gas	P7	Vertical Migration Subsoil	R7	Future Site Users	Unlikely	Mild	Very Low Risk	Existing clay cap c.1-2m . Engineered cap will eliminate vertical migration of gas and atmospheric dispersion and dilution at surface. New buildings adjacent to site to be constructed with full gas protection measures. No buildings proposed to be constructed on waste bodies.
				R8	Construction Workers	Likely	Severe	High Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
				R9	Adjacent Buildings and Structures	Low Likelihood	Severe	Moderate Risk	Landfill gas known to be present onsite however no credible dataset available. No offsite monitoring completed. Age, extent, volume and composition of waste known. Water level and effect on gassing regime known. Potential for exposure to construction workers during excavations. Potential for ingress to existing and proposed buildings and structures. Vegetation die back noted.
				R10	Non Designated Land	Likely	Minor	Very Low/Low Risk	
S4	Landfill Gas	P8	Existing & Proposed Services Routes	R9	Adjacent Buildings and Structures	Low Likelihood	Severe	Low / Moderate Risk	Offsite gas monitoring known to have been completed. No buildings proposed to be constructed on waste bodies. New buildings adjacent to site to be constructed with full gas protection measures.

8 SUMMARY AND CONCLUSIONS

Five unregulated historical landfill sites are situated immediately south of the County Brook River (Fassaroe Stream) in Fassaroe, Co. Wicklow (Site 1, 2, 3A, 3B ad 3C). The five former landfill sites are the responsibility Wicklow County Council (WCC), with four (Site 2, 3A, 3B and 3C) having been designated Historic Unregulated Local Authority Landfills in accordance with Section 22 of the Waste Management Act 1996 as amended (the Act) and presented in the Eastern Midlands Region Waste Management Plan 2015 – 2021. All landfill sites are associated with the historical deposition of municipal waste with the exception of Site 1 that contains predominantly C&D waste. The historical landfill sites all operated between the early 1970's and mid-1990s.

Current land-use on the Fassaroe site is characterised by one-off housing developments in a predominantly agricultural setting. The Fassaroe site and associated landfills are located on land in the ownership of Cosgrave Developments is zoned for major new development under the Draft Bray Municipal District Local Area Plan 2018, including residential high density open space and a neighbourhood centre. Before any redevelopment of the Fassaroe Site can be undertaken, an Environmental Risk Assessment is required that evaluates the risk that historical waste deposition poses to environmental receptors and human health. The ERA must be undertaken in accordance with the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008) and adopt the approach of the EPA Code of Practice for Unregulated Waste Disposal Sites (EPA, 2007).

The ERA outlined herein delivers a Tier 1 desk based risk assessment, followed by a Tier 2 intrusive investigation and associated programme of environmental monitoring. The Tier 1 and Tier 2 works then inform a Tier 3 Quantified Risk Assessment that defines the risk to environmental receptors and human health and underpins the Remediation Options Appraisal. The ROA therefore conforms to the EPA Code of Practice and identifies feasible mitigation measures that would protect the environmental and human health receptors from the predicted and/or observed impacts associated with historical waste disposal at the five former landfill sites. The ERA therefore forms the key element of supporting information required for the application for a Certificate of Authorisation from the Environment Protection Agency (EPA) in relation to the historic landfill sites, as descried in the Waste Management Regulations 2008 (S.I. No. 524 of 2008).

Following the completion of the Tier 1 desk based risk assessment an initial Conceptual Site Model for baseline conditions on the Fassaroe site was developed; the highest risk active Source-Pathway-Receptor (Pollutant) Linkages identified; and a Tier 1 Risk Prioritisation & Classification exercise completed. These works identified the need for a Tier 2 intrusive investigation and associated programme of environmental investigation undertaken between December 2015 and March 2018. Tier 2 works undertaken on the Fassaroe Site included:

- Geophysical Investigation;
- Trial Pits: Excavation of twenty eight (28) trial pits and the collection of soil samples using 50m (Sites 1, 3b and 3C) and 75m (Sites 2 and 3A) sampling grids;
- Monitoring Boreholes: Completion of intrusive targeted investigation involved the installation of twenty one (21) combined gas/leachate monitoring boreholes, twenty five (25) gas monitoring boreholes and eleven (11) groundwater monitoring boreholes by cable and rotary percussive drilling

- Landfill gas monitoring programme comprising eighteen (18) monitoring rounds that included 8 No. weekly rounds between 7th March and 27th April 2016 and 10 No. monthly gas monitoring round between May 2016 to February 2017.
- Environmental monitoring programme that involved sampling leachate, groundwater, spring water and surface water monitoring network over three rounds at contrasting times within the hydrogeological system [Round 1 (High Groundwater Level) - 15th - 23rd of March 2016; Round 2 (Low Groundwater Level) – 30th August – 1st September 2016; and Round 3 (High Groundwater Level) - 15th March 2018].

All water samples (leachate, groundwater, spring and surface water) were subject to an extensive suite of analysis that included contaminants of concern typically associated with methanongenic historic landfill sites.

The key characteristics of each landfill site is summarized below:

- **Site 1:** Surface area of 0.53 Ha with maximum proven depth of waste of 14m. Predominantly C&D waste with pockets of municipal waste. Evidence of filling since 1970's. Active gassing of methane and carbon dioxide, although less than seen for other sites infilled with municipal waste. Appears to be a perched landfill system, with unsaturated zone beneath waste mass hence mixing of groundwater and leachate at the water table. Spring SP2 situated c. 85m down gradient of the site and characterised by clear flow, tufa formation and elevated (mildly alkaline) pH.
- **Site 2:** Surface area of 4.5 Ha with maximum proven depth of waste of 19m. Municipal waste deposited between 1979and 1991. Discrete leachate body although there may be direct continuity between leachate and groundwater in the north. Notable vegetation die back on / around landfill in 2015. Visible erosion and waste exposure in north of site. Active gassing of carbon dioxide and methane. Spring SP1 situated c. 60m down gradient from site and is characterised by ochre, sheening and absence of tufa in most rounds.
- **Site 3A:** Surface area of 4.5 Ha with maximum proven depth of waste of 16m. Municipal waste although age of deposition uncertain. Active gassing of carbon dioxide and methane. Unsaturated waste mass, with leachate only in north. Presumed to be a largely perched landfill system with mixing of leachate and groundwater at the water table. Spring SP4 situated c. 25m down gradient of the landfill site and Spring SP5 situated c. 60m down gradient. SP4 characterised by ochre staining whereas SP5 characterised by clear water and tufa formation.
- **Site 3B:** Surface area of 0.44 Ha with maximum proven depth of waste of 4.9m. Municipal waste deposited between 1994 and 1995. Active gassing of carbon dioxide and methane. Notable vegetation die-back in 2015. Presumed to be a perched landfill system with mixing at the water table.
- **Site 3C:** Surface area of 0.9 Ha with maximum proven depth of waste of 13m. Municipal waste deposited between 1992 and 1995. Active gassing of carbon dioxide and methane. Notable vegetation die-back in 2015. Appears to be a subwater table waste with groundwater and leachate in continuity. Several springs situated down gradient of the site although none sampled.

The five landfill sites are located in particularly sensitive environmental setting, with the following principal environmental receptors identified:

- **Ballyman Glen SAC**: The five landfill sites are situated immediately south of the SAC which is located in the river valley and designated on the basis of petrifying springs with tufa

formation and alkaline fens. The SAC is dependant of groundwater discharge and therefore constitutes a Groundwater Dependent Terrestrial Ecosystem;

- **County Brook River (Fassaroe Stream)**: WFD surface waterbody of good status; and
- **Enniskerry Groundwater Body** (IE_EA_G_038): Designated a locally important gravel aquifer (Lg) although there is no down-gradient use of groundwater. This waterbody is considered to have a WFD quality status of good.

A detailed summary of the effects of the five landfill sites has been provided in Section 7.2 in terms of the observed impact or potential risk to the environmental receptors, human health or associated with landfill gas.

Landfill gas has been demonstrated to represent a significant risk to current and future site users that requires mitigation particularly if the Fassaroe site is to be redeveloped. The concentration of PAHs and limited presence asbestos containing materials in the waste mass and current capping materials has been shown to potentially represent a risk to human health and does require mitigation.

Groundwater has been shown to have been impacted by leachate generated on the landfill sites. Similarly a water quality impact observed at a number of the springs situated down-gradient of the landfill sites has been demonstrated, although many springs do not show any impact being characterised by clear flow and tufa formation.

The landfill sites do have the potential to affect surface water quality within the County Brook river (Fassaroe Stream) although water quality effects are not routinely observed, are largely restricted to upstream sections when they occur and are observed at locations situated upstream of the landfill sites. It seems that the very high dilution capacity within the County Brook River does afford protection to that watercourse. These observations are consistent with the continued WFD Status of the County Brook Stream, which is classified as ‘good’.

The evidence collected to date demonstrates that the five landfill sites have the potential to affect conditions within the alkaline fen of the Ballyman Glen SAC and its associated drainage system. It is possible that this affect could have a localised impact on tufa forming potential and water quality within a small number of the streams situated downstream of affected springs, as evidenced at two springs. The ecological appraisal of the SAC will determine the extent and significance of any measurable effects on the designated features of the Ballyman Glen SAC (i.e. tufa forming potential and alkaline fens).

The results of the Detailed Quantified Risk Assessment (DQRA) suggest that the mixing of leachate with laterally flowing groundwater in the saturated gravel aquifer affords significant protection to the SAC, its drainage system and watercourses situated down gradient of the landfill sites. The most significant effects of the landfills would appear to be restricted to those areas where leachate and groundwater are found to be in direct continuity (i.e. submerged landfill waste mass) although this only occurs locally at some of the landfill sites. The results of the DQRA demonstrate that a significant net betterment, in terms of water quality, can be achieved by controlling infiltration using an engineered low permeability cap. Furthermore the construction of such cap is unlikely to significantly reduce the quantitative net groundwater flow to the SAC, would address risks to human health and would allow greater control of risks associated with landfill gases generated on the landfill sites.

Although waste removal would remove the contamination source, thus severing the pollutant (SPR) linkage entirely, short term impacts at the SAC and watercourse could be exacerbated and stability issues may affect its delivery. Notwithstanding the high cost of full waste removal it is uncertain whether there are appropriate sites for the disposal of the volume excavated materials that would be required. It is for this reason an engineered low permeability capping solution allied with controlled water and ecological monitoring would represent the preferred strategy for managing the risks associated with the historical landfill sites, assuming a net betterment approach be acceptable to the regulator.

APPENDIX A

Ballyman Glen SAC Site Synopsis Report

SITE SYNOPSIS

Site Name: Ballyman Glen SAC

Site Code: 000713

Ballyman Glen is situated approximately 3 km north of Enniskerry and straddles the County boundary between Dublin and Wicklow. It is orientated in an east-west direction with a stream running through the centre. The glen is bounded mostly by steeply sloping pasture with Gorse (*Ulex europaeus*) and areas of wood and scrub.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

[7220] Petrifying Springs*
[7230] Alkaline Fens

Ballyman Glen contains a small strip of alkaline fen which is associated with petrifying spring/seepage areas that have given rise to thick deposits of marl. The vegetation of the main part of the fen is dominated by Greater Tussock-sedge (*Carex paniculata*), Tall Fescue (*Festuca arundinacea*), butterworts (*Pinguicula vulgaris* and *P. lusitanica*), Black Bog-rush (*Schoenus nigricans*) and Broad-leaved Cottongrass (*Eriophorum latifolium*). The site is particularly notable for its orchids, with species including Early Marsh-orchid (*Dactylorhiza incarnata*), Narrow-leaved Marsh-orchid (*D. traunsteineri*) and Marsh Helleborine (*Epipactis palustris*) occurring. In addition, twenty species of sedge have been recorded in the area, including the scarce Long-stalked Yellow-sedge (*Carex lepidocarpa*). The fen area is being invaded by Downy Birch (*Betula pubescens*).

Associated with the fen, and also with the woodland elsewhere in the site, are petrifying springs. These lime-encrusted seepage areas are rich in bryophytes including such diagnostic species as *Cratoneuron commutatum* and *C. filicinum*.

Wet woodland and scrub occur along the margins of the stream for most of the length of the glen, extending outwards in areas to create inaccessible and species-rich patches of woodland. The canopy is dominated by Alder (*Alnus glutinosa*), willow (*Salix* spp.) and Ash (*Fraxinus excelsior*). The woodland has a dense shrub layer which includes Hawthorn (*Crataegus monogyna*) and Spindle (*Euonymus europaeus*), and a diverse ground flora with Marsh Hawk's-beard (*Crepis paludosa*), Sanicle (*Sanicula europaea*), Herb-Robert (*Geranium robertianum*), Bugle (*Ajuga reptans*), horsetails (*Equisetum* spp.), Meadowsweet (*Filipendula ulmaria*) and some sedges (*Carex* spp.). Areas of marsh are found in the wetter areas by the stream, particularly at the western end of the site.

There is an area of broadleaved woodland on the steeper southern slopes of the glen. Common species occurring here are Ash and Sycamore (*Acer pseudoplatanus*), with Bramble (*Rubus fruticosus* agg.) colonizing the more open areas.

An area of land that slopes towards the fen has been used as a landfill site for domestic refuse. The site is also used for a clay pigeon shoot and shattered clay pigeons are scattered throughout the area.

The fen vegetation at this site is well developed, with an unusually large number of sedge species present. The presence of alkaline fen and of petrifying spring/seepage areas is also particularly notable, as these habitats are listed, the latter with priority status, on Annex I of the E.U. Habitats Directive. Fens are rare in Wicklow and Dublin, and this is one of only two sites in Wicklow for the Narrow-leaved Marsh-orchid.

APPENDIX B

Tier 1 Risk Screening and Prioritisation

Site 1

Site 1 – Tier 1 Screening Assessment

Source Assessment	Score Matrix	Score	Rational/Comments
Leachate	1a	0.5	0.8ha C&D (Source: WCC and Atkins)
Gas	1b	0.5	0.8ha C&D (Source: WCC and Atkins)
Leachate Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Vertical Pathway (Aquifer Vulnerability)	2a	2	High
Horizontal Pathway (Groundwater Flow Regime)	2b	2	Lg Locally important sand/gravel aquifers
Surface Water Pathway	2c	2	possible direct linkage - to be mapped
Gas Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Assuming lateral migration (assuming receptor within 250m of source)	2d	3	GLs (glaciofluvial sands and gravels). Farm building located c.270m from site boundary
Vertical migration (assuming receptor located above source)	2e	0	No receptors located above source
Receptor Assessment	**Score Matrix**	**Score**	**Rational**
Residential dwellings with potential for private water supply	3a	1	Nearest domestic dwelling located c.300m from site
Protected Areas	3b	3	SAC located within 50m
Aquifer	3c	3	Lg Locally important sand/gravel aquifers
Public Water Supplies	3d	0	No public water supplies within 1km of the site (Source: WCC)
Surface Water Bodies	3e	2	County Brook River located c.100m to north of site
Buildings and enclosed spaces used by humans or livestock	3f	0	Farm building located c.270m from site boundary

Site 1 – Tier 1 Risk Classification

	Source	Pathway	Receptor	% Score	Risk Classification
SPR1	(1a) Leachate	(2a,b&c) Groundwater and Surface Water migration	(3e) Surface Water body	2	Low
SPR2			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	3	Low
SPR3		(2a&b) Groundwater Migration	(3a) Private Well	1	Low
SPR4			(3b) Protected Area (Groundwater dependent terrestrial ecosystem)	3	Low
SPR5			(3c) Aquifer	2	Low
SPR6			(3d) Public Water Supply	0	No linkage
SPR7			(3e) Surface Water body	2	Low
SPR8		(2c) Surface Water Migration	(3e) Surface Water body	3	Low
SPR9			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	5	Low
SPR10	(1b) Landfill Gas	(2d) Lateral migration in subsoil	(3f) Human Presence (Buildings, enclosed spaces)	0	Low
SPR11		(2e) Vertical Migration in subsoil		0	No linkage

	Risk Classification
High	≥70% for any individual SPR linkage
Moderate	Between 40-70% for any individual SPR linkage
Low	≤40% for any individual SPR linkage

SITE RISK CLASSIFICATION	**LOW**	

Site 2

Site 2 – Tier 1 Screening Assessment

Source Assessment	Score Matrix	Score	Rational/Comments
Leachate	1a	7	4.6ha MSW (Source: Muir, WCC and Atkins)
Gas	1b	7	4.6ha MSW (Source: Muir, WCC and Atkins)
Leachate Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Vertical Pathway (Aquifer Vulnerability)	2a	2	High
Horizontal Pathway (Groundwater Flow Regime)	2b	2	Lg Locally important sand/gravel aquifers
Surface Water Pathway	2c	2	possible direct linkage - to be mapped
Gas Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Assuming lateral migration (assuming receptor within 250m of source)	2d	3	GLs (glaciofluvial sands and gravels). Building located <50m from site boundary
Vertical migration (assuming receptor located above source)	2e	0	No buildings located above source
Receptor Assessment	**Score Matrix**	**Score**	**Rational**
Residential dwellings with potential for private water supply	3a	2	Nearest domestic dwelling located c.70m from site
Protected Areas	3b	3	SAC located within 50m
Aquifer	3c	3	Lg Locally important sand/gravel aquifers
Public Water Supplies	3d	0	No public water supply within 1km of site (Source: WCC)
Surface Water Bodies	3e	3	County Brook River located c.50 from the site
Buildings and enclosed spaces used by humans or livestock	3f	5	Building located <50m from site boundary

Site 2 Tier 1 Risk Classification

	Source	Pathway	Receptor	% Score	Risk Classification
SPR1	(1a) Leachate	(2a,b&c) Groundwater and Surface Water migration	(3e) Surface Water body	42	Moderate
SPR2			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	42	Moderate
SPR3		(2a&b) Groundwater Migration	(3a) Private Well	23	Low
SPR4			(3b) Protected Area (Groundwater dependent terrestrial ecosystem)	35	Low
SPR5			(3c) Aquifer	21	Low
SPR6			(3d) Public Water Supply	0	No linkage
SPR7			(3e) Surface Water body	35	Low
SPR8		(2c) Surface Water Migration	(3e) Surface Water body	70	High
SPR9			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	70	High
SPR10	(1b) Landfill Gas	(2d) Lateral migration in subsoil	(3f) Human Presence (Buildings, enclosed spaces)	70	High
SPR11		(2e) Vertical Migration in subsoil		0	No linkage

	Risk Classification
High	≥70% for any individual SPR linkage
Moderate	Between 40-70% for any individual SPR linkage
Low	≤40% for any individual SPR linkage

SITE RISK CLASSIFICATION	**HIGH**	

Site 3A

Site 3A – Tier 1 Screening Assessment

Source Assessment	Score Matrix	Score	Rational/Comments
Leachate	1a	7	2ha, MSW (source WCC)
Gas	1b	7	2ha, MSW (source WCC)
Leachate Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Vertical Pathway (Aquifer Vulnerability)	2a	2	High
Horizontal Pathway (Groundwater Flow Regime)	2b	2	Lg Locally important sand/gravel aquifers
Surface Water Pathway	2c	2	possible direct linkage - to be mapped
Gas Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Assuming lateral migration (assuming receptor within 250m of source)	2d	3	GLs (glaciofluvial sands and gravels)
Vertical migration (assuming receptor located above source)	2e	0	No receptors located above source
Receptor Assessment	**Score Matrix**	**Score**	**Rational**
Residential dwellings with potential for private water supply	3a	2	Nearest domestic dwellings located 175m and 230m from site (source: WCC)
Protected Areas	3b	3	SAC located within 50m
Aquifer	3c	3	Lg Locally important sand/gravel aquifers
Public Water Supplies	3d	0	No public water supplies within 1km
Surface Water Bodies	3e	2	County Brook River located c.70m to north of site (Source: WCC)
Buildings and enclosed spaces used by humans or livestock	3f	3	Enniskerry FC located 130m from site boundary

Site 3A – Tier 1 Risk Classification

	Source	Pathway	Receptor	% Score	Risk Classification
SPR1	(1a) Leachate	(2a,b&c) Groundwater and Surface Water migration	(3e) Surface Water body	28	Low
SPR2			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	42	Moderate
SPR3		(2a&b) Groundwater Migration	(3a) Private Well	23	Low
SPR4			(3b) Protected Area (Groundwater dependent terrestrial ecosystem)	35	Low
SPR5			(3c) Aquifer	21	Low
SPR6			(3d) Public Water Supply	0	No linkage
SPR7			(3e) Surface Water body	23	Low
SPR8		(2c) Surface Water Migration	(3e) Surface Water body	47	Moderate
SPR9			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	70	High
SPR10	(1b) Landfill Gas	(2d) Lateral migration in subsoil	(3f) Human Presence (Buildings, enclosed spaces)	42	Moderate
SPR11		(2e) Vertical Migration in subsoil		0	No linkage

	Risk Classification
High	≥70% for any individual SPR linkage
Moderate	Between 40-70% for any individual SPR linkage
Low	≤40% for any individual SPR linkage

SITE RISK CLASSIFICATION	HIGH

Site 3B

Site 3B – Tier 1 Screening Assessment

Source Assessment	Score Matrix	Score	Rational/Comments
Leachate	1a	5	0.9ha, MSW (Source WCC, EPA)
Gas	1b	5	0.9ha, MSW (Source WCC, EPA)
Leachate Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Vertical Pathway (Aquifer Vulnerability)	2a	2	High
Horizontal Pathway (Groundwater Flow Regime)	2b	2	Lg Locally important sand/gravel aquifers
Surface Water Pathway	2c	0	No direct linkage
Gas Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Assuming lateral migration (assuming receptor within 250m of source)	2d	3	GLs (glaciofluvial sands and gravels)
Vertical migration (assuming receptor located above source)	2e	0	No receptors located above source
Receptor Assessment	**Score Matrix**	**Score**	**Rational**
Residential dwellings with potential for private water supply	3a	2	Nearest domestic dwelling c.100m from site boundary. Farm buildings and Enniskerry FC c.100m from site boundary
Protected Areas	3b	1	SAC located c.300m
Aquifer	3c	3	Lg Locally important sand/gravel aquifers
Public Water Supplies	3d	0	No public water supplies within 1km
Surface Water Bodies	3e	1	County Brook River located c.350m to north of site. Glencullen River located c.600m
Buildings and enclosed spaces used by humans or livestock	3f	3	Buildings located c.100m from site boundary

Site 3B – Tier 1 Risk Classification

	Source	Pathway	Receptor	% Score	Risk Classification
SPR1	(1a) Leachate	(2a,b&c) Groundwater and Surface Water migration	(3e) Surface Water body	7	Low
SPR2			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	7	Low
SPR3		(2a&b) Groundwater Migration	(3a) Private Well	17	Low
SPR4			(3b) Protected Area (Groundwater dependent terrestrial ecosystem)	8	Low
SPR5			(3c) Aquifer	15	Low
SPR6			(3d) Public Water Supply	0	No linkage
SPR7			(3e) Surface Water body	8	Low
SPR8		(2c) Surface Water Migration	(3e) Surface Water body	0	No linkage
SPR9			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	0	No linkage
SPR10	(1b) Landfill Gas	(2d) Lateral migration in subsoil	(3f) Human Presence (Buildings, enclosed spaces)	30	Low
SPR11		(2e) Vertical Migration in subsoil		0	No linkage

	Risk Classification
High	≥70% for any individual SPR linkage
Moderate	Between 40-70% for any individual SPR linkage
Low	≤40% for any individual SPR linkage

SITE RISK CLASSIFICATION	LOW	

Site 3C

Site 3C – Tier 1 Screening Assessment

Source Assessment	Score Matrix	Score	Rational/Comments
Leachate	1a	5	07ha, MSW (Source: WCC)
Gas	1b	5	07ha, MSW (Source: WCC)
Leachate Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Vertical Pathway (Aquifer Vulnerability)	2a	2	High
Horizontal Pathway (Groundwater Flow Regime)	2b	2	Lg Locally important sand/gravel aquifers
Surface Water Pathway	2c	2	possible direct linkage - to be mapped
Gas Migration Pathway Assessment	**Score Matrix**	**Score**	**Rational**
Assuming lateral migration (assuming receptor within 250m of source)	2d	3	GLs (glaciofluvial sands and gravels)
Vertical migration (assuming receptor located above source)	2e	0	No receptors located above source
Receptor Assessment	**Score Matrix**	**Score**	**Rational**
Residential dwellings with potential for private water supply	3a	3	Nearest domestic dwelling c.70m from site boundary. Farm buildings c.50m from site boundary
Protected Areas	3b	3	SAC located within 50m
Aquifer	3c	3	Lg Locally important sand/gravel aquifers
Public Water Supplies	3d	0	No public water supplies within 1km
Surface Water Bodies	3e	3	County Brook River located c.50m to north of site (Source: WCC)
Buildings and enclosed spaces used by humans or livestock	3f	5	Farm buildings located c.50m from site boundary

Site 3C – Tier 1 Risk Classification

	Source	Pathway	Receptor	% Score	Risk Classification
SPR1	(1a) Leachate	(2a,b&c) Groundwater and Surface Water migration	(3e) Surface Water body	30	Low
SPR2			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	30	Low
SPR3		(2a&b) Groundwater Migration	(3a) Private Well	25	Low
SPR4			(3b) Protected Area (Groundwater dependent terrestrial ecosystem)	25	Low
SPR5			(3c) Aquifer	15	Low
SPR6			(3d) Public Water Supply	0	No linkage
SPR7			(3e) Surface Water body	25	Low
SPR8		(2c) Surface Water Migration	(3e) Surface Water body	50	Moderate
SPR9			(3b) Protected Area (Surface Water dependent terrestrial ecosystem)	50	Moderate
SPR10	(1b) Landfill Gas	(2d) Lateral migration in subsoil	(3f) Human Presence (Buildings, enclosed spaces)	50	Moderate
SPR11		(2e) Vertical Migration in subsoil		0	No linkage

	Risk Classification
High	≥70% for any individual SPR linkage
Moderate	Between 40-70% for any individual SPR linkage
Low	≤40% for any individual SPR linkage

SITE RISK CLASSIFICATION	MODERATE	

APPENDIX C

Geophysical Report

AGL15302_02

REPORT

ON THE

GEOPHYSICAL SURVEY

AT

FASSAROE LANDFILL, CO. WICKLOW

FOR

RPS.

9TH MAY 2016

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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	AGL15302		
AUTHOR	**CHECKED**	**REPORT STATUS**	**DATE**
EURGEOL YVONNE O'CONNELL P.GEO., M.SC	EURGEOL PETER O'CONNOR P.GEO., M.SC., DIP. EIA MGT.	V.01	20TH APRIL 2016
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1. EXECUTIVE SUMMARY

APEX Geoservices Limited was requested by RPS Group to carry out a geophysical investigation at 5 No. historical, disused landfill sites that occupy previous sand/gravel extraction sites at Fassaroe, County Wicklow. The sites are located west of the Greenstar Waste Transfer Centre, north and south of Berryfield Lane. The sites collectively cover an area of approximately 9 Ha.

The requirement for a geophysical survey to assess the areas of landfill has come about due to the proposed development of the area into residential and parkland areas. The investigation consisted of Electromagnetic ground conductivity mapping, Electrical Resistivity Tomography (ERT) and seismic refraction profiling.

The survey was carried out to identify the lateral extent of the waste bodies, identify the thickness of the waste bodies and presence of any anomalous features and identify any leachate plumes outside of or below the waste body. It was indicated that the geophysical survey was unlikely to provide information on trace metals that could potentially be leaching from the site.

The sites lie at elevations ranging from c.50 to 100 m OD, sloping downwards sharply to the north and northeast towards a stream at the base of the slope.

The integrated interpretation of the geophysical results with the borehole and trial pit data identified 0.53 Ha waste at Site 1, 4.1 Ha at Site 2, 1.75 Ha at Site 3a, 0.44 Ha at Site 3b, and 0.8 Ha at Site 3c.

Interpreted waste thicknesses of up to 16 m at Site 1, up to 26m at Site 2, up to 20 m at Site 3a, up to 8.5 m at Site 3b, and up to 20.5 m at Site 3c were identified.

Very low resistivities (<30 Ohm-m) beneath the waste bodies suggest high levels of leachate in the underlying material at Sites 2, 3a and 3c.

The migration of leachate beyond the boundary of the waste bodies, down-slope to the north and north east is suggested at Sites 2, 3a and 3c with the strongest likelihood at Site 2.

Evidence of landslide/slip material is also suggested on the northern/north eastern slopes of Sites 2, 3a and 3c.

The slope material should be investigated by hand dug trial pits to confirm the presence of and determine the extent of waste material from landslides/slips. Consideration should be made to the slope stability when targeting any intrusive investigations on the slope.

Seepage was noted on the slope at Site 2. Sampling should be carried out at the base of the slopes at Sites 1, 2, 3a and 3c to investigate the migration of leachate.

The findings of the geophysical investigation should be reviewed following any further intrusive investigations.

2. INTRODUCTION

APEX Geoservices Limited was requested by RPS Group to carry out a geophysical investigation at 5 No. historical, disused landfill sites at Fassaroe, County Wicklow. The requirement to assess the areas of landfill has come about due to the proposed development of the area into residential and parkland areas.

2.1 Survey Objectives

The objectives of the investigation were:

- Identify the lateral extent of the waste body,
- Identify the thickness of the waste body and presence of any anomalous features,
- Identify any leachate plumes outside of or below the waste body,
- *Trace metals that could potentially be leaching from the site.

**It was indicated that the geophysical survey was unlikely to provide information on trace metals.*

2.2 Site Background

The sites are located in Fassaroe, west of the Greenstar Waste Transfer Centre, north and south of Berryfield Lane. The sites collectively cover an area of approximately 9 Ha. The sites have been referenced as site 1, 2, 3a, 3b and 3c by the client as highlighted on Figure 2.1 below. It is understood that the disused landfill occupies previous sand/gravel extraction sites.

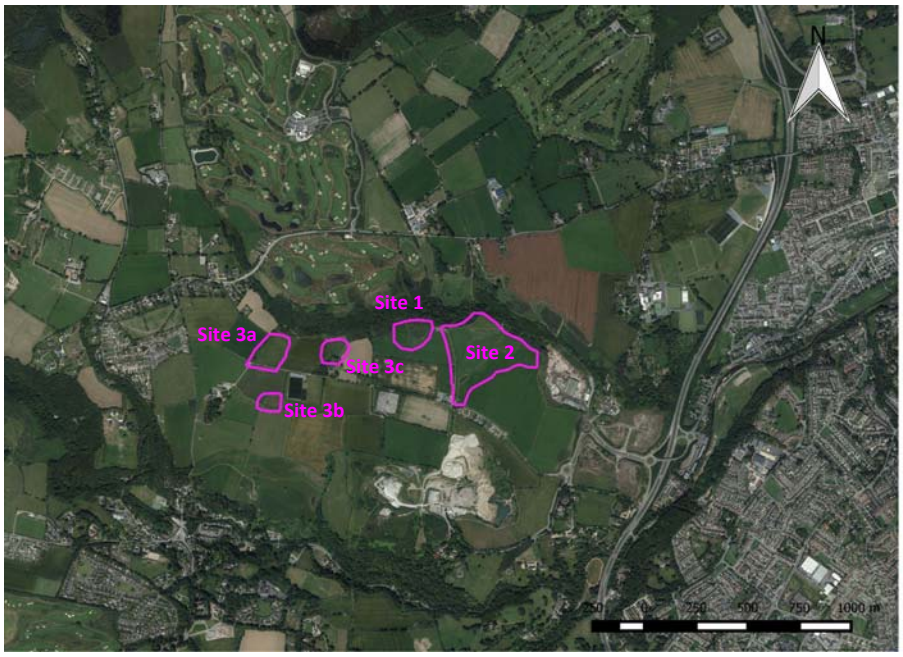


Fig 2.1: Location map (site marked in magenta)



Fig 2.2: Site 1 Looking towards the south east



Fig 2.3: Site 2 Looking towards the south east



Fig 2.4: Site 3a Looking towards the south east



Fig 2.6: Site 3b Looking towards the south east



Fig 2.5: Site 3c Looking towards the south east

2.2.1 Topography

The sites lie at elevations ranging from c.50 to 100 mOD, sloping downwards sharply to the north and northeast towards a stream at the base of the slope. Elevations range from 50-90 mOD at Site 2, 90-95 mOD at 1 and 3c and c. 100mOD at Site 3a and 3b.

2.2.2 Geology

The GSI bedrock geology map (Fig. 2.7) shows that all sites are underlain by slate, commonly laminated with pale siltstones with some schists of the Maulin Formation. South of the landfill sites, the bedrock is comprised of tuff & greywacke of the Glencullen River Formation. A fault line between the Glencullen and Maulin Formations is inferred to run south of the site in an east-west direction. Bedrock is buried at depth across the site, overlain by significant thickness of subsoil.

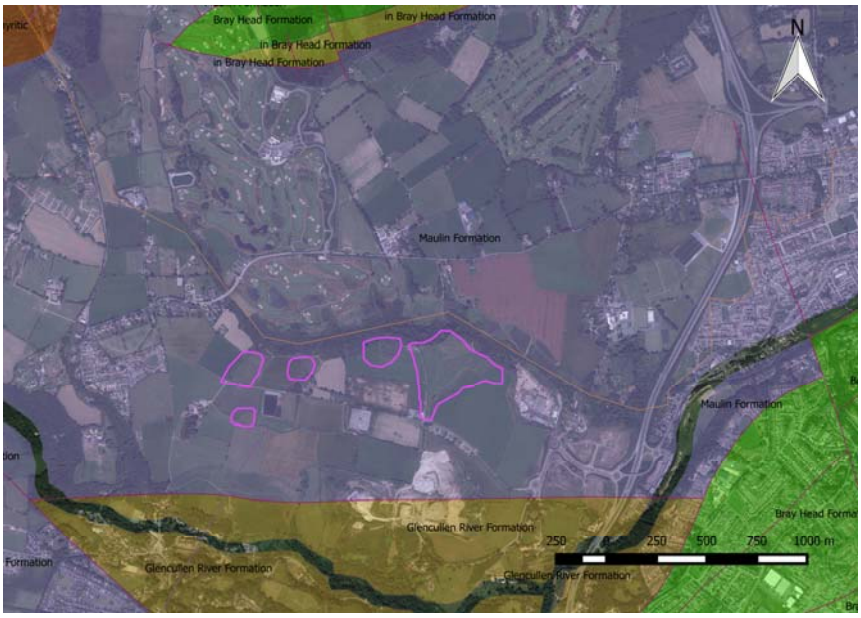


Fig 2.7: The GSI bedrock map (sites marked in magenta, Maulin Formation (purple) and Glencullen River Formation (brown))

2.2.3 Soils

According to the Teagasc Subsoil map the soil across the sites consist of sands and gravels derived from Carboniferous limestone.

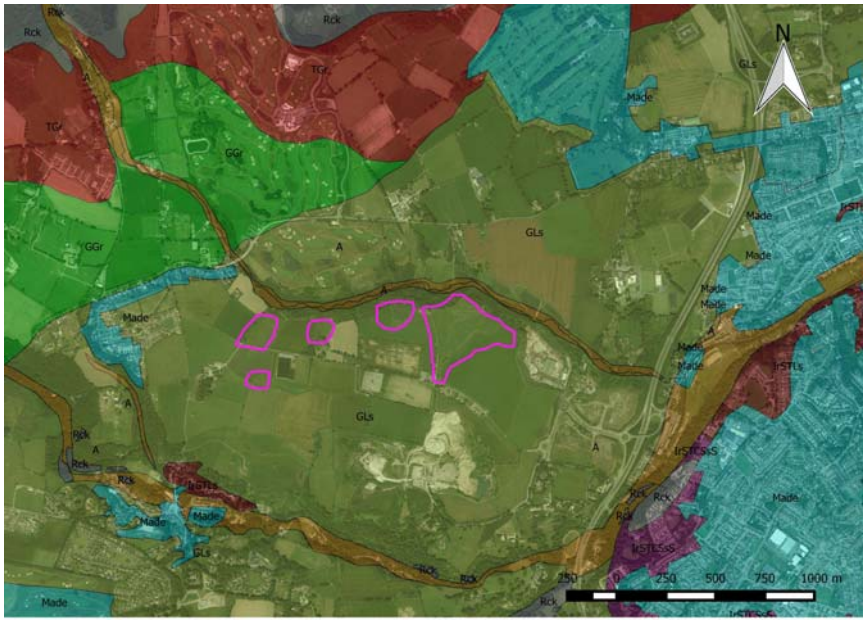


Fig 2.8: The Teagasc soil map with Limestone sands and gravels (GLs) (sites marked in magenta). Alluvium is indicated at the bottom of the valley that bounds the site to the north.

2.2.4 Vulnerability

The groundwater vulnerability map shows an area of high vulnerability (green) at the landfill locations and moderate vulnerability (purple) to the north of the sites.



Fig 2.9: The Vulnerability map (sites marked in magenta).

2.2.5 Aquifer Classification

The gravels have been categorised as a locally important gravel aquifer while the bedrock is aquifer is classified as locally important (Li) i.e. the bedrock is only productive in localised zones.

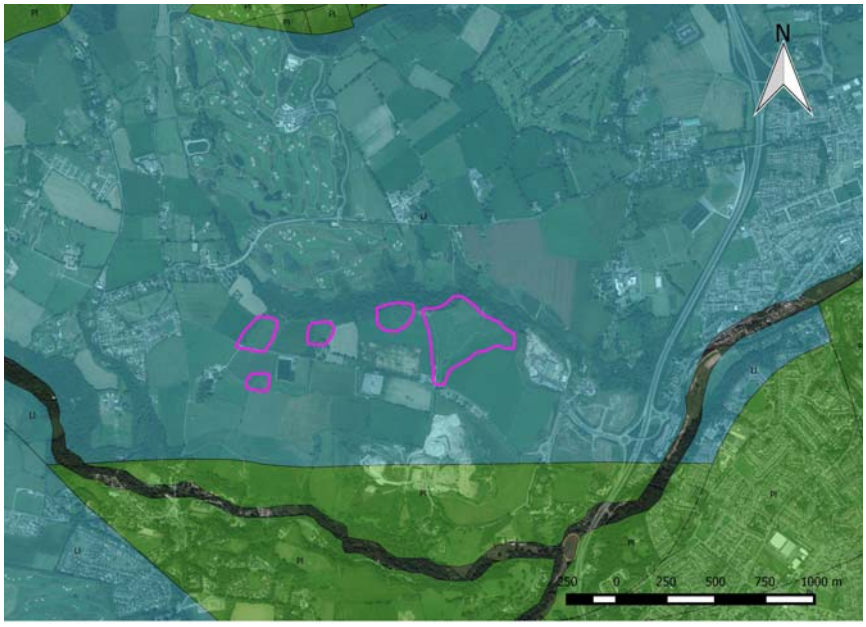


Fig 2.10: The GSI aquifer map indicating Li bedrock aquifer(pale blue) with sites marked in magenta.

2.2.6 Site investigation data

Borehole and trial pit data was provided for the five sites in April 2016. Twenty cable percussive and rotary cored boreholes and twenty five trial pits were opened across the five waste bodies. A further thirty eight boreholes were cored outside the bounds of the waste bodies. The natural ground comprises sandy gravelly clay, silty clayey sand/gravel and sand/gravel. The waste material predominantly contains household waste, metals, glass, plastic, timber, paper and textiles mixed with clay and/or gravel.

2.3 Survey Rationale

The following techniques have been employed to achieve the objectives of the survey:

- Electromagnetic EM31 ground conductivity mapping has been carried out over the filled area in order to map the extent of the fill and variations in the fill, and also to screen for any leachate plumes and obtain background values for the soils and rock.

- Electrical Resistivity Tomography (ERT) has been carried out across the fill to investigate variations in the thickness and extent of the fill material and leachate, as well as to investigate the overburden and bedrock geology.

- Seismic refraction was carried out at selected locations. The results of the seismic survey have been used to outline the fill/soil boundary and confirm depth to bedrock.

By employing complimentary geophysical techniques it is possible to produce an integrated interpretation with less ambiguity and more confidence.

The initial output from the geophysical investigation should be used to target further investigations where necessary and to produce a final integrated ground model for the site.

3. RESULTS

The survey was carried out between the 3rd and 9th December and on the 16th December 2015 with a return to site on the 29th March 2016. Geophysical surveying included EM conductivity mapping at all five sites and the collection of 15 no. ERT profiles and 5 no. seismic refraction profiles.

3.1 EM31 Electromagnetic Conductivity Mapping

The EM ground conductivity results are indicative of the bulk conductivity of the ground materials from 0-6.0m bgl. Drawings AGL15302_02 and _05 show the contoured conductivity results with values in the range 2 – 140 mS/m (milli Siemens/meter).

The recorded EM Inphase values were contoured and plotted on Drawings AGL15302_03 and _06. The inphase value is sensitive to the presence of metal objects. Large variations in the inphase values reflect the presence of surface or subsurface metal. High inphase values were found to be concurrent with high conductivity values (>37 mS/m) and localised anomalous variations were consistent with the presence of metal objects (e.g., metal box, container, fence, etc..) noted on the ground surface.

The ground conductivity values have been interpreted in conjunction with the inphase, ERT, borehole and trial pit data as follows:

Conductivity (mS/m)	*Interpretation*
2-17	Natural Ground
17-37	Extent of Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
37-140	Extent of Waste with high Organic & Metallic content

Table 1: Conductivity values and corresponding interpretation.

3.2 Electrical Resistivity Tomography

Fifteen ERT profiles (R01 to R15) have been acquired across the 5 sites. The resistivity values ranged from 4 - 750 Ohm-m. Typical resistivities of Irish overburden deposits as experienced by the author range from 20 Ohm-m for pure clay to around 3000 Ohm-m for clean dry gravel, with the resistivity generally increasing as the sand/gravel content increases. Silty clay typically has values in the range 30-50 Ohm-m and silty gravelly clay typically has resistivity values in the range 50-100 Ohm-m. (An exception is the Irish Sea Till which occurs along the east coast of Wicklow and Wexford and which has resistivity values as low as 10 Ohm-m).

Deposits of predominantly organic waste such as those occurring in municipal landfills typically have resistivities in the range 5-30 Ohm-m. Inert C & D waste such as concrete, brick and mixed stone and clay will have resistivities similar to gravelly material (50-500 Ohm-m).

The resistivity of combined organic and inert material will depend on the percentage of organic material present. If sufficient organic content and moisture is present to for connecting electrical

conductivity pathways throughout the C & D material then resistivities would be expected to be similar to the range for municipal waste. If the organic waste only occurs in isolated lenses and pockets above the watertable then resistivities would be expected to be similar to the lower end of the range for C & D waste.

The resistivity data at the five sites has been interpreted in conjunction with the EM, borehole and trial pit data as follows:

	Resistivity (Ohm.m)	***Interpretation***
Waste	<30	Waste with high Organic & Metallic content
	30-130	Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
Leachate	<30	Possible high level of LEACHATE in underlying material
	30-130	Possible lower level of LEACHATE in underlying material
Natural Ground	30-50	SILT/CLAY
	50-130	Sandy gravelly SILT/CLAY
	>130	Silty clayey SAND/GRAVEL

Table 2: Resistivity values and corresponding interpretation.

3.3 Seismic refraction profiling

Five seismic refraction spreads were recorded on selected ERT profiles. Profiles were recorded to assist in determining the base of the landfill material which may be masked in the ERT results by the migration of leachate. Data quality was poor due as signal transmission was limited due to the significant thickness and heterogeneous nature of the unconsolidated waste material. The processed P-wave seismic velocities across the survey area range from 100 to 2200 m/s. A base of landfill material was estimated between 500 and 600 m/s. these values would typically indicative of soft-firm or loose to medium dense material. Underlying velocities indicated firm to very stiff or medium dense to very dense material.

3.4 Interpretation

The integrated interpretation of the geophysical results with the borehole and trial pit data is presented below and summarised in Drawings AGL15302_04 and _07. Interpreted ERT profiles are presented in Drawings AGL15302_08 to _22.

3.4.1 Landfill Site 1

The interpreted lateral extent of the waste material is c. 0.53 Ha and is indicated on Drawing AGL15302_04. Two ERT profiles (R11 and R12) were collected across the site (Drawings AGL15302_18 and 19 respectively). Up to 16m waste has been interpreted based on values contained in Table 2. A maximum thickness of 6m of waste with high organic and metallic content has been observed.

3.4.2 Landfill Site 2

The interpreted lateral extent of the waste material is c. 4.1 Ha and is indicated on Drawing AGL15302_04. Four ERT profiles (R01, R02, R03 & R15) were collected across the site (Drawings AGL15302_08, 09, 10 and 22 respectively). Up to 26m waste has been interpreted based on values contained in Table 2 containing up to18.5m of waste with high organic and metallic content. The landfill waste appears to extend beyond the site boundary fence towards the lower ground to the north east.

Very low resistivities (<30 Ohm-m) beneath the waste body suggest high levels of leachate in the underlying material, focussed at two locations as indicated on Drawing AGL15302_04. In addition, a possible leachate plume has been mapped on R15, migrating downslope to the northeast from the bounds of the landfill material. Seepage was also noted part way down the slope on R15 at the location indicated on Drawing AGL15302_ 22.

After periods of heavy rainfall surface water runoff is high with the water being funnelled down-slope to the north east. A previous collapse of the bank to the river occurred sometime in the past with the water being diverted over the edge of the scarp slope slightly further to the east. The previous collapse was c. 5m wide with a back wall of c. 2-3m high. This collapse appears to have occurred at the edge of the current waste extents. On diverting the water, subsequent erosion exposed a number of pipes draining from the landfill to the north east. During the survey session on the 3rd December 2015 extremely high rainfall was observed with surface water streams running off the landfill. Erosion of the embankment to the north east resulted in a minor landslide washing soil into the stream. The soil slope was found to be very unstable in localised areas where the affect of the surface water runoff was greatest. Evidence of landslide/slip material is suggested on R02 and R15 (Drawings AGL15302_09 and 22 respectively). Waste was observed on surface of slope.

3.4.3 Landfill Site 3a

The interpreted lateral extent of the waste material is c. 1.75 Ha and is indicated in Drawing AGL15302_07. The western boundary of the waste body was not defined by the geophysical survey and may extend beyond the boundary indicated on Drawing AGL15302_07. Six ERT profiles (R04, R05, R06, R07, R10 & R14) were collected across the waste site (Drawings AGL15302_11, 12, 13, 14, 17 and 21 respectively). Up to 20m of waste with high organic and metallic content has been interpreted based on values contained in Table 2.

Very low resistivities (<30 Ohm-m) beneath the waste body suggest high levels of leachate in the underlying material, focussed at the location in the north east of Site 3a, indicated on Drawing AGL15302_074. In addition, a possible leachate plume has been mapped on R14, migrating downslope to the northeast from the bounds of the landfill material.

Anecdotal evidence suggests that landfill 3a has previously suffered landslides/slips to the north east. The presence of rock drains on the surface may be an indication of previous remediation works. Evidence of landslide/slip material is suggested on R14 (Drawing AGL15302_21).

3.4.4 Landfill Site 3b

The interpreted lateral extent of the waste material is c. 0.44 Ha and is indicated in Drawing AGL15302_07. One ERT profile (R13) was collected across the waste site (Drawing AGL15302_20). Up to 8.5m waste with high organic and metallic content has been interpreted based on values contained in Table 2.

Low resistivities beneath the waste body suggest downward migration of leachate in to the underlying material. No leachate plume has been mapped exiting the bounds of the landfill material.

3.4.5 Landfill Site 3c

The interpreted lateral extent of the waste material is c. 0.8 Ha and is indicated in Drawing AGL15302_07. Two ERT profiles (R08 & R09) were collected across the waste site (Drawings AGL15302_15 and 16 respectively). Up to 20.5m of waste with high organic and metallic content has been observed.

Very low resistivities (<30 Ohm-m) beneath the waste body on suggest high levels of leachate in the underlying material, focussed in the north east of the site as indicated on Drawing AGL15302_04. A possible leachate plume has been mapped on R09, migrating down-slope to the northeast from the bounds of the landfill material.

Anecdotal evidence suggests that landfill 3b has previously suffered landslides/slips to the north east. The presence of rock drains on the surface may be an indication of previous remediation works. Evidence of landslide/slip material is suggested on R09 (Drawing AGL15302_16).

3.5 Discussion

Sites 1, 2, 3a and 3c which slope to the north appear to exhibit leachate migration down-slope.

A landslide/slip was observed on the north east of Site 2 while anecdotal evidence suggests that landfills 3a and 3c have previously suffered landslides/slips to the north east. Evidence of landslides/slips on the northern slopes is confirmed by the geophysical data at sites 2, 3a and 3c.

4. RECOMENDATIONS

The slope material should be investigated by hand dug trial pits to confirm the presence of and determine the extent of waste material from landslides/slips.

Consideration should be made to the slope stability when targeting any intrusive investigations on the slope to the north and north east of the landfill.

Seepage was noted on the slope at Site 2. Sampling should be carried out at the base of the slopes at Sites 1, 2, 3a and 3c to investigate the migration of leachate.

Additional EM31 mapping and ERT should be considered to the west of Site 3a to confirm/determine the western extent of the waste body.

The findings of the geophysical investigation should be reviewed following any further intrusive investigations.

5. REFERENCES

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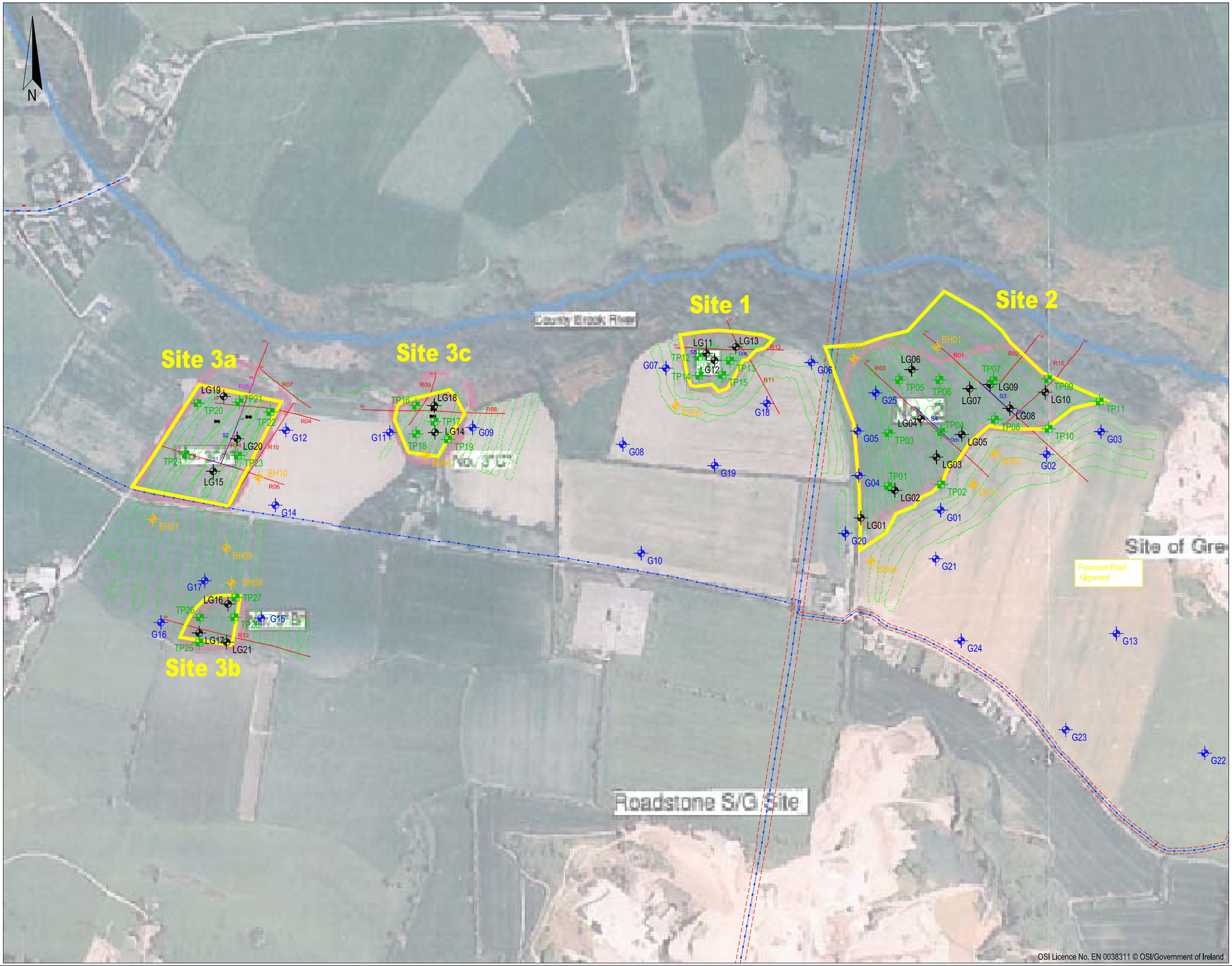
APPENDIX A: DRAWINGS

The information derived from the geophysical investigation as well as correlation with the available direct investigation is presented in the following drawings:

AGL15302_01	Geophysical survey locations	Scale 1:5000 @A3
AGL15302_02	Conductivity Contours – Sites 1 & 2	Scale 1:2000 @A3
AGL15302_03	Inphase Contours – Sites 1 & 2	Scale 1:2000 @A3
AGL15302_04	Summary interpretation Map – Sites 1 & 2	Scale 1:2000 @A3
AGL15302_05	Conductivity Contours – Sites 3a, 3b & 3c	Scale 1:2000 @A3
AGL15302_06	Inphase Contours – Sites 3a, 3b & 3c	Scale 1:2000 @A3
AGL15302_07	Summary interpretation Map – Sites 3a, 3b & 3c	Scale 1:2000 @A3
AGL15302_08	ERT Profile R1	Scale 1:1500 @A3
AGL15302_09	ERT Profile R2	Scale 1:1000 @A3
AGL15302_10	ERT Profile R3	Scale 1:1500 @A3
AGL15302_11	ERT Profile R4	Scale 1:1000 @A3
AGL15302_12	ERT Profile R5	Scale 1:1000 @A3
AGL15302_13	ERT Profile R6	Scale 1:1000 @A3
AGL15302_14	ERT Profile R7	Scale 1:1000 @A3
AGL15302_15	ERT Profile R8	Scale 1:1000 @A3
AGL15302_16	ERT Profile R9	Scale 1:1000 @A3
AGL15302_17	ERT Profile R10	Scale 1:1000 @A3
AGL15302_18	ERT Profile R11	Scale 1:1000 @A3
AGL15302_19	ERT Profile R12	Scale 1:1000 @A3
AGL15302_20	ERT Profile R13	Scale 1:1000 @A3
AGL15302_21	ERT Profile R14	Scale 1:1000 @A3
AGL15302_22	ERT Profile R15	Scale 1:1000 @A3

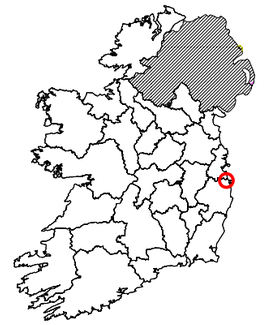
FIGURE 1: GEOPHYSICAL AND (AS BUILT) SI LOCATIONS

SCALE 1:5000



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INDEX MAP:



LEGEND:

- Site boundary
- R1 — ERT profile
- S1 — Seismic refraction profile
- Conductivity measurments
- LG20 — Cable/Rotary Core
- BH10 — Rotary Core
- G13 — Rotary Core
- TP23 — Trial Pit
- Water Main

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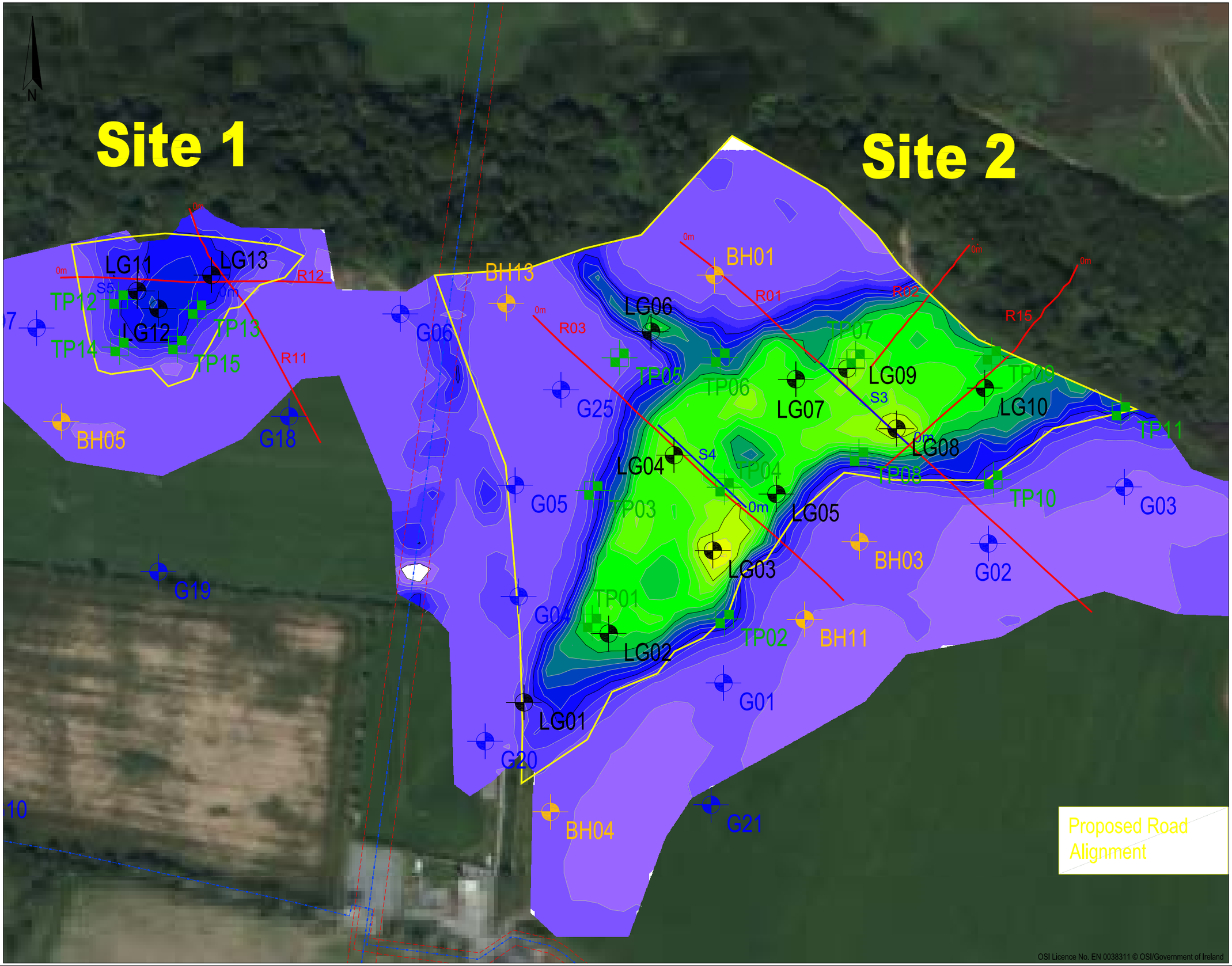
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DRAWING NO:	AGL15302_01
SCALE:	AS INDICATED @ A3
DATE:	20th April 2016

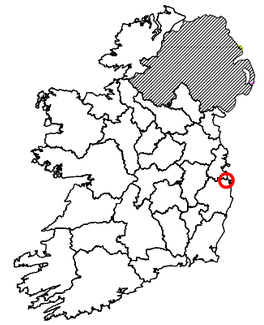
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FIGURE 1: CONDUCTIVITY CONTOURS (mS/m)

SCALE 1:2000



INDEX MAP:



LEGEND:

- Site boundary
- R1 ERT profile
- S1 Seismic refraction profile

Conductivity (mS/m)

137
132
127
122
117
112
107
102
97
92
87
82
77
72
67
62
57
52
47
42
37
32
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22
17
12
7
2

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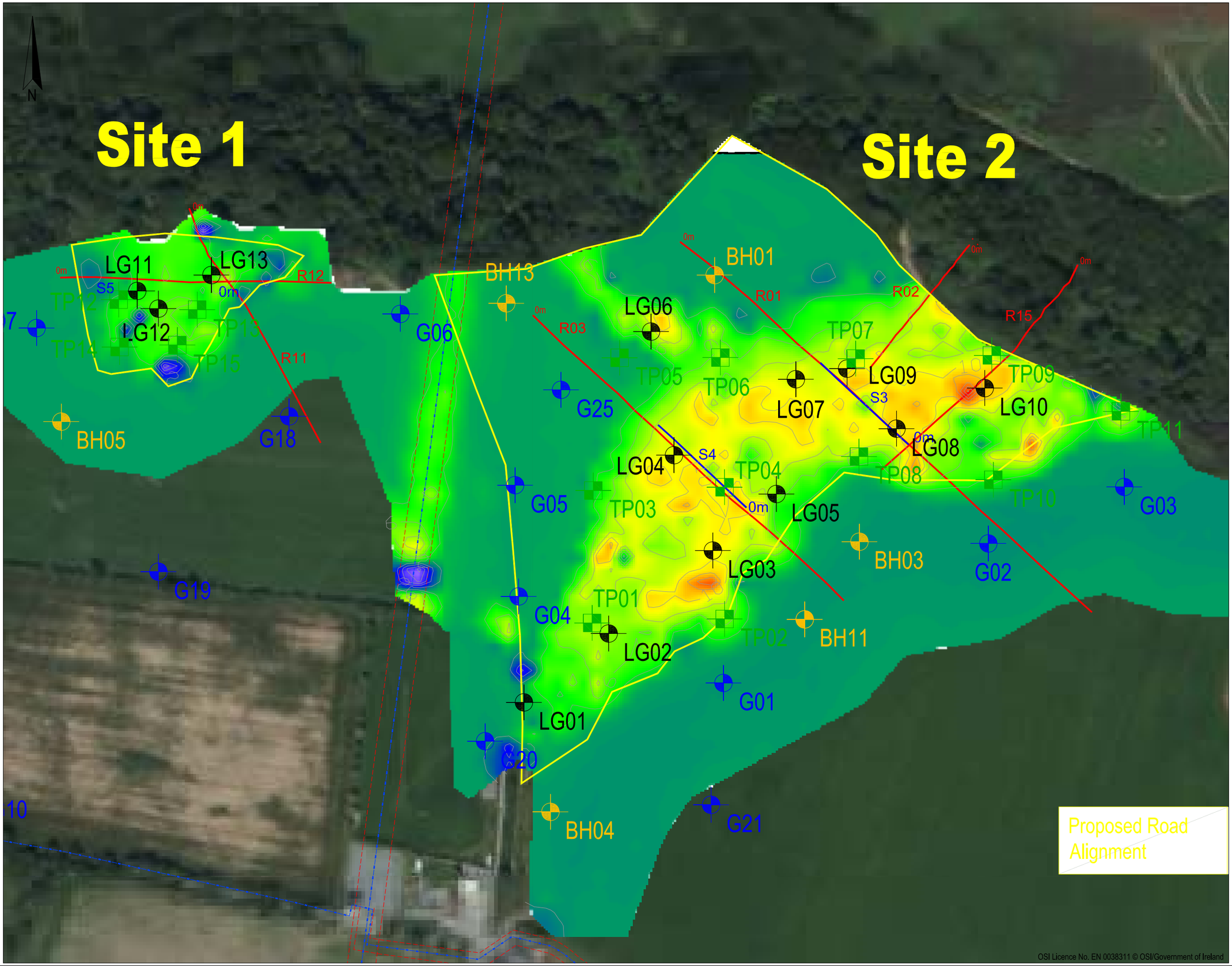
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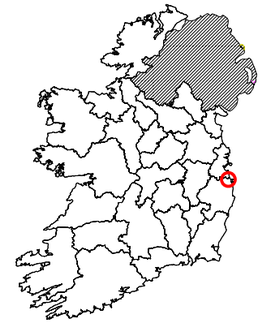
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FIGURE 1: INPHASE CONTOURS

SCALE 1:2000



INDEX MAP:



LEGEND:

Site boundary

R1 ERT profile

S1 Seismic refraction profile

Inphase Values

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4 -5 -6

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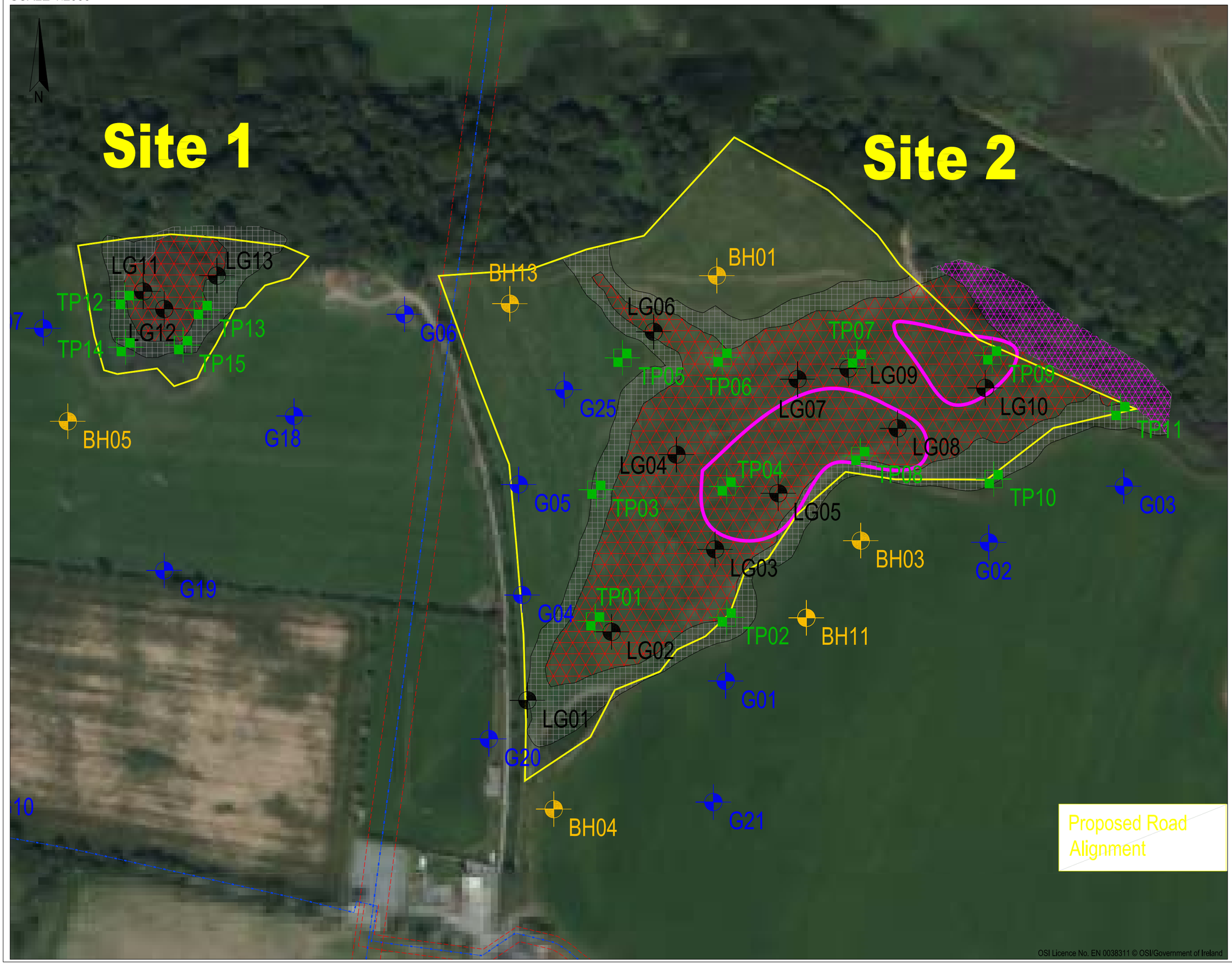
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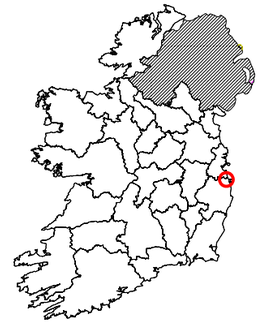
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FIGURE 1: SUMMARY MAP - Sites 1 & 2

SCALE 1:2000



INDEX MAP:



LEGEND:

- Extent of Waste with high Organic & Metallic content
- Extent of Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Landslide and/or potential leachate
- Zone of high levels of leachate beneath waste body

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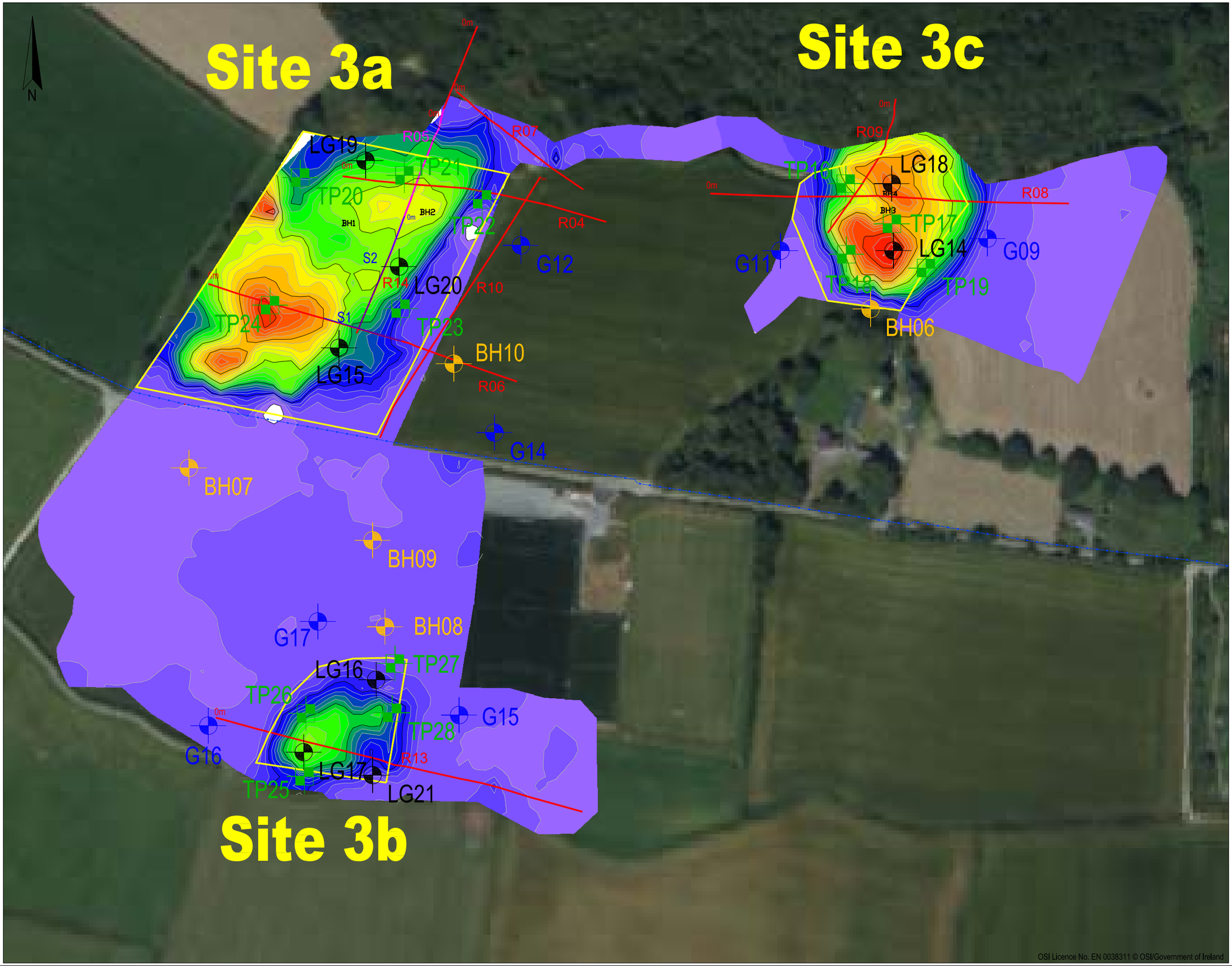
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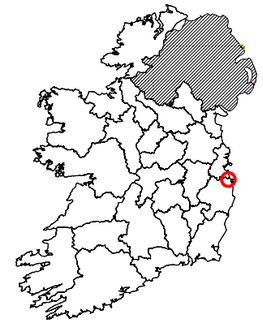
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FIGURE 1: CONDUCTIVITY CONTOURS (mS/m)

SCALE 1:2000



INDEX MAP:



LEGEND:

Site boundary

R1 ERT profile

S1 Seismic refraction profile

137
132
127
122
117
112
107
102
97
92
87
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2

Conductivity (mS/m)

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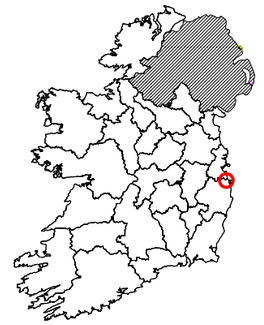
FIGURE 1: INPHASE CONTOURS

SCALE 1:2000



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INDEX MAP:



LEGEND:

Site boundary

R1 ERT profile

S1 Seismic refraction profile

Inphase Values

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4 -5 -6

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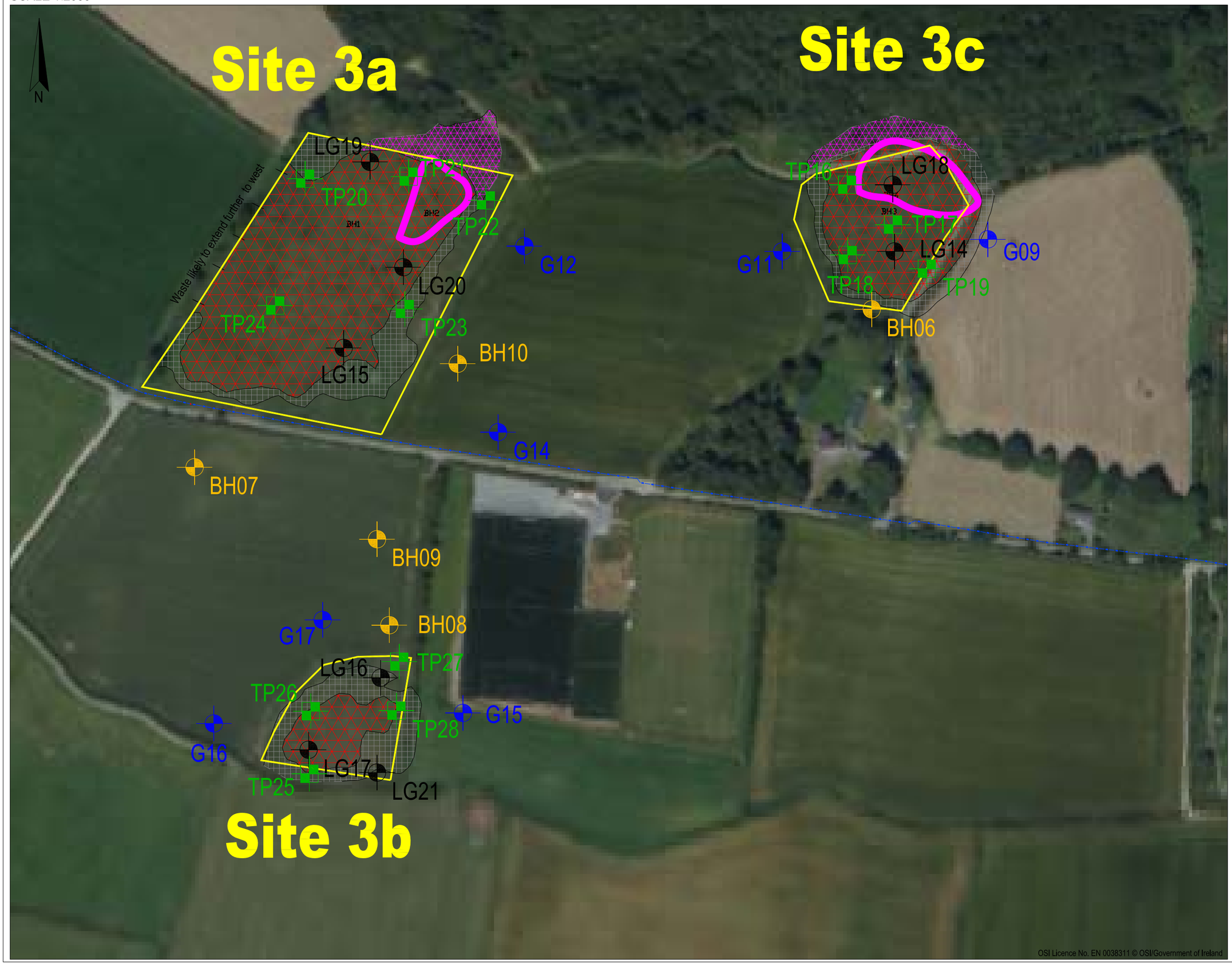
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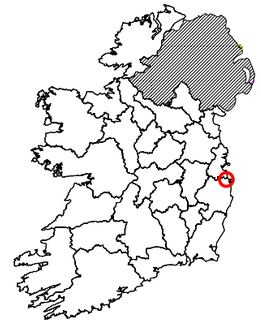
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FIGURE 1: SUMMARY MAP - Sites 3a, 3b & 3c

SCALE 1:2000



INDEX MAP:



LEGEND:

- Extent of Waste with high Organic & Metallic content
- Extent of Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Landslide and/or potential leachate
- Zone of high levels of leachate beneath waste body

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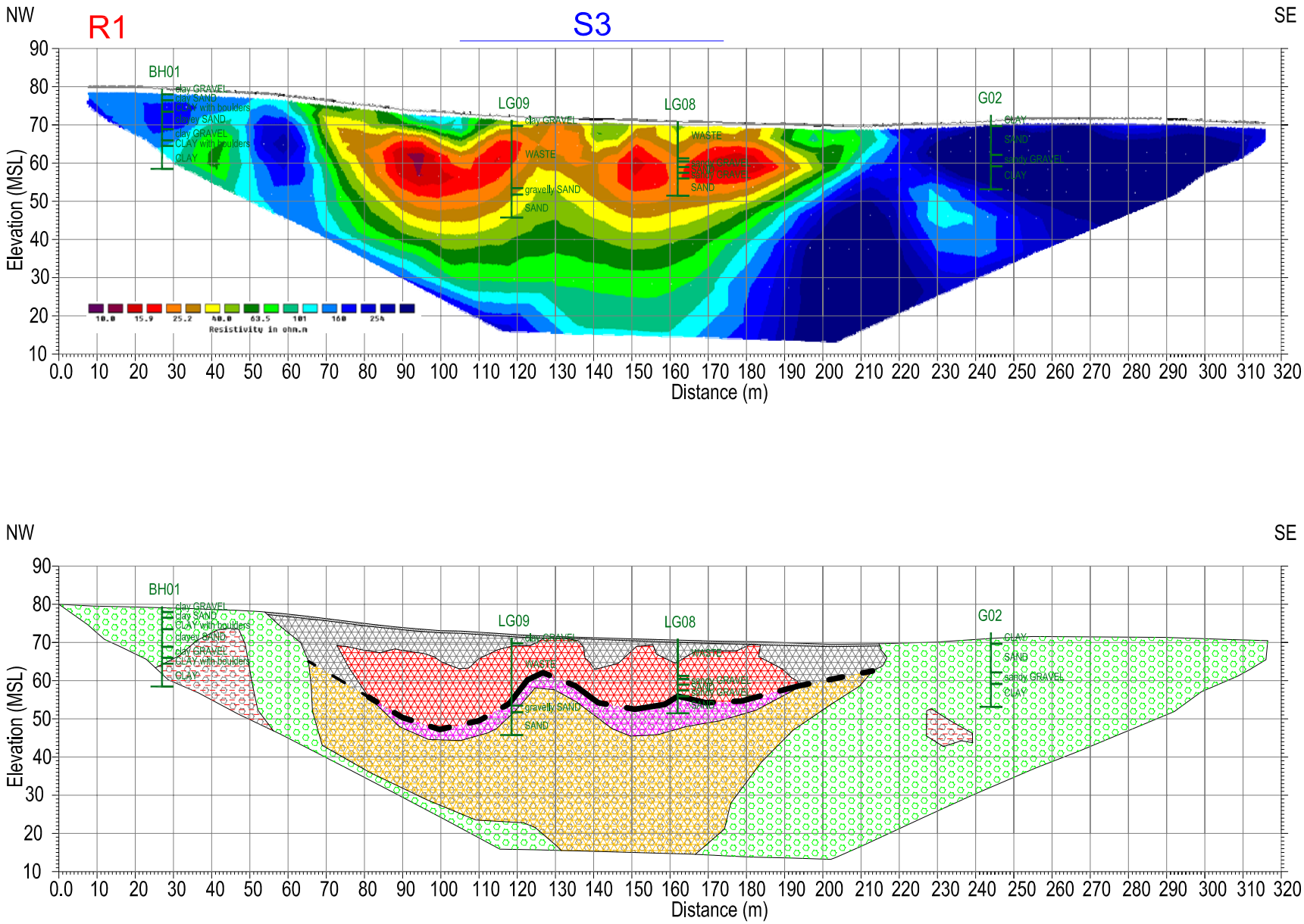
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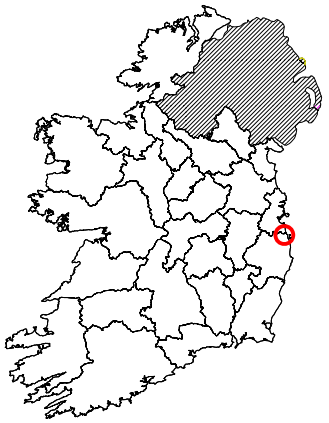
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02	09/05/2016	YOC	

FIGURE 1 : ERT PROFILE - R1

SCALE 1: 1500



INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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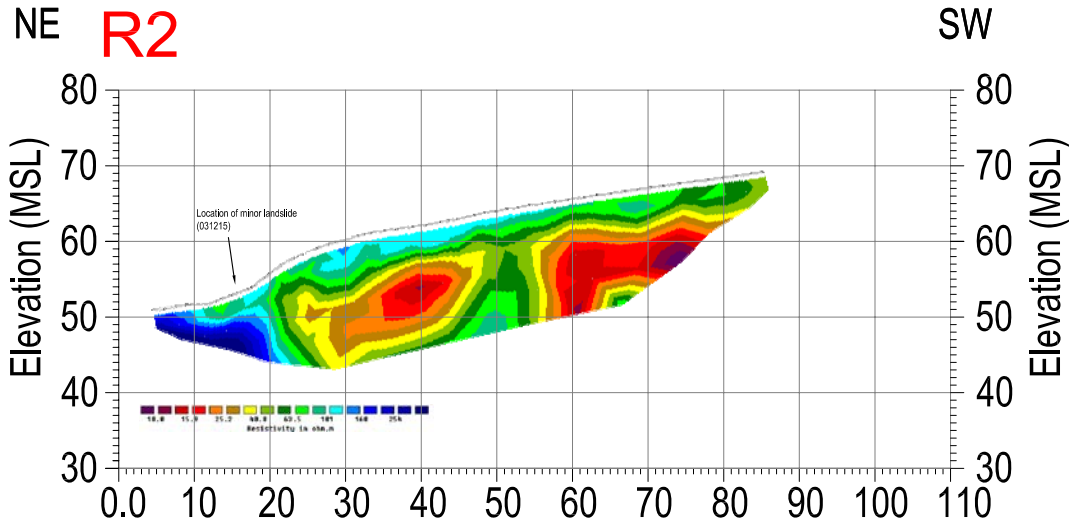
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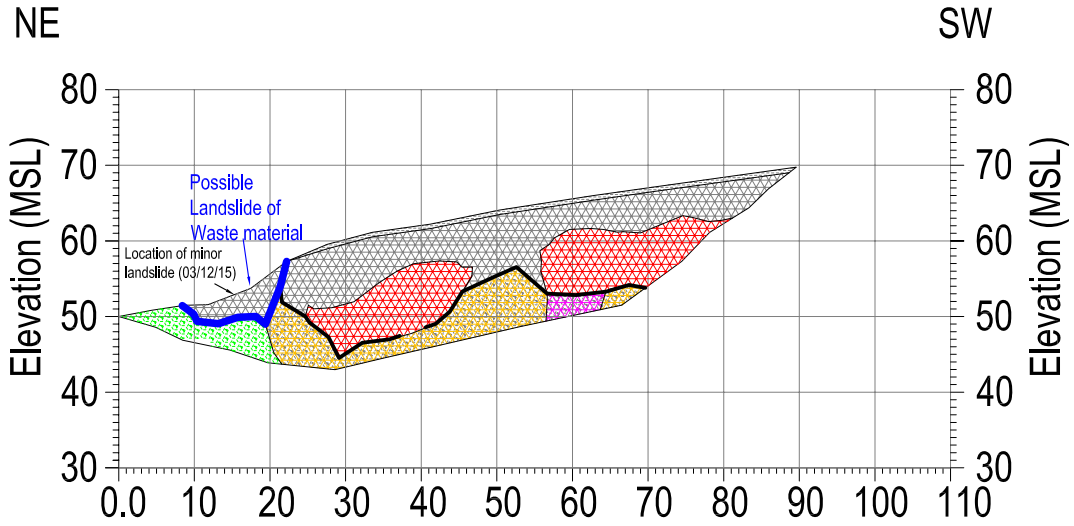
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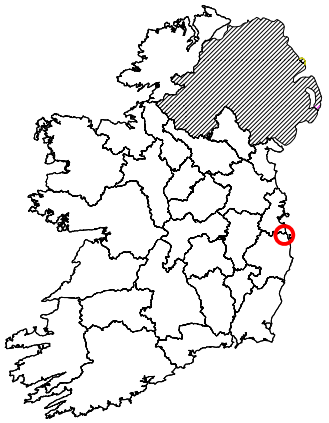
FIGURE 1 : ERT PROFILE - R2

SCALE 1: 1000





INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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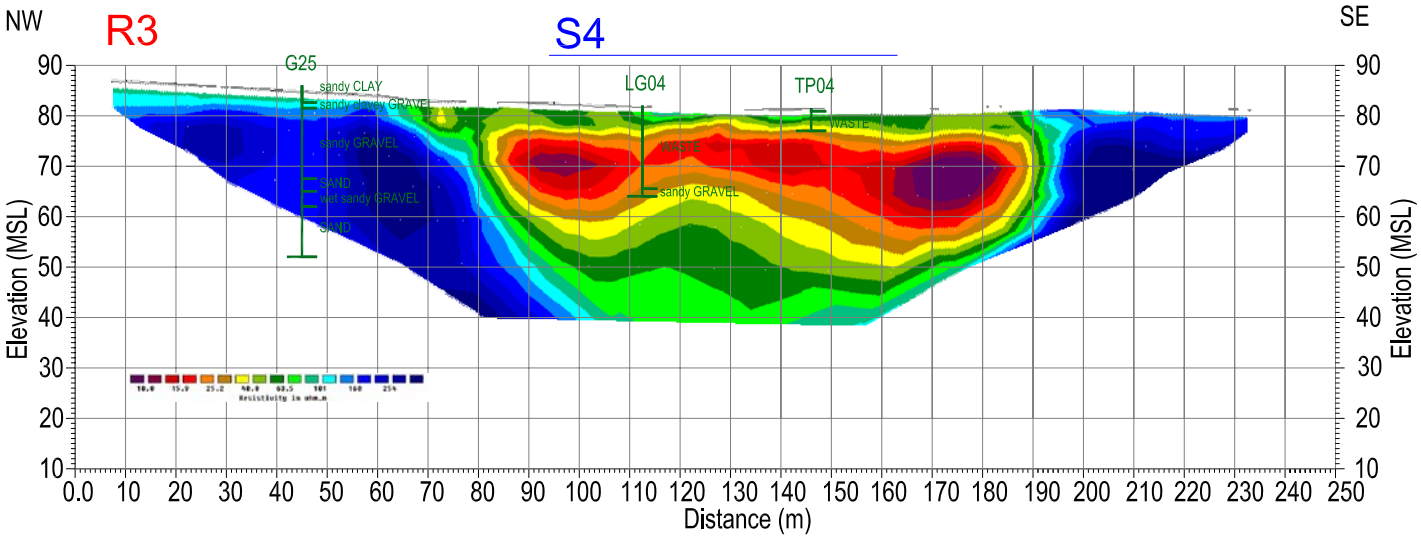
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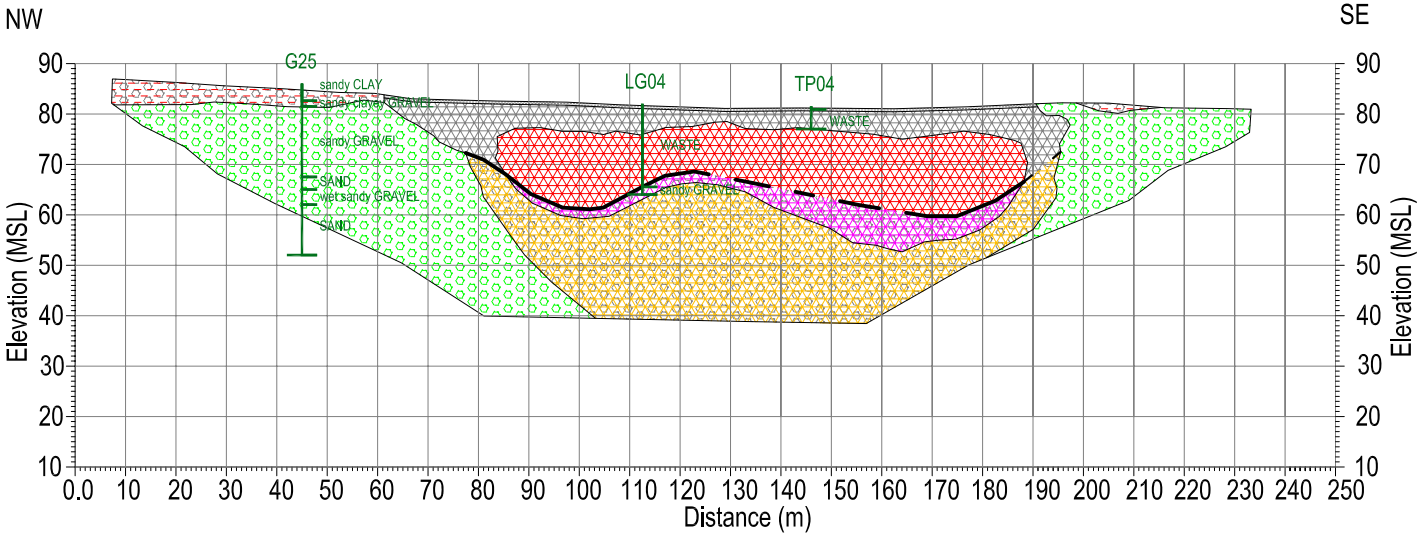
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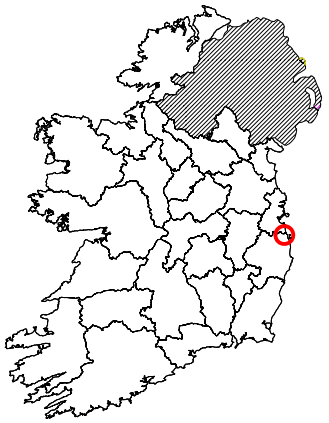
FIGURE 1 : ERT PROFILE - R3

SCALE 1: 1500





INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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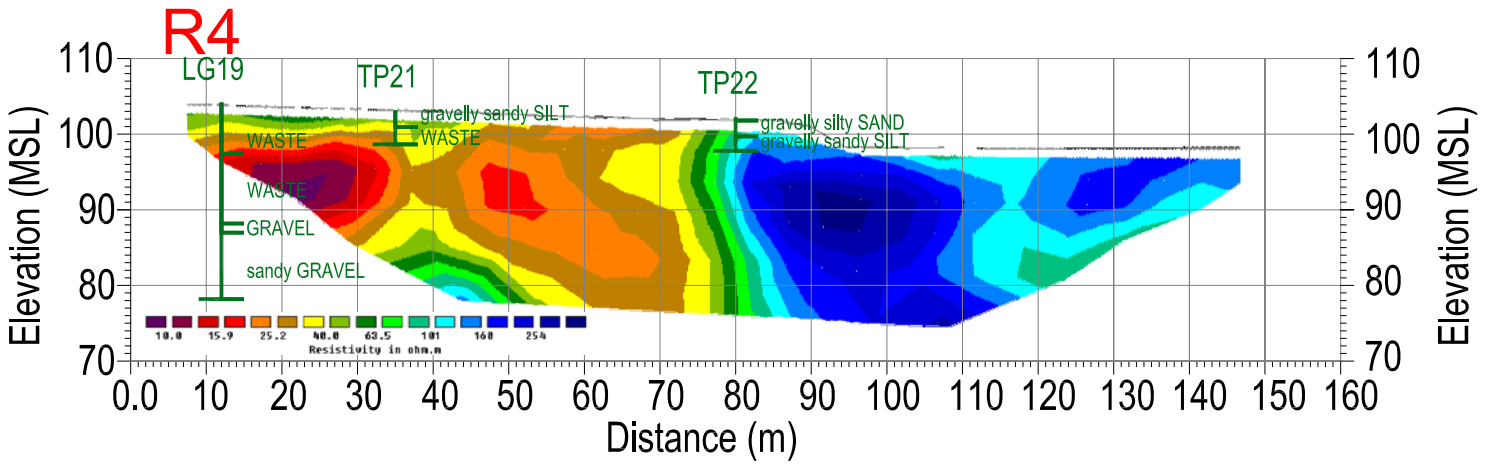
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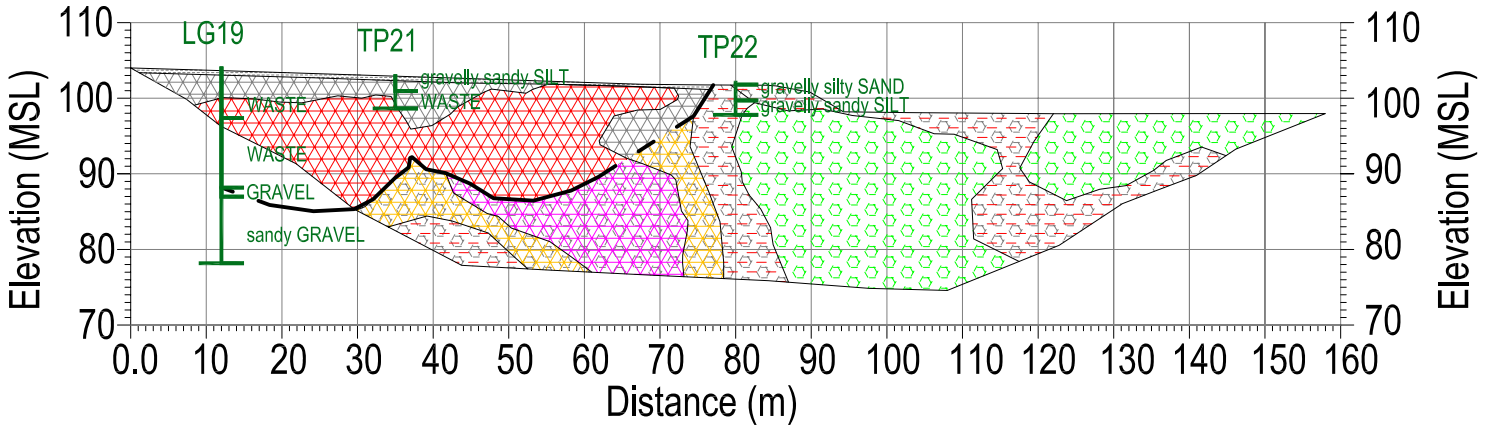
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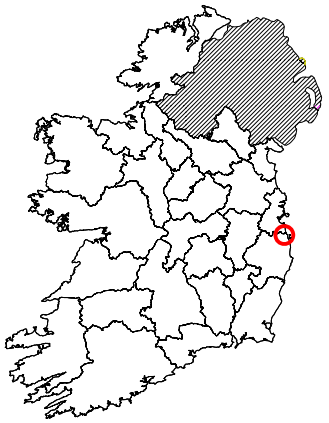
FIGURE 1 : ERT PROFILE - R4

SCALE 1: 1000





INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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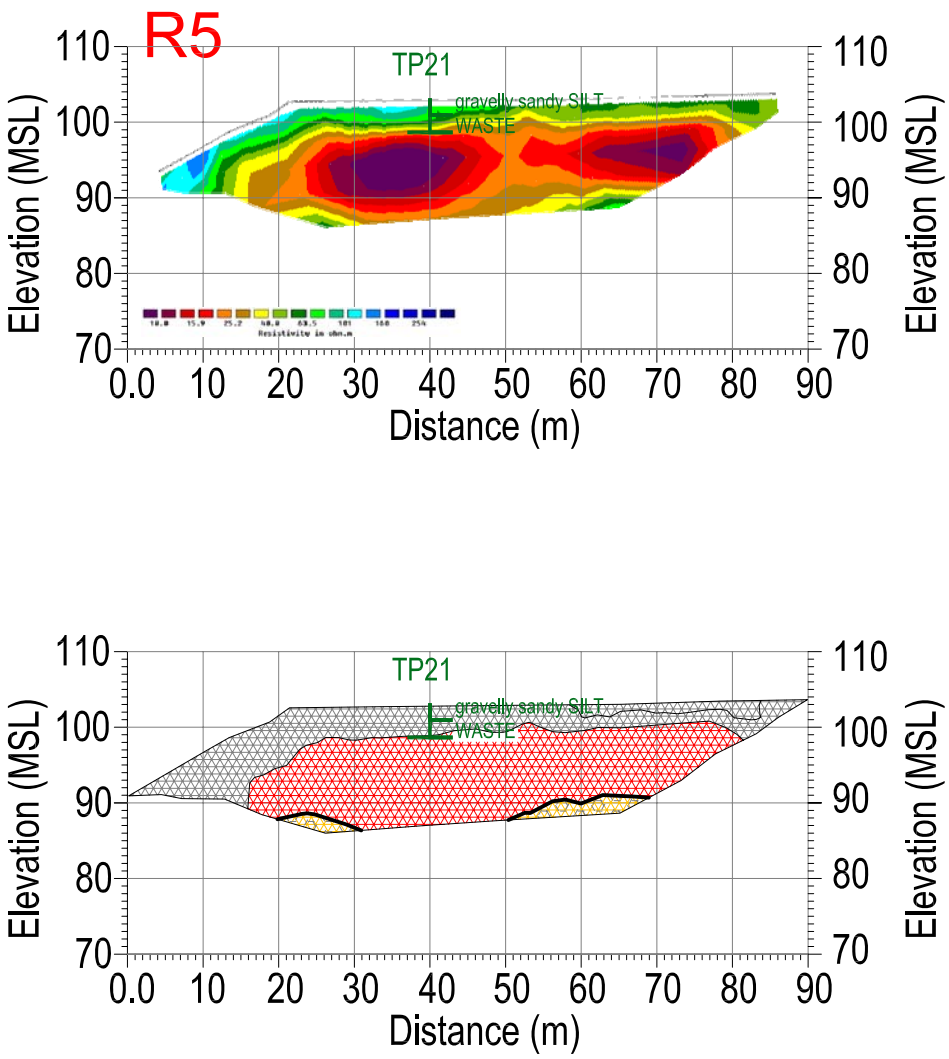
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E Info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

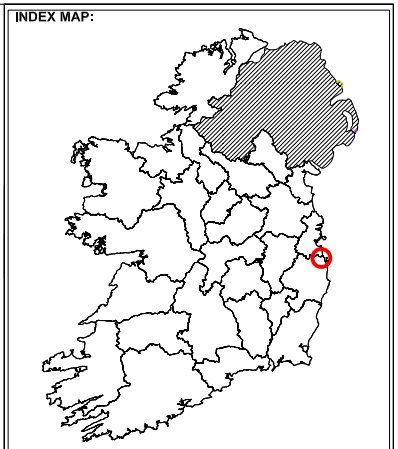
PROJECT:	FASSAROE UNATHOURISED LANDFILL SITES GEOPHYSICAL INVESTIGATION
DRAWING No.:	AGL15302_11
DATE:	20th April 2016
CLIENT:	RPS CONSULTING ENGINEERS
SCALE:	AS INDICATED @ A4

Version:	Date:	Drawn By:	Checked:
01	20/04/2016	YOC	

FIGURE 1 : ERT PROFILE - R5

SCALE 1: 1000





LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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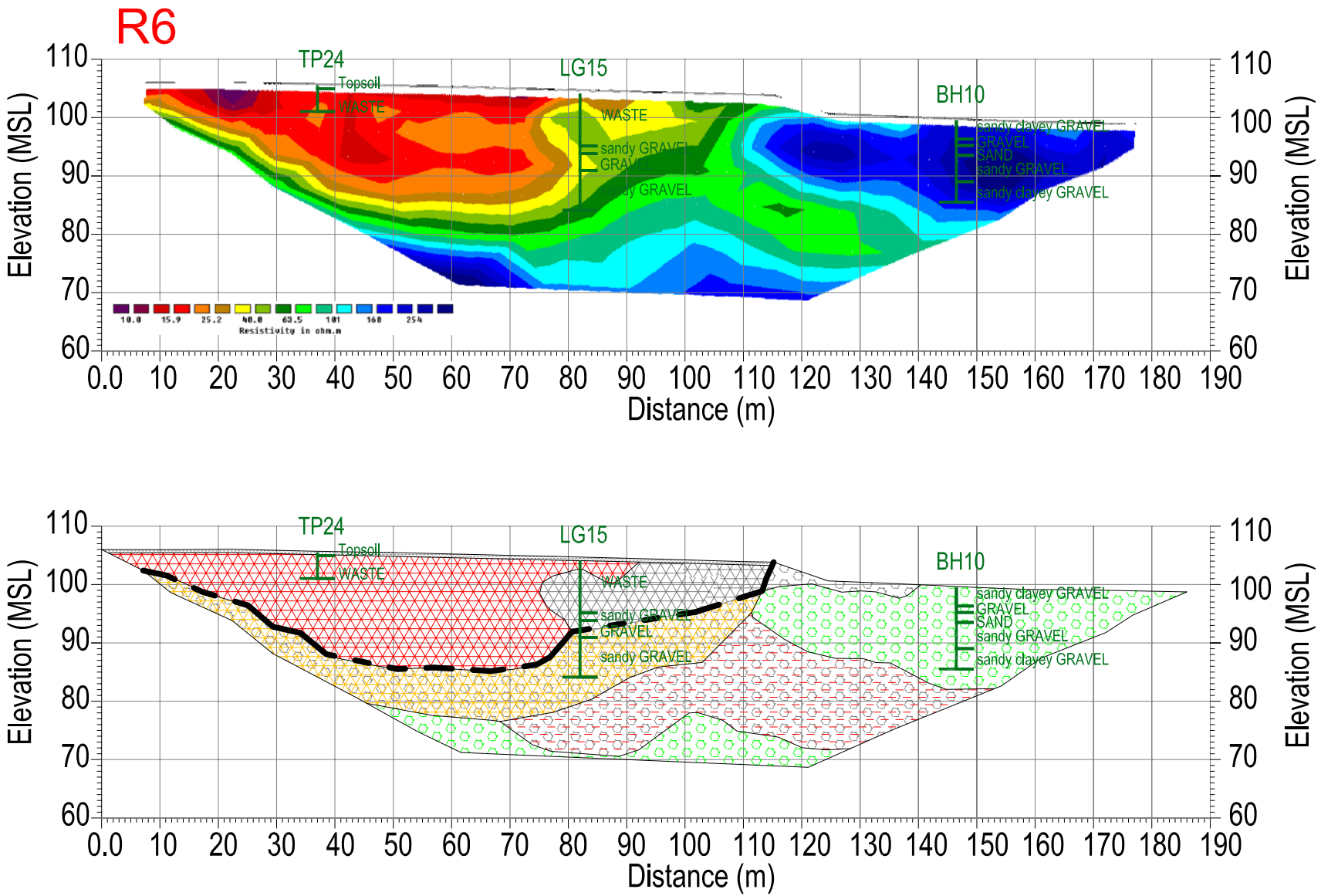
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PROJECT:	FASSAROE UNATHOURISED LANDFILL SITES GEOPHYSICAL INVESTIGATION
DRAWING No.:	AGL15302_12
DATE:	20th April 2016
CLIENT:	RPS CONSULTING ENGINEERS
SCALE:	AS INDICATED @ A4

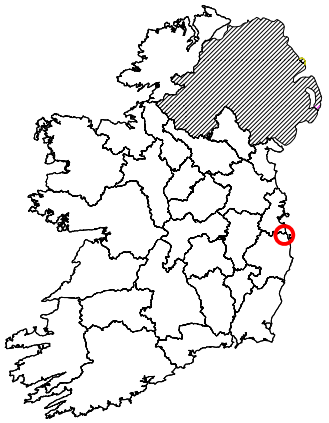
Version:	Date:	Drawn By:	Checked:
01	20/04/2016	YOC	

FIGURE 1 : ERT PROFILE - R6

SCALE 1: 1000



INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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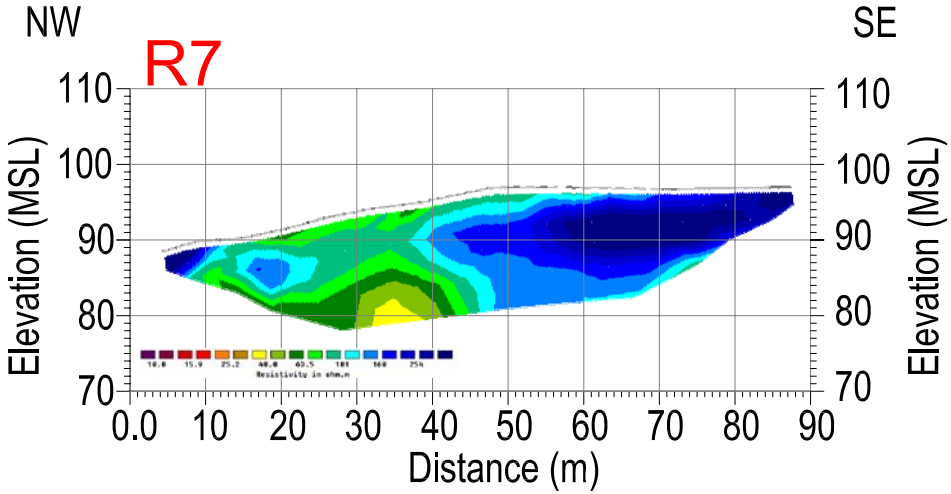
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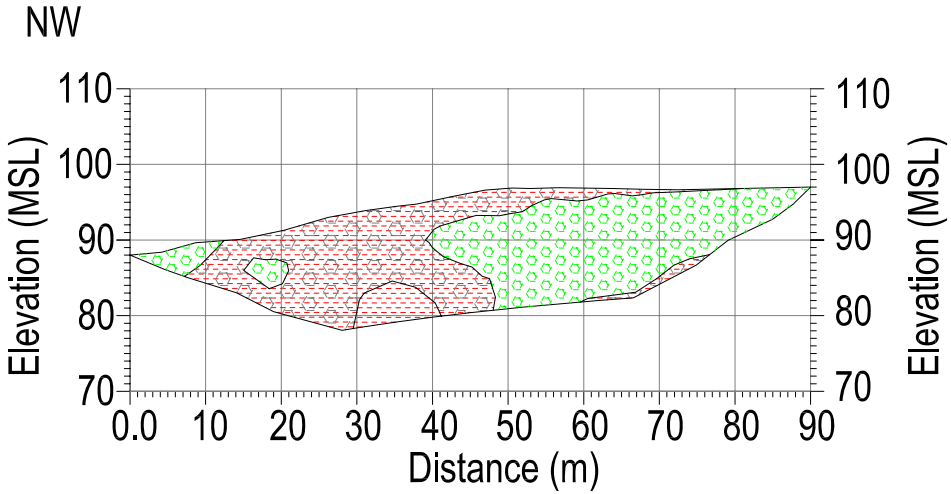
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DRAWING No.:	AGL15302_13
DATE:	20th April 2016
CLIENT:	RPS CONSULTING ENGINEERS
SCALE:	AS INDICATED @ A4

Version:	Date:	Drawn By:	Checked:
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02	09/05/2016	YOC	

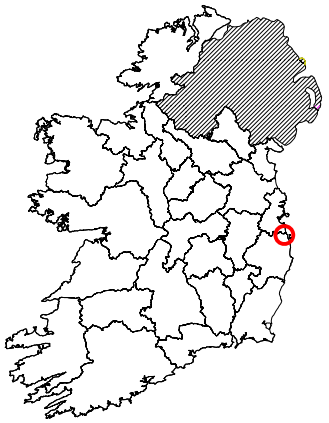
FIGURE 1 : ERT PROFILE - R7

SCALE 1: 1000





INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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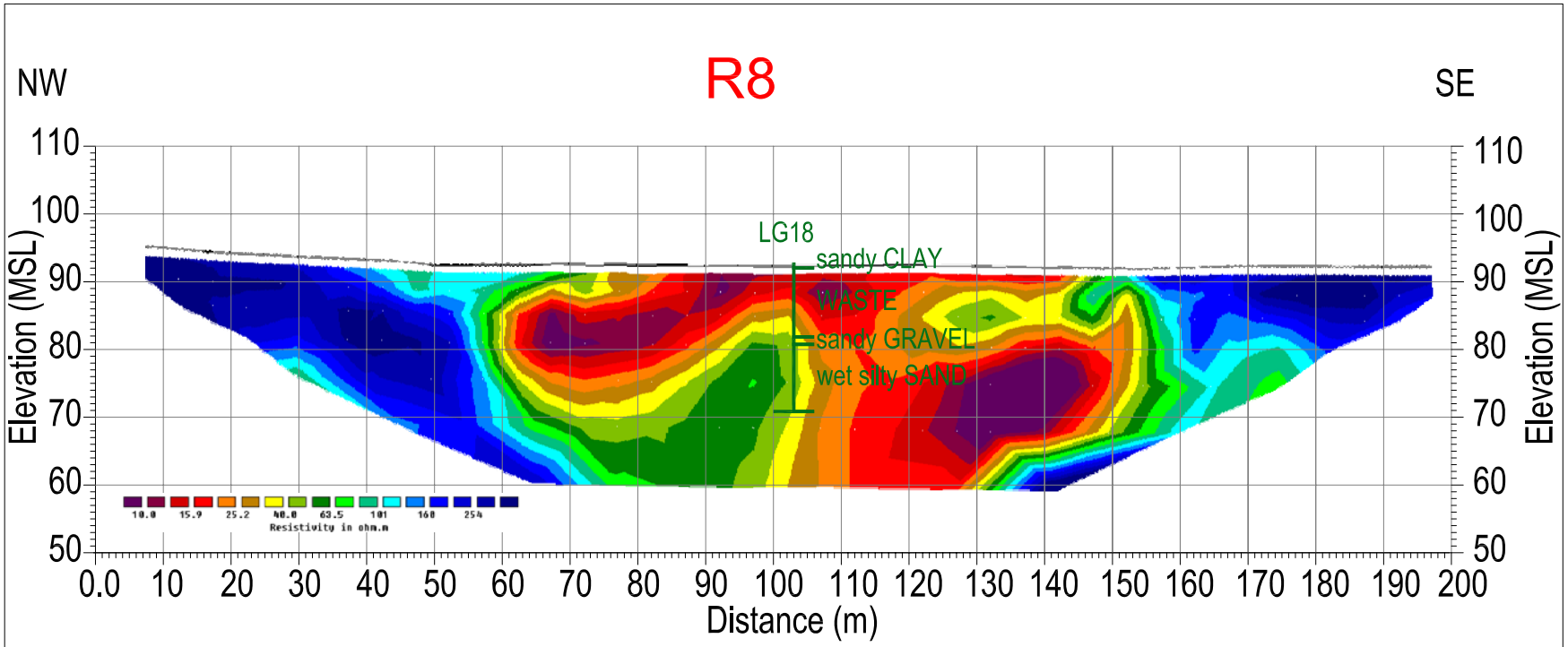
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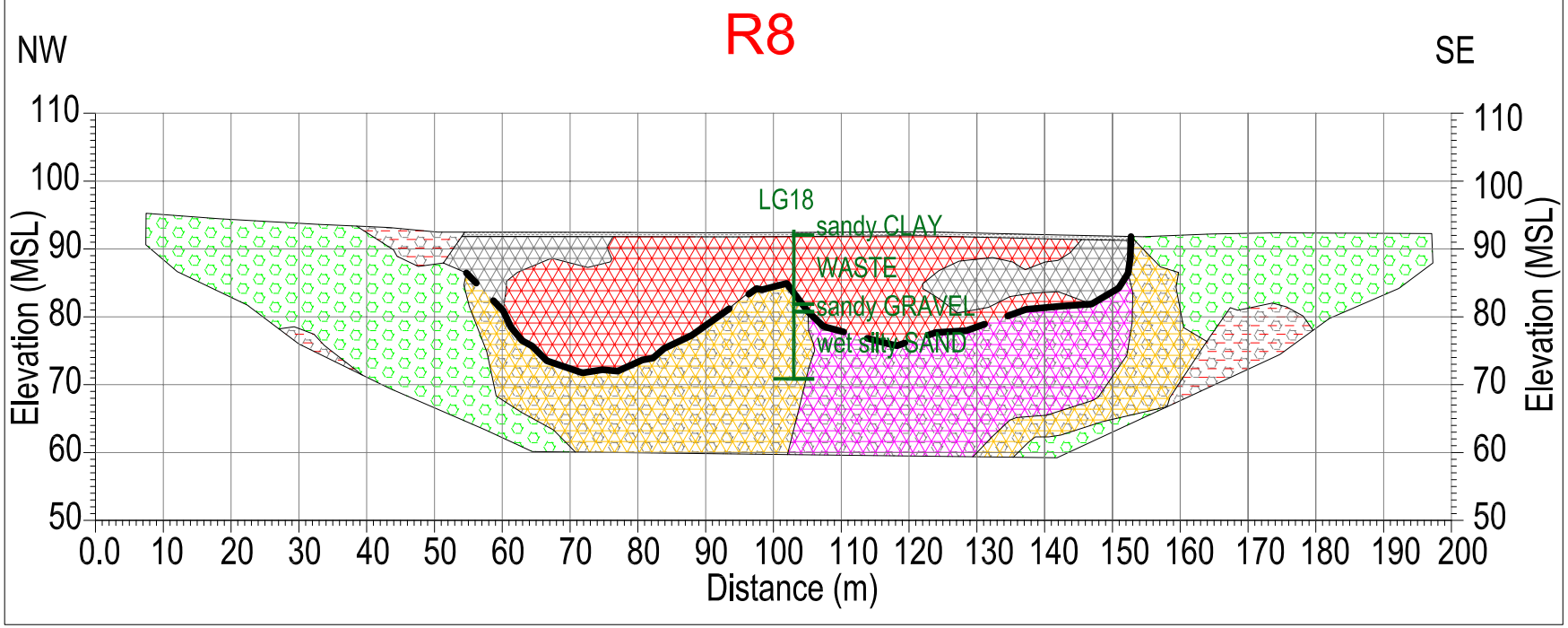
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DRAWING No.:	AGL15302_14
DATE:	20th April 2016
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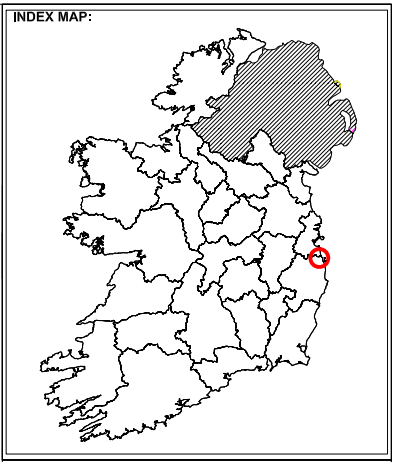
Version:	Date:	Drawn By:	Checked:
01	20/04/2016	YOC	

FIGURE 1 : ERT PROFILE - R8

SCALE 1: 1000







LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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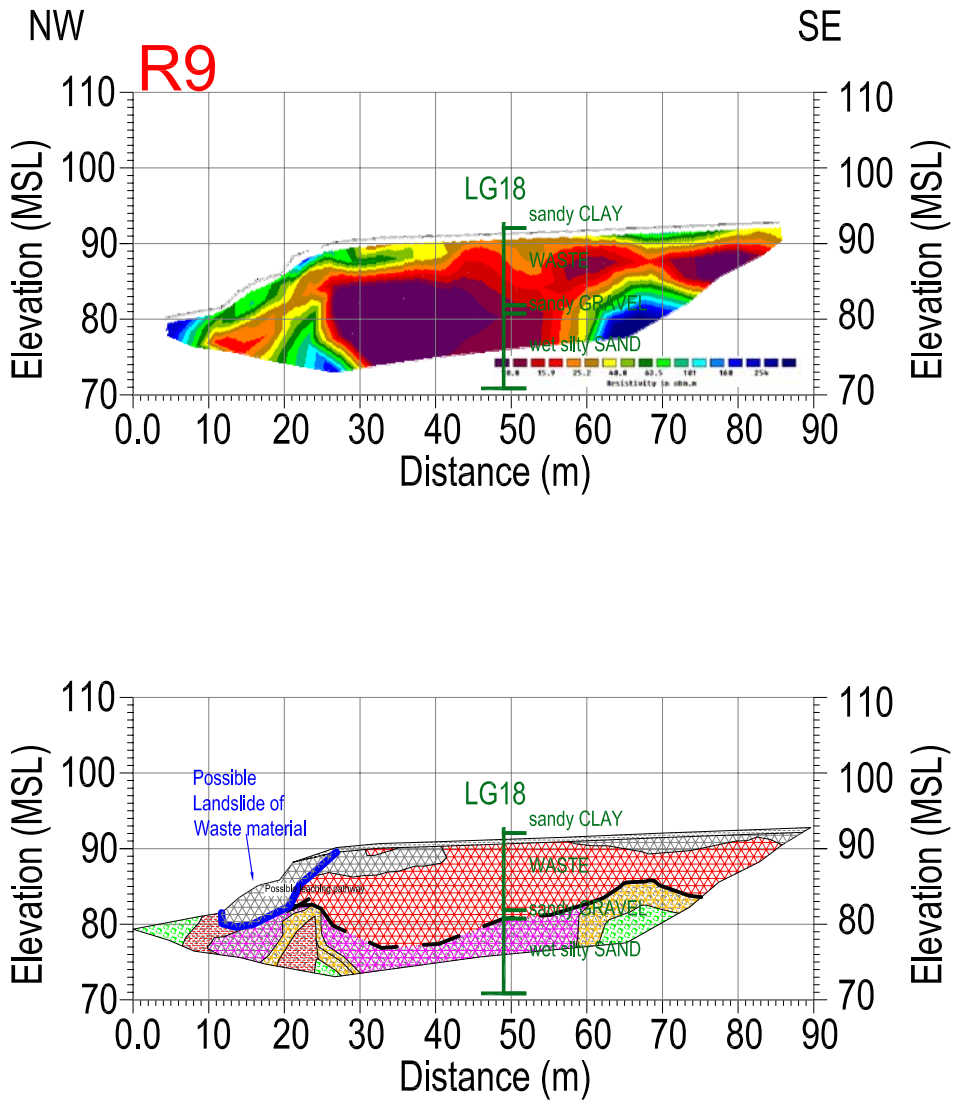
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PROJECT:	FASSAROE UNATHOURISED LANDFILL SITES GEOPHYSICAL INVESTIGATION
DRAWING No.:	AGL15302_15
DATE:	20th April 2016
CLIENT:	RPS CONSULTING ENGINEERS
SCALE:	AS INDICATED @ A4

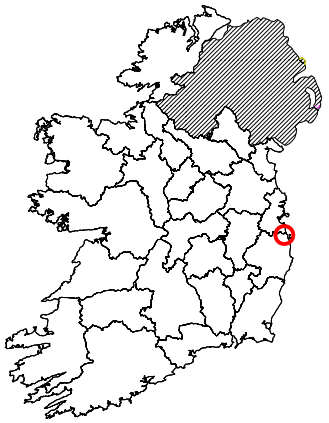
Version:	Date:	Drawn By:	Checked:
01	20/04/2016	YOC	

FIGURE 1 : ERT PROFILE - R9

SCALE 1: 1000



INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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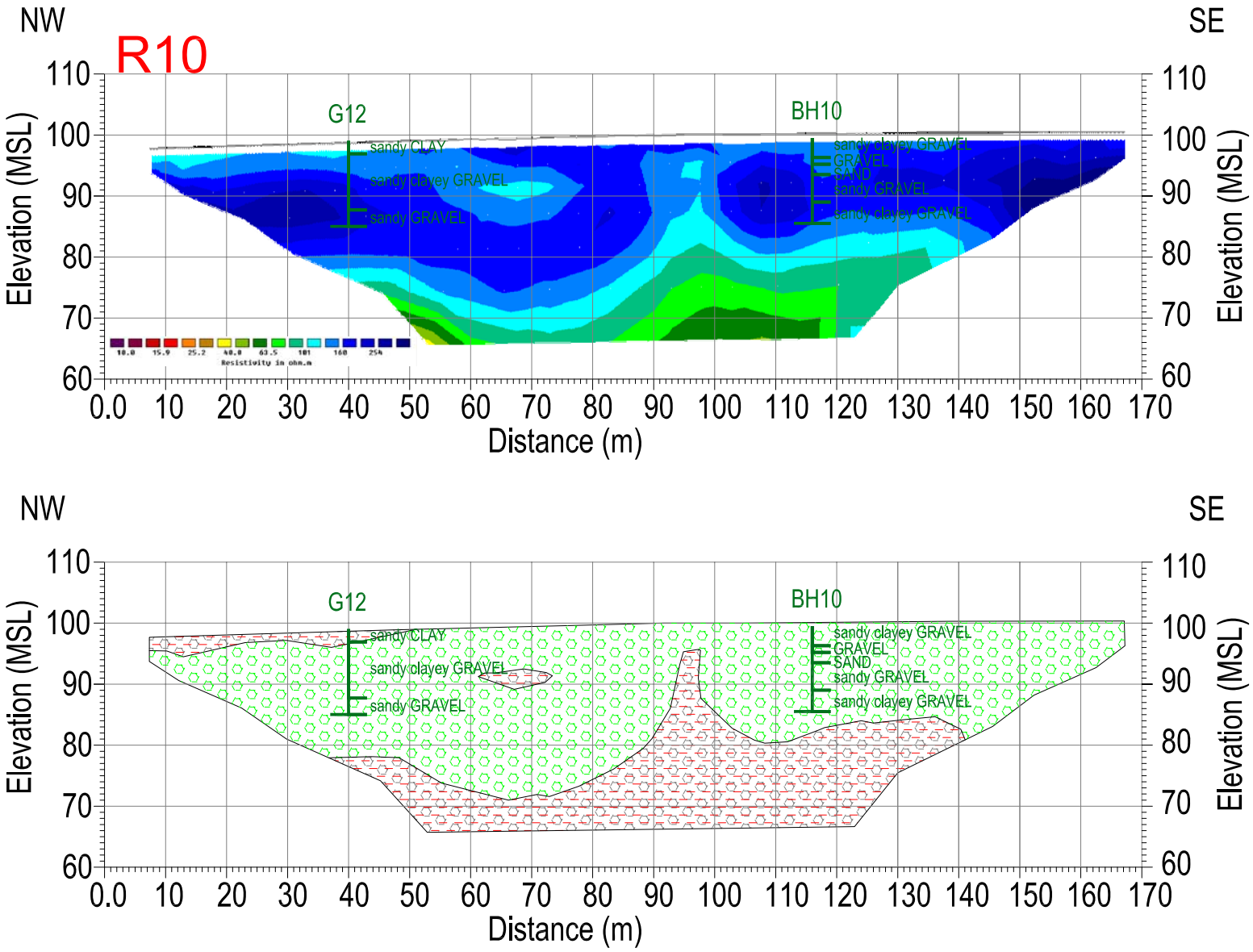
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PROJECT:	FASSAROE UNATHOURISED LANDFILL SITES GEOPHYSICAL INVESTIGATION
DRAWING No.:	AGL15302_16
DATE:	20th April 2016
CLIENT:	RPS CONSULTING ENGINEERS
SCALE:	AS INDICATED @ A4

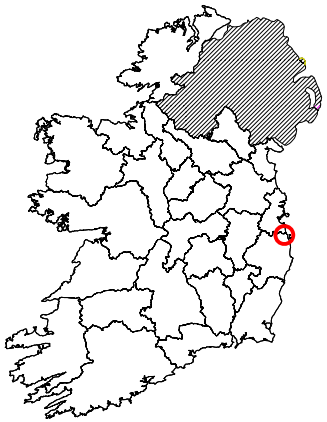
Version:	Date:	Drawn By:	Checked:
01	20/04/2016	YOC	

FIGURE 1 : ERT PROFILE - R10

SCALE 1: 1000



INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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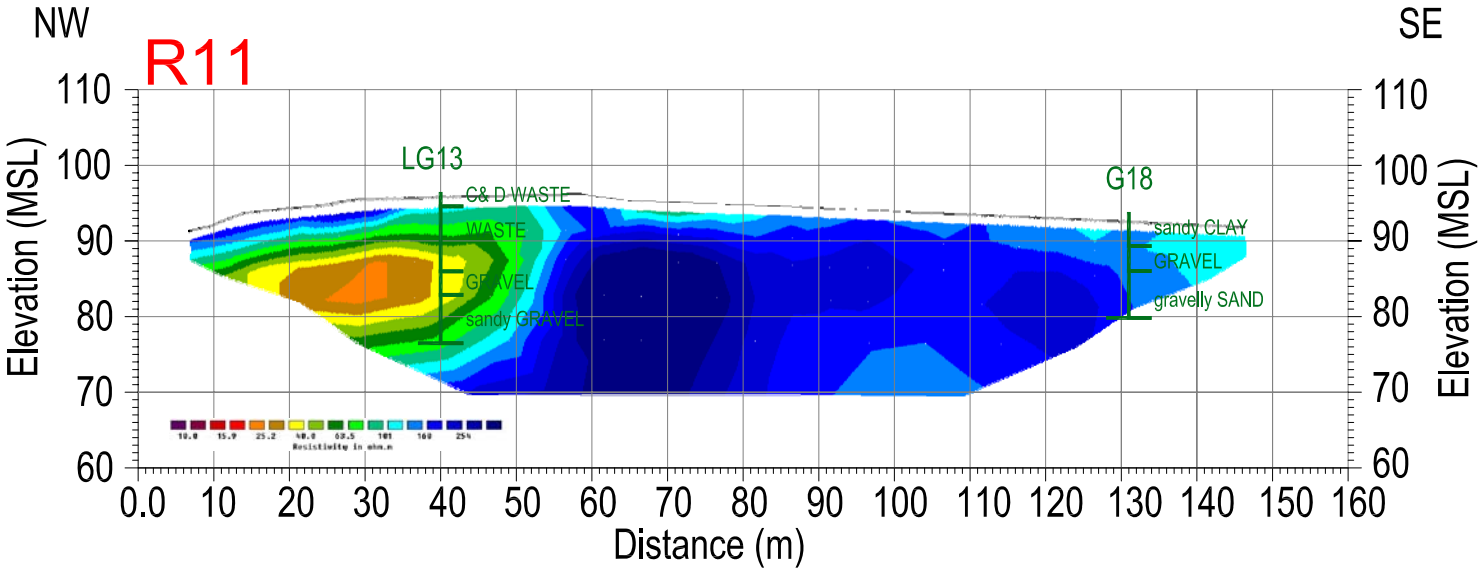
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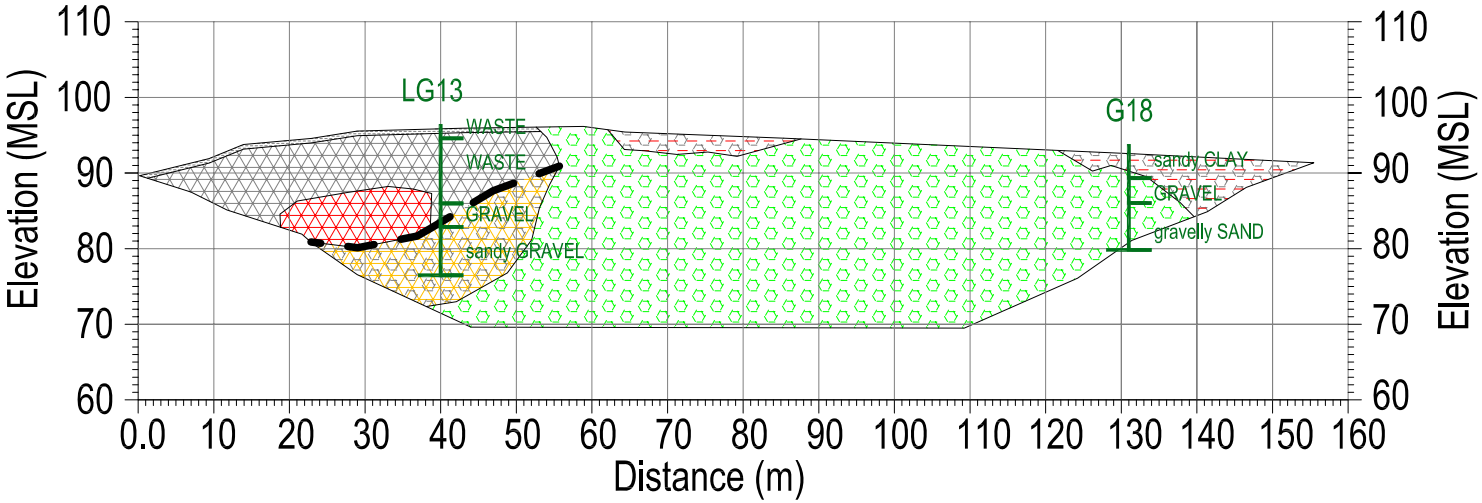
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DRAWING No.:	AGL15302_17
DATE:	20th April 2016
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Version:	Date:	Drawn By:	Checked:
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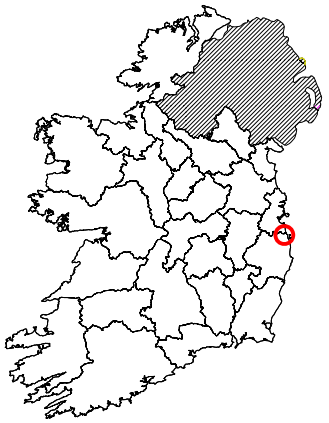
FIGURE 1 : ERT PROFILE - R11

SCALE 1: 1000





INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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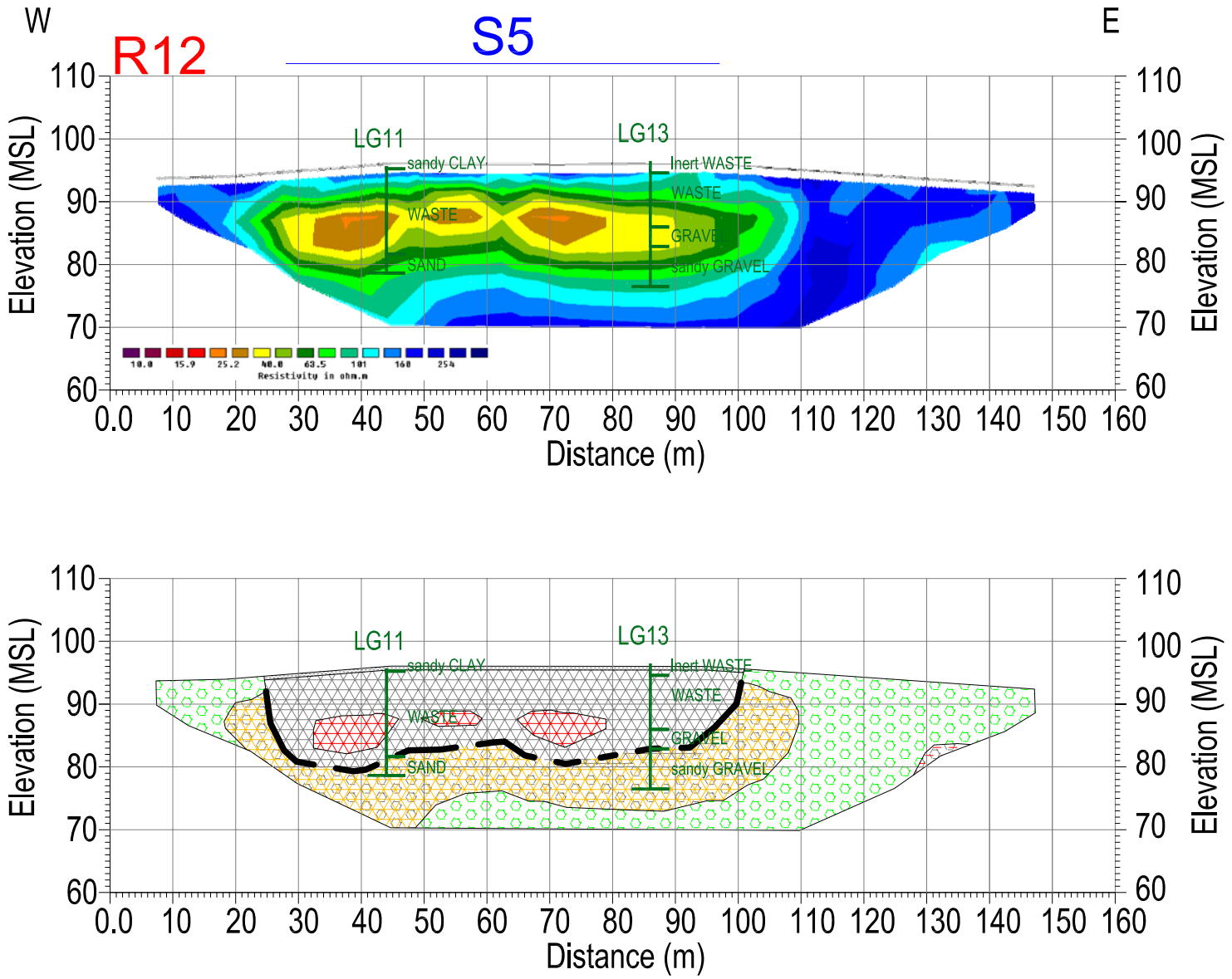
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PROJECT:	FASSAROE UNATHOURISED LANDFILL SITES GEOPHYSICAL INVESTIGATION
DRAWING No.:	AGL15302_18
DATE:	20th April 2016
CLIENT:	RPS CONSULTING ENGINEERS
SCALE:	AS INDICATED @ A4

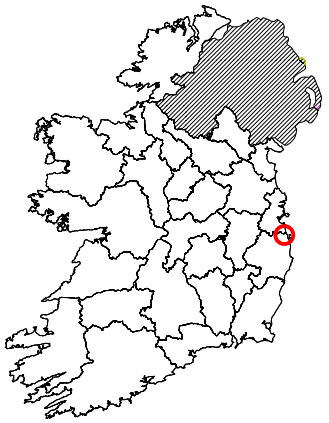
Version:	Date:	Drawn By:	Checked:
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FIGURE 1 : ERT PROFILE - R12

SCALE 1: 1000



INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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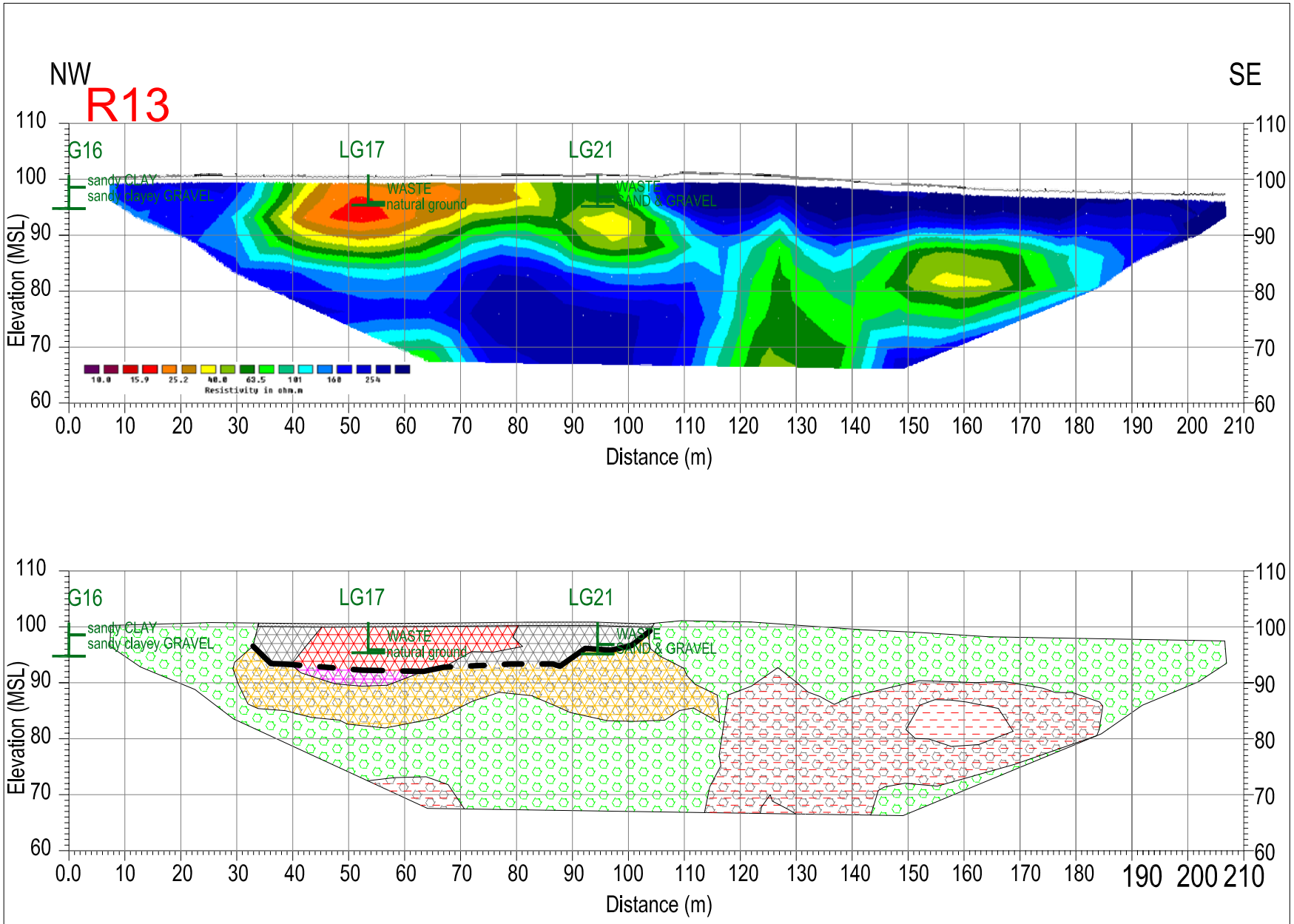
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PROJECT:	FASSAROE UNATHOURISED LANDFILL SITES GEOPHYSICAL INVESTIGATION
DRAWING No.:	AGL15302_19
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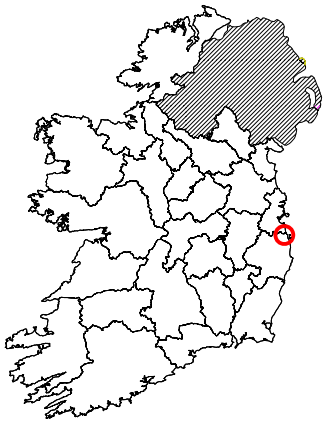
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FIGURE 1 : ERT PROFILE - R13

SCALE 1: 1000



INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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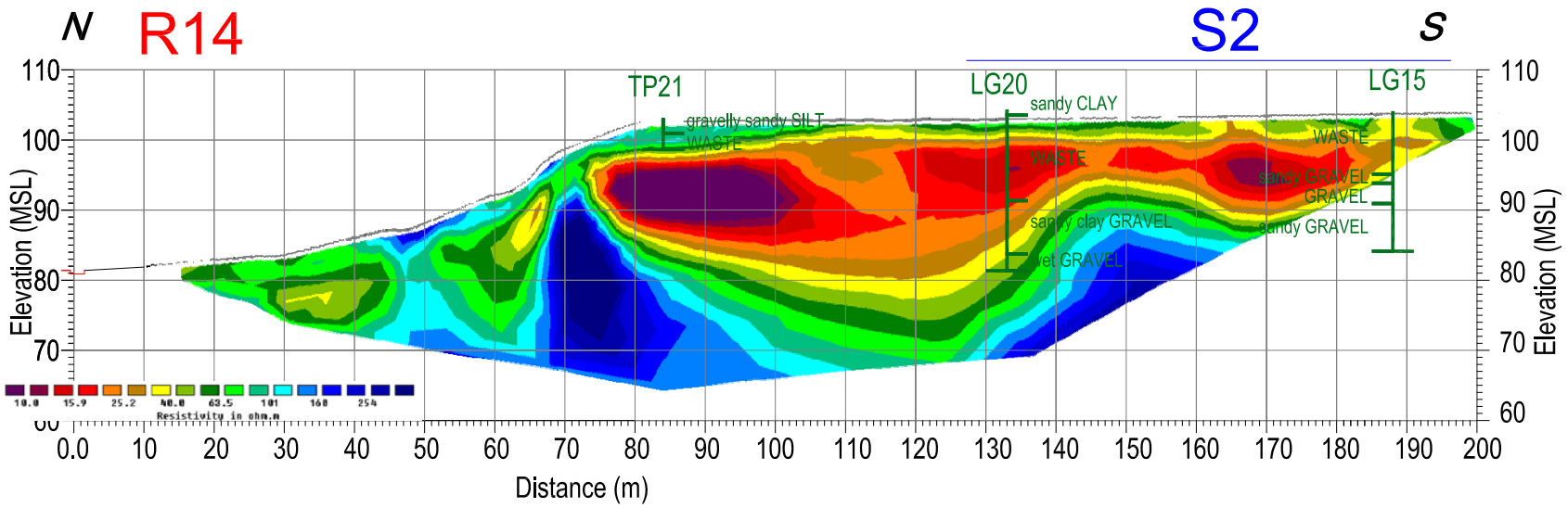
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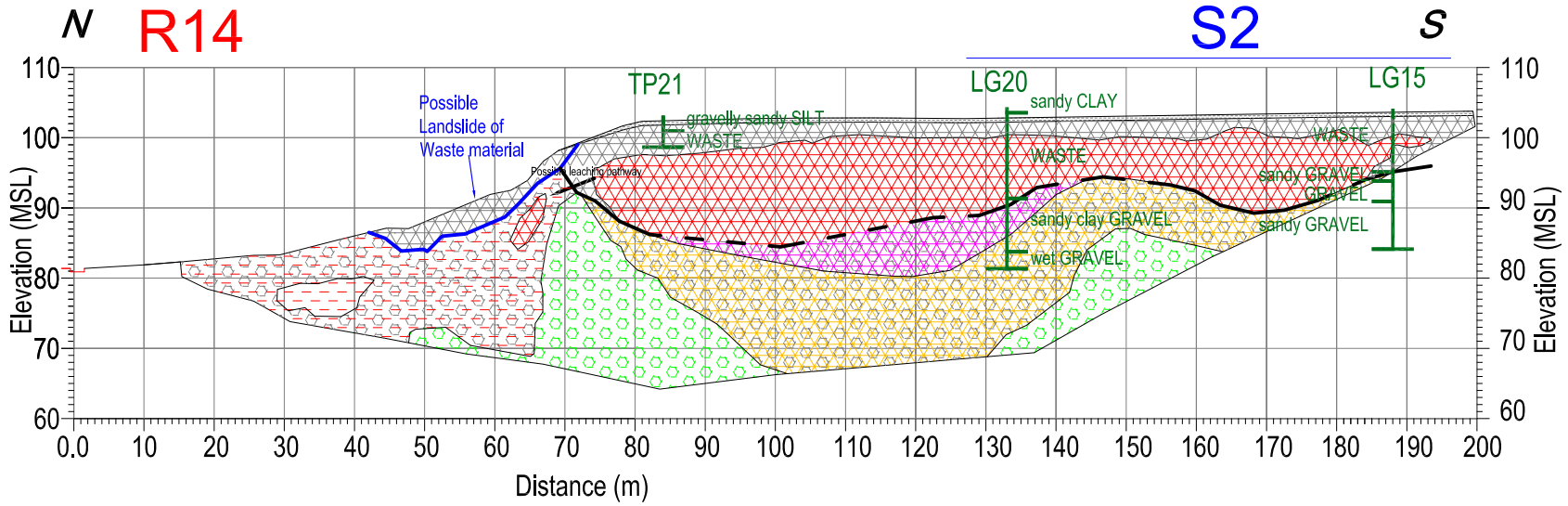
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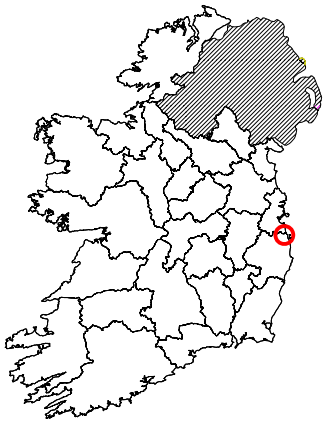
FIGURE 1 : ERT PROFILE - R14

SCALE 1: 1000





INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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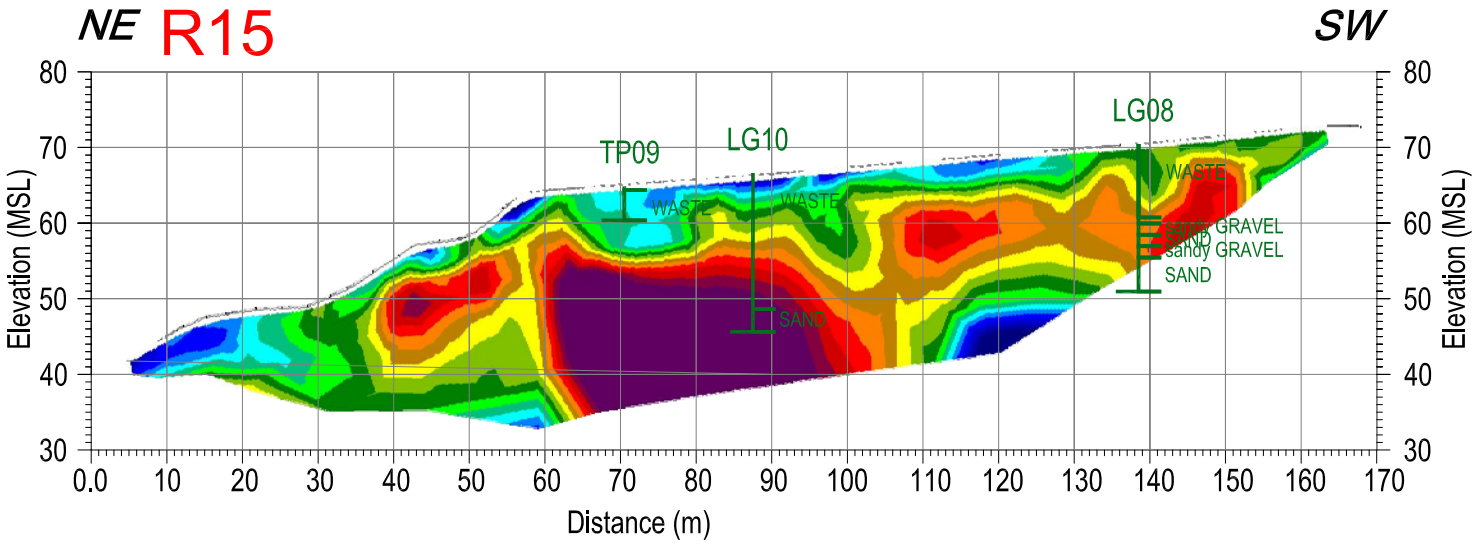
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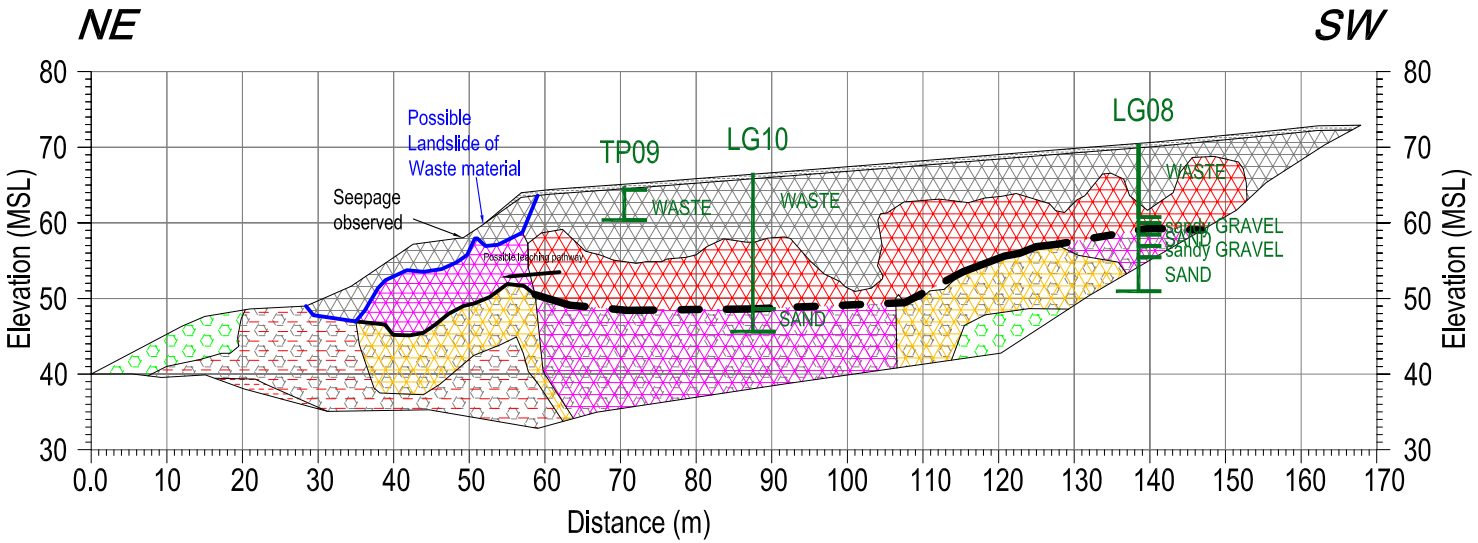
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DRAWING No.:	AGL15302_21
DATE:	20th April 2016
CLIENT:	RPS CONSULTING ENGINEERS
SCALE:	AS INDICATED @ A4

Version:	Date:	Drawn By:	Checked:
01	20/04/2016	YOC	

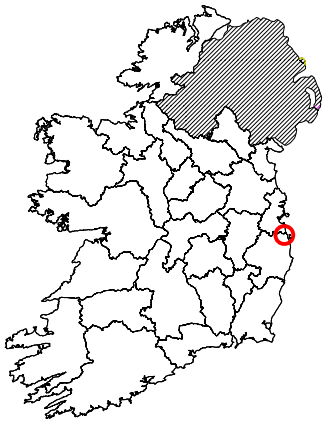
FIGURE 1 : ERT PROFILE - R15

SCALE 1: 1000





INDEX MAP:



LEGEND:

- Capping Material
- Waste with high Organic & Metallic content
- Waste with lower Organic & Metallic content Or Waste mixed with silty clayey SAND/GRAVEL
- Natural Ground with possible high level of LEACHATE in underlying material
- Natural Ground with possible lower level of LEACHATE in underlying material
- SILT/CLAY
- Sandy gravelly SILT/CLAY
- Silty clayey SAND/GRAVEL
- Interpreted Base of Waste Material

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PROJECT:	FASSAROE UNATHOURISED LANDFILL SITES GEOPHYSICAL INVESTIGATION
DRAWING No.:	AGL15302_22
DATE:	20th April 2016
CLIENT:	RPS CONSULTING ENGINEERS
SCALE:	AS INDICATED @ A4

Version:	Date:	Drawn By:	Checked:
01	20/04/2016	YOC	

APPENDIX B: DETAILED METHODOLOGY

A combination of a number of geophysical techniques was used to provide the high quality interpretation and reduce any ambiguities, which may otherwise exist.

B.1 EM ground conductivity mapping

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

B.1.1 Principles

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 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.

B.1.2 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 across the site. Local conditions and variations were recorded.

B.1.3 Data processing

The conductivity and in-phase field readings were downloaded, contoured and plotted using the SURFER 9 program (Golden Software, 2009). 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.

B.1.4 Relocation

All data were referenced using a GPS system and all positions are given in Irish National Grid coordinates.

B.2 Electrical Resistivity Tomography

Electrical Resistivity Tomography was carried out to provide information on lateral variations in the overburden material as well as on the underlying overburden and bedrock.

B.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 64 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

B.2.2 Data collection

Profiles were recorded using a Tigre resistivity meter, imaging software, two 32 takeout multicore cables and up to 64 stainless steel electrodes. 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 survey.

B.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 alongside the processed seismic sections. Distance is indicated along the horizontal axis of the profiles. Profiles have been contoured using the same contour intervals and colour codes.

B.3 Seismic refraction profiling

B.3.1 Principles

This method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities.

Seismic profiling measures the p-wave velocity (Vp) 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 Vp velocities while soft, loose or fractured materials have lower Vp velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

B.3.2 Data collection

A Geode high resolution 24 channel digital seismograph, 24 10HZ vertical geophones and a 10 kg hammer were used to provide first break information, with a 24 take-out cable (3m spacing). Equipment was carried was operated by a two-person crew.

Readings are taken using geophones connected via multi-core cable to a seismograph. The depth of resolution of soil/bedrock boundaries is determined by the length of the seismic spread, typically the depth of resolution is about one third the length of the profile (eg. 69m profile ~23m depth, 33m profile ~ 11m depth)

Shots from seven different positions were taken (2 x off-end, 2 x end, 3 x middle) to ensure optimum coverage of all refractors. All profiles were surveyed to Irish National Grid using a ProXR dGPS system.

B.3.3 Data processing

First break picking in digital format was carried out using the FIRSTPIX software program to construct p-wave (Vp) traveltime plots for each spread. Velocity phases were selected from these plots using the GREMIX software program and were used to calculate the thickness of individual velocity units. Topographic data were input. Material types were assigned and estimation made of material properties, cross-referenced to borehole and MASW data. The processed seismic data are displayed in Appendix A.

Approximate errors for Vp velocities are estimated to be +/- 10%. Errors for the calculated layer thicknesses are of the order of +/-20%. Possible errors due to the "hidden layer" and "velocity inversion" effects may also occur (Soske, 1959).

APPENDIX D

Site Investigation Factual Report

Our Ref: GH/Rp/P15180 + attachments (*.pdf)

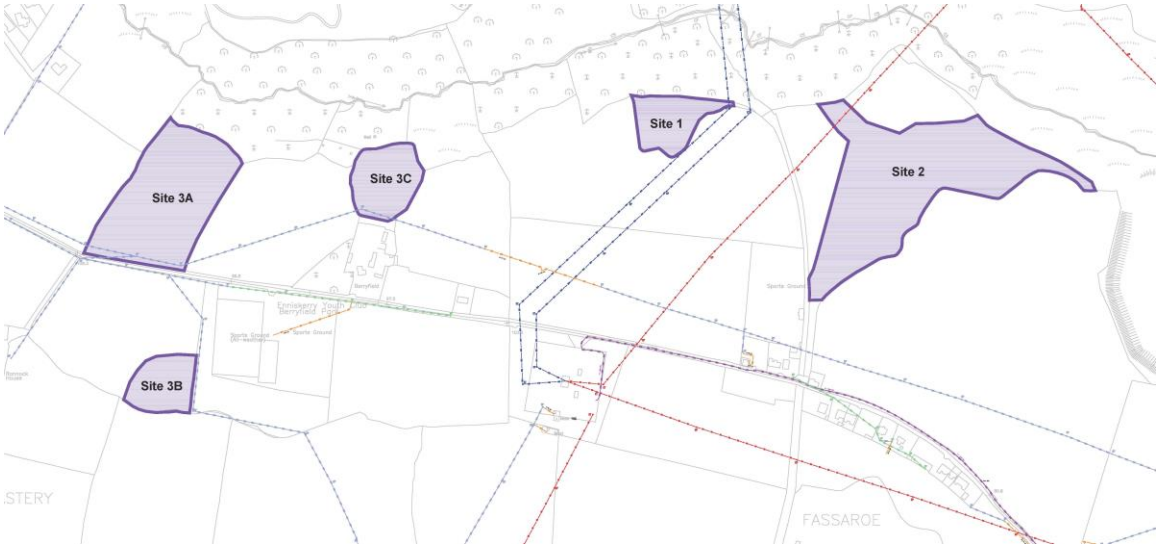
27th May, 2016

Messrs. RPS
West Pier Business Campus,
Dun Laoghaire,
County Dublin.
Ireland

Re: Fassaroe Historic Landfills, Site Investigations, Factual Report

Introduction

In November, 2015, Priority Geotechnical (PGL) were requested by RPS to undertake a direct ground investigation across five (5) number historical landfill sites in Fassaroe, Co. Wicklow.



Scope

The revised scope of the ground investigation, which was specified by RPS, comprised of the following:

- 28No. trial pit excavations;
- 10No. cable percussion boreholes;
- 47No. rotary boreholes (provisional);
- Installation and monitoring groundwater / ground gas standpipes and
- Factual reporting.

Objectives

The purpose of the investigation was to install standpipe wells to allow for the monitoring by Others, of groundwater and ground gas.

This factual report presents the records and data obtained with regard to the ground investigation and should be read in conjunction with the exploratory and photographic records accompanying this factual report.

Site Works

This investigation was carried out in accordance with the contract specification: Eurocode 7- Geotechnical Design Part 2, ground investigation and testing (BS EN 1997-2: 2007) and the relevant British Standards (BS 5930 (1999) Code of Practice for Site Investigation +A2:2010 and BS 1377, Method of Tests for Soil for Civil Engineering Purposes, *in situ* Tests Parts 1 to 9).

The fieldworks were undertaken between the 07th December, 2015 and the 01st March, 2016 under the supervision of PGL, Engineering Geologist(s). Details of the plant and equipment used are detailed on the relevant exploratory records, attached.

Trial pit excavations

A total of twenty eight (28) number trial pit excavations (TP01 to TP28 inclusive) were excavated to depths of 3.5m below existing ground level (bgl) to 4.5m bgl using a 13t tracked excavator. Trial pits terminated for a variety of reasons, these being outlined on the relevant exploratory records attached, herein.

Cable percussion boreholes

A total of ten (10) cable percussion boreholes (CP) were bored using a Dando 2000 light cable percussive rig with 200mm diameter casing. The records are attached, herein.

Two (2) cable percussion boreholes (LG[1]17 and LG21) were bored to depths between 5.5m bgl and 5.7m bgl. These boreholes were terminated after one (1) hour of chiseling on obstructions within the municipal solid (MSW) and mixed waste.

A further eight (8) number cable percussion boreholes (LG02, LG04, LG07, LG10, LG11, LG14, LG15 and LG19) were bored to depths 0.5m bgl (LG11) to 10.7m bgl. The boreholes were terminated after one (1) hour of chiseling (on obstructions within the MSW. These were subsequently followed on with rotary open-hole drilling.

Rotary boreholes

Fifty five (55[2]) rotary boreholes (LG01, *LG02,* LG03, *LG04*, LG05, LG06, *LG07*, LG08, LG09, LG10, *LG11,* LG12, LG13, *LG14, LG15*, LG16, LG18, *LG19* and LG20; BH[3]01, BH03, BH04, BH05, BH06, BH07, BH08, BH09, BH10, BH11 and BH13; G[4]01, G02, G03, G04, G05, G06, G07, G08, G09, G10, G11, G12, G13, G14, G15, G16, G17, G18, G19, G20, G21, G22, G23, G24 and G25) were drilled by Symmetrex open hole boring (RO/RC), to depths between 6.0m bgl and 35.0m bgl using a PGL's Deltabase 520, 6t rotary rig. The records are attached, herein.

Survey and Drawings

[1] LG combined gas/ leachate monitoring well
[2] 47 No. rotary boreholes with 8No. cable percussion with subsequent rotary follow-on shown in italic, 55No. in total.
[3] BH combined groundwater/ gas monitoring well
[4] G gas monitoring well

Upon completion of the fieldworks, the 'as built' exploration locations were surveyed using Trimble 5700/5800 GPS equipment to the Ordinance Survey Irish Transverse Mercator system of co-ordinates (ITM) and elevations (existing ground level) to Malin Head datum. The exploratory locations were shown on the Exploratory Location Plan (dwg. P15180-SI-A, P15180-SI-01 and P15180-SI-02, attached.

SUMMARY OF GROUND INVESTIGATION

Location	Easting	Northing	Ground level mOD, Malin	Depth, m bgl	Start date dd/mm/yyyy	Borehole type
BH01	723751.99	718464.30	79.22	21.00	04/02/2016	RO
BH03	723833.94	718313.09	78.65	19.50	04/02/2016	RO
BH04	723658.95	718159.83	84.41	25.50	17/02/2016	RO
BH05	723381.97	718381.36	96.06	35.00	27/01/2016	RO
BH06	723028.34	718310.42	95.27	14.00	17/02/2016	RO
BH07	722641.50	718220.00	106.11	21.00	09/02/2016	RO
BH08	722752.55	718129.88	98.80	13.50	09/02/2016	RO
BH09	722746.09	718179.23	97.97	12.00	09/02/2016	RO
BH10	722791.60	718279.04	99.31	14.00	11/02/2016	RO
BH11	723802.55	718268.99	82.65	33.00	24/02/2016	RO
BH13	723633.99	718448.25	87.99	19.50	03/02/2016	RO
G01	723757.16	718233.48	84.99	19.30	23/02/2016	RO
G02	723906.63	718311.72	72.66	19.50	03/02/2016	RO
G03	723983.99	718344.07	69.50	19.50	08/02/2016	RO
G04	723640.81	718281.92	85.62	20.00	22/01/2016	RO
G05	723638.54	718344.71	86.72	20.00	27/01/2016	RO
G06	723574.11	718441.69	90.99	12.00	26/01/2016	RO
G07	723368.28	718433.97	93.03	14.00	28/01/2016	RO
G08	723306.94	718326.45	94.29	14.00	29/01/2016	RO
G09	723094.22	718349.84	93.56	15.00	17/02/2016	RO
G10	723333.19	718171.75	98.86	20.00	04/02/2016	RO
G11	722977.05	718343.28	97.21	15.00	18/02/2016	RO
G12	722830.39	718345.89	98.91	14.00	12/02/2016	RO
G13	724005.71	718058.48	75.82	20.00	26/02/2016	RO
G14	722815.16	718240.44	98.62	14.00	11/02/2016	RO
G15	722795.09	718080.09	99.17	6.00	08/02/2016	RO
G16	722652.69	718073.96	100.38	6.00	08/02/2016	RO
G17	722714.71	718133.46	98.42	6.00	08/02/2016	RO
G18	723510.87	718384.05	93.73	14.00	01/02/2016	RO
G19	723436.56	718295.62	98.24	14.00	02/02/2016	RO

Location	Easting	Northing	Ground level mOD, Malin	Depth, m bgl	Start date dd/mm/yyyy	Borehole type
G20	723622.08	718199.83	85.55	27.00	02/02/2016	RO
G21	723750.29	718164.27	86.66	20.00	23/02/2016	RO
G22	724131.18	717889.25	63.68	20.00	01/03/2016	RO
G23	723934.27	717921.64	78.95	20.00	29/02/2016	RO
G24	723786.07	718048.15	86.83	20.00	25/02/2016	RO
G25	723664.35	718398.59	85.64	34.00	03/02/2016	RO
LG01	723643.77	718221.92	83.76	16.00	21/01/2016	RO
LG02	723692.44	718261.44	83.19	12.00	11/02/2016	CP+RO
LG03	723751.30	718307.50	82.25	29.00	20/01/2016	RO
LG04	723728.58	718362.08	81.88	18.00	10/02/2016	CP+RO
LG05	723787.00	718340.40	80.14	25.50	15/01/2016	RO
LG06	723716.45	718432.32	82.68	17.50	20/01/2016	RO
LG07	723798.30	718404.52	74.87	17.50	10/02/2016	CP+RO
LG08	723854.76	718376.73	70.77	19.50	29/01/2016	RO
LG09	723827.26	718410.84	71.06	25.50	02/02/2016	RO
LG10	723905.21	718400.28	66.37	21.00	08/02/2016	CP+RO
LG11	723425.30	718455.26	95.37	17.00	18/02/2016	CP+RO
LG12	723436.86	718445.09	95.96	24.00	27/01/2015	RO
LG13	723466.52	718463.67	96.05	20.00	22/02/2016	RO
LG14	723040.80	718343.19	93.44	23.00	15/02/2016	CP+RO
LG15	722726.87	718288.02	103.97	20.00	17/02/2016	CP+RO
LG16	722747.85	718100.42	99.52	16.00	04/02/2016	RO
LG17	722707.07	718059.12	100.51	5.50	18/02/2016	CP
LG18	723040.16	718381.47	92.42	22.00	15/02/2016	RO
LG19	722742.40	718394.04	103.90	26.00	16/02/2016	CP+RO
LG20	722760.54	718333.71	103.82	23.00	10/02/2016	RO
LG21	722746.33	718045.61	100.58	5.70	17/02/2016	CP
TP01	723682.650	718266.990	83.330	4.40	07/12/2015	TP
TP02	723757.630	718269.220	83.070	4.50	07/12/2015	TP
TP03	723683.290	718342.000	83.580	4.60	07/12/2015	TP
TP04	723757.610	718343.860	81.520	4.50	07/12/2015	TP
TP05	723698.180	718417.170	83.950	4.50	08/12/2015	TP
TP06	723755.250	718417.290	80.070	4.00	08/12/2015	TP
TP07	723831.840	718416.680	70.030	4.50	08/12/2015	TP
TP08	723833.740	718361.200	73.400	4.50	08/12/2015	TP
TP09	723908.990	718418.510	64.870	4.50	08/12/2015	TP
TP10	723909.820	718348.090	69.450	4.50	08/12/2015	TP
TP11	723982.100	718386.820	65.940	4.50	08/12/2015	TP

Location	Easting	Northing	Ground level mOD, Malin	Depth, m bgl	Start date dd/mm/yyyy	Borehole type
TP12	723414.490	718450.110	95.190	4.50	08/12/2015	TP
TP13	723458.970	718444.410	96.120	4.50	08/12/2015	TP
TP14	723414.970	718423.270	95.650	4.50	08/12/2015	TP
TP15	723447.720	718424.380	96.270	4.50	08/12/2015	TP
TP16	723014.000	718380.990	92.170	4.50	09/12/2015	TP
TP17	723040.130	718358.270	93.520	4.50	09/12/2015	TP
TP18	723014.330	718340.980	93.960	4.50	09/12/2015	TP
TP19	723059.400	718333.160	92.690	4.50	09/12/2015	TP
TP20	722705.010	718384.460	105.130	4.50	10/12/2015	TP
TP21	722764.010	718385.630	103.150	4.50	10/12/2015	TP
TP22	722808.050	718372.090	102.300	4.50	10/12/2015	TP
TP23	722761.860	718310.220	103.650	4.50	09/12/2015	TP
TP24	722687.960	718312.140	105.530	4.50	10/12/2015	TP
TP25	722707.430	718045.320	100.980	4.50	10/12/2015	TP
TP26	722708.270	718080.970	99.720	4.50	10/12/2015	TP
TP27	722758.680	718109.210	99.540	4.50	10/12/2015	TP
TP28	722757.060	718081.290	99.580	3.50	10/12/2015	TP

Sampling

No sampling was required.

In-situ testing

No *in situ* testing was required.

Laboratory Testing

No laboratory testing was required.

Published Geology

The geology of the study area (GSI 1:100,000 mapping Sheet 16) is characterised by the Maulin Formation, (MN) described as dark blue-grey Slate, Phyllite and Schist. And the Glencullen River Formation (GL) described as buff-coloured Tuff and Greywacke. The formations are delineated by a geological fault structure. A geological thrust feature lay immediately south of the study area. Teagasc subsoil mapping indicates that the area is underlain by glaciofluvial sands and gravels.

Ground conditions

Waste was encountered to depths up to 19m below existing ground level (bgl). This was underlain by CLAY and SAND and GRAVEL deposits to depths up to 35m bgl.

The full details of the ground conditions encountered are provided for on the exploratory records accompanying this report. The records provide descriptions, in accordance with BS 5930 (1999) +A2: 2010 and Eurocode 7, Geotechnical Investigation and Testing, Identification and classification of soils, Part 1, Identification and description (EN ISO 14688-1: 2002),– Identification and Classification of Soil, Part 2: Classification Principles (EN ISO 14688-2:2004) and Identification and Classification of Rock, Part 1: Identification & Description (EN ISO 14689-1:2004) of the materials encountered, , together with any observations made during the ground investigation.

Ground water conditions

Groundwater was recorded when encountered during boring over a period of 20 minutes, noting any changes that may occur in cable percussion boreholes. Groundwater levels were also monitored at start and end of drilling shifts.

It should be noted that the normal rate of boring may not permit the recording of equilibrium groundwater levels for any one groundwater water strike where casing may exclude low volume flows or perched groundwater/ leachate as the borehole progresses. Groundwater conditions observed in the borings or pits are those appertaining to the period of the investigation. Groundwater levels may be subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions, tidal variations etc. Note wet strata were encountered with no significant flow of groundwater / leachate.

The groundwater regime should be assessed from standpipe well installations, where available. A summary of groundwater is presented below and detailed on the exploratory records, herein.

SUMMARY OF GROUNDWATER

Location	Depth of water strike, m bgl
BH01	15.00
BH04	18.70
BH05	24.00
BH06	6.10
BH08	13.50
BH09	6.00
BH10	6.00
BH10	9.10
BH13	11.10
G02	3.20
G09	13.30
G10	20.00
G11	12.00
G12	14.00
G14	6.00
G23	19.50
LG01	3.00
LG01	10.20
LG02	7.30
LG03	6.00
LG03	11.10
LG04	9.70
LG04	12.10
LG06	16.60
LG07	9.30
LG14	23.00
LG16	1.20
LG16	11.20
LG18	22.00
LG19	6.80
LG19	26.00
TP01	3.50
TP09	1.50
TP10	1.20
TP23	4.00
TP24	3.00

Fifty seven (57) number 50mm diameter HDPE groundwater standpipe installations were installed, else exploratory boreholes were backfilled with arisings.



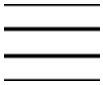
Arisings, backfill to borehole



BENTONITE, backfill to installation/ borehole



GRAVEL, backfill to installation/ borehole



uPVC slotted pipe (well)

Rubber bung and valve, gas taps were fitted to all fifty five (55) number wells.

The standpipe well construction is summarized as follows;

Well	Interval m bgl		Pipework
BH01	0.0	5.0	Plain pipe
	5.0	21.0	Slotted pipe
BH03	0.0	4.5	Plain pipe
	4.5	19.5	Slotted pipe
BH04	0.0	13.0	Plain pipe
	13.0	25.5	Slotted pipe
BH05	0.0	19.0	Plain pipe
	19.0	29.0	Slotted pipe
BH06	0.0	2.0	Plain pipe
	2.0	14.0	Slotted pipe
BH07	0.0	11.0	Plain pipe
	11.0	21.0	Slotted pipe
BH08	0.0	3.5	Plain pipe
	3.5	13.5	Slotted pipe
BH09	0.0	2.0	Plain pipe
	2.0	12.0	Slotted pipe
BH10	0.0	4.0	Plain pipe
	4.0	14.0	Slotted pipe
BH11	0.0	1.0	Plain pipe
	1.0	33.0	Slotted pipe
BH13	0.0	4.5	Plain pipe
	4.5	19.5	Slotted pipe
G01	0.0	1.0	Plain pipe
	1.0	17.0	Slotted pipe
G02	0.0	1.0	Plain pipe
	1.0	19.5	Slotted pipe
G03	0.0	1.0	Plain pipe
	1.0	19.5	Slotted pipe

Well	Interval m bgl		Pipework
G04	0.0	3.0	Plain pipe
	3.0	20.0	Slotted pipe
G05	0.0	1.0	Plain pipe
	1.0	20.0	Slotted pipe
G06	0.0	1.0	Plain pipe
	1.0	20.0	Slotted pipe
G07	0.0	1.0	Plain pipe
	1.0	20.0	Slotted pipe
G08	0.0	1.0	Plain pipe
	1.0	20.0	Slotted pipe
G09	0.0	1.0	Plain pipe
	1.0	14.0	Slotted pipe
G10	0.0	1.0	Plain pipe
	1.0	20.0	Slotted pipe
G11	0.0	1.0	Plain pipe
	1.0	15.0	Slotted pipe
G12	0.0	1.0	Plain pipe
	1.0	14.0	Slotted pipe
G13	0.0	1.0	Plain pipe
	1.0	20.0	Slotted pipe
G14	0.0	1.0	Plain pipe
	1.0	14.0	Slotted pipe
G15	0.0	1.0	Plain pipe
	1.0	6.0	Slotted pipe
G16	0.0	1.0	Plain pipe
	1.0	6.0	Slotted pipe
G17	0.0	1.0	Plain pipe
	1.0	6.0	Slotted pipe
G18	0.0	1.0	Plain pipe
	1.0	14.0	Slotted pipe
G19	0.0	1.0	Plain pipe
	1.0	14.0	Slotted pipe
G20	0.0	1.0	Plain pipe
	1.0	20.0	Slotted pipe
G21	0.0	1.0	Plain pipe
	1.0	17.0	Slotted pipe
G22	0.0	1.0	Plain pipe
	1.0	15.0	Slotted pipe
G23	0.0	1.0	Plain pipe
	1.0	20.0	Slotted pipe

Well	Interval m bgl		Pipework
	0.0	1.0	Plain pipe
G24	1.0	20.0	Slotted pipe
	0.0	1.0	Plain pipe
G25	1.0	20.0	Slotted pipe
	0.0	1.0	Plain pipe
LG01	1.0	5.5	Slotted pipe
	0.0	1.0	Plain pipe
LG02	1.0	9.0	Slotted pipe
	0.0	1.0	Plain pipe
LG03	1.0	18.0	Slotted pipe
	0.0	1.0	Plain pipe
LG04	1.0	15.0	Slotted pipe
	0.0	1.0	Plain pipe
LG05	1.0	14.0	Slotted pipe
	0.0	1.0	Plain pipe
LG06	1.0	6.4	Slotted pipe
	0.0	1.0	Plain pipe
LG07	1.0	17.1	Slotted pipe
	0.0	1.0	Plain pipe
LG08	1.0	8.0	Slotted pipe
	0.0	1.0	Plain pipe
LG09	1.0	17.0	Slotted pipe
	0.0	1.0	Plain pipe
LG10	1.0	18.0	Slotted pipe
	0.0	1.0	Plain pipe
LG11	1.0	13.0	Slotted pipe
	0.0	1.0	Plain pipe
LG12	1.0	12.0	Slotted pipe
	0.0	1.0	Plain pipe
LG13	1.0	9.0	Slotted pipe
	0.0	1.0	Plain pipe
LG14	1.0	12.0	Slotted pipe
	0.0	1.0	Plain pipe
LG15	1.0	8.0	Slotted pipe
	0.0	1.0	Plain pipe
LG16	1.0	3.5	Slotted pipe
	0.0	1.0	Plain pipe
LG17	1.0	4.0	Slotted pipe
	0.0	1.0	Plain pipe
LG18	1.0	10.0	Slotted pipe

Well	Interval m bgl		Pipework
LG19	0.0	1.0	Plain pipe
	1.0	15.0	Slotted pipe
LG20	0.0	1.0	Plain pipe
	1.0	12.0	Slotted pipe
LG21	0.0	1.0	Plain pipe
	1.0	4.0	Slotted pipe

Should you have any queries in relation to the data collected and presented herein, please do not hesitate to contact our office.

Yours sincerely,
For **Priority Geotechnical,**



Greg Hayes BE MEngSc CEng MIEI
Geotechnical Specialist

No responsibility can be held by PGL for ground conditions between exploratory locations. The exploratory logs provide for ground profiles and configuration of strata relevant to the investigation depths achieved during the fieldworks. Caution shall be taken when extrapolating between such exploratory locations. No liability is accepted for ground conditions extraneous to the exploratory locations.

No account has been taken of potential subsidence or ground movement due to mineral extraction, mining works or karstification below or in proximity to the site, unless specifically addressed.

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KEY TO SYMBOLS ON EXPLORATORY HOLE RECORDS

All linear dimensions are in metres or millimetres

DESCRIPTIONS

**	Drillers Description
Friable	Easily crumbled

SAMPLES

U( )	Undisturbed 102mm diameter sample, ( ) denotes number of blows to drive sampler
U( )F, U( )P	F- not recovered, P-partially recovered
U38	Undisturbed 38mm diameter sample
P(F), (P)	Piston sample - disturbed
B	Bulk sample - disturbed
D	Jar Sample - disturbed
W	Water Sample
CBR	California Bearing Ratio mould sample
ES	Chemical Sample for Contamination Analysis
SPTLS	Standard Penetration Test S lump sample from split sampler

CORE RECOVERY AND ROCK QUALITY

TCR	Total Core Recovery (% of Core Run)
SCR	Solid Core Recovery (length of core having at least one full diameter as % of core run)
RQD	Rock Quality Designation (length of solid core greater than 100mm as % of core run)

Where there is insufficient space for the TCR, SCR and RQD, the results may be found in the remarks column

If	Fracture Spacing in mm (Minimum/Average/Maximum) NI - non intact, NR - no recovery
AZCL	Assumed Zone of Core Loss
NI	Non intact

GROUNDWATER

▽	Groundwater strike
▼	Groundwater level after standing period
Date/Water	Date of shift (day/month)/Depth to water at end of previous shift shown above the date and depth to water at beginning of shift given below the date

INSITU TESTING

S	Standard Penetration Test - split barrel sampler
C	Standard Penetration Test - solid 60^o cone
SW	Self Weight Penetration
Ivp, HVp (R)	In Situ Vane Test, Hand Vane Test (R) demonstrates remoulded strength
K(F), (C), (R), (P)	Permeability Test
HP	Hand Penetrometer Test

MEASURED PROPERTIES

N	Standard Penetration Test - blows required to drive 300mm after seating drive
x/y	Denotes x blows for y mm within the Standard Penetration Test
x*/y	Denotes x blows for y mm within the seating drive
c_u	Undrained Shear Strength (kN/m^2)
CBR	California Bearing Ratio

ROTARY DRILLING SIZES

Index Letter	Nominal Diameter (mm)	
	Borehole	Core
N	75	54
H	99	76
P	120	92
S	146	113

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Drilled By	Borehole No
GW	**LG01**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723644E - 718222N	Rotary
Client: RPS Consulting Engineers	**Dates:** 21/01/2016	**Level:** 83.76 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						82.46	1.30	Open hole drilling. Driller described (MADE GROUND) Topsoil and Gravel.	
	▽					80.76	3.00	Open hole drilling. Driller described (MADE GROUND) Waste.	
						79.26	4.50	Open hole drilling. (MADE GROUND) Driller described wet waste mixed with silty Sand.	
						77.76	6.00	Open hole drilling. (MADE GROUND) Driller described wet waste mixed with Gravel.	
						75.16	8.60	Open hole drilling. Driller describes sandy GRAVEL.	
								Open hole drilling. Driller describes sandy CLAY.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
3.00m	-	-	-	Refer to detail.
10.20m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
16.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 16.0m bgl. 50mm dia. standpipe installed, response zone 1m to 5.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	21/01/2016	16.00m	End of shift

Equipment & Methods: Delta base 520

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Drilled By	Borehole No
GW	**LG01**
Logged By GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723644E - 718222N	Rotary
Client: RPS Consulting Engineers	**Dates:** 21/01/2016	**Level:** 83.76 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
	▽							Open hole drilling. Driller describes sandy CLAY.	
								10.2 to 16.0m bgl Arisings are wet.	
						72.46	11.30	Open hole drilling. Driller described SAND.	
					16.00	67.76	16.00	End of Borehole at 16.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
3.00m	-	-	-	Refer to detail.
10.20m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
16.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 16.0m bgl. 50mm dia. standpipe installed, response zone 1m to 5.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	21/01/2016	16.00m	End of shift

Equipment & Methods: Delta base 520

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Drilled By KL/AK
Logged By KL/AK

Borehole No **LG02**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723692E - 718261N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 11/02/2016-17/02/2016	**Level:** 83.19 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						82.19	1.00	(MADE GROUND) Driller described clayey waste.	
						80.19	3.00	(MADE GROUND) Driller described plastic waste.	
						79.19	4.00	(MADE GROUND) Driller described plastic and timber.	
						78.19	5.00	(MADE GROUND) Driller described waste bags and steel.	
						77.19	6.00	(MADE GROUND) Driller described waste and paper.	
	▽					76.19	7.00	(MADE GROUND) Driller described waste.	
						75.19	8.00	(MADE GROUND) Driller described steel and plastic	
						74.69	8.50	(MADE GROUND) Driller described strips of steel	
					8.90	74.29	8.90	(MADE GROUND) Driller described bits of steel.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
7.30m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.90m	-	200mm
12.00m	-	131mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
7.80	to	8.00	0100	Chisel
8.85		8.90	0100	Chisel

Remarks: Cable tool borehole complete at 8.90m bgl. Rotary openhole borehole complete at 12.0m bgl. 50mm standpipe installed response zone 1m to 9m.

Equipment & Methods: Dando 2000
Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/02/2016	8.50m	End of shift
-	15/02/2016	8.90m	End of shift
-	17/02/2016	12.00m	End shift

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Drilled By KL/AK
Logged By KL/AK

Borehole No
LG02
Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723692E - 718261N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 11/02/2016-17/02/2016	**Level:** 83.19 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND) Driller described plastic and rubbish.	
						72.69	10.50	Open hole drilling, Driller described CLAY	
					12.00	71.19	12.00	End of Borehole at 12.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
7.30m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.90m	-	200mm
12.00m	-	131mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
7.80	to	8.00	0100	Chisel
8.85		8.90	0100	Chisel

Remarks: Cable tool borehole complete at 8.90m bgl. Rotary openhole borehole complete at 12.0m bgl. 50mm standpipe installed response zone 1m to 9m.

Equipment & Methods: Dando 2000
Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/02/2016	8.50m	End of shift
-	15/02/2016	8.90m	End of shift
-	17/02/2016	12.00m	End shift

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Drilled By	Borehole No
GW	**LG03**
Logged By GW	Sheet 1 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723751E - 718308N	Rotary
Client: RPS Consulting Engineers	**Dates:** 20/01/2016-21/01/2016	**Level:** 82.25 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. (MADE GROUND) Driller describes Topsoil, sand and gravel.	
						80.95	1.30	Open hole drilling. (MADE GROUND) Driller describes waste mixed with gravel.	
						77.75	4.50	Open hole boring. (MADE GROUND) Driller described waste with boulders and or concrete blocks.	
	▽					76.25	6.00	Open hole drilling. Driller describes Waste. 6.0 to 7.40m bgl. Arisings are wet possibly due to leachate.	
						74.85	7.40	Open hole drilling. (MADE GROUND) Driller describes Clay. 7.40m bgl to 8.70m bgl Arising are dry.	
						73.55	8.70	Open hole drilling. (MADE GROUND) Driller describes	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	-	Refer to detail
11.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
29.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 29.0m bgl. 50mm dia. standpipe installed, response zone 1m to 18m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	20/01/2016	13.50m	End of shift
-	21/01/2016	29.00m	End of shift

Equipment & Methods: Deltbase 520

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Borehole No
LG03

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723751E - 718308N	Rotary
Client: RPS Consulting Engineers	**Dates:** 20/01/2016-21/01/2016	**Level:** 82.25 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Waste.	
	▽					71.15	11.10	Open hole drilling. Driller describes concrete. 11.1 to 11.90m bgl Driller notes large amount of water (leachate) in arisings.	
						70.35	11.90	Open hole drilling. (MADE GROUND) Driller describes waste. 11.90 to 13.50m bgl Waste is slightly wet.	
						68.75	13.50	Open hole drilling. (MADE GROUND) Driller describes waste. 13.5 to 18.20m bgl Waste is dry	
								Continued next sheet	

10 11 12 13 14 15 16 17

Water | Depth (m) | Type | Results | Casing | Level | Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	-	Refer to detail
11.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
29.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 29.0m bgl. 50mm dia. standpipe installed, response zone 1m to 18m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	20/01/2016	13.50m	End of shift
-	21/01/2016	29.00m	End of shift

Equipment & Methods: Deltbase 520

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Drilled By GW
Logged By GW

Borehole No
LG03

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723751E - 718308N	Rotary
Client: RPS Consulting Engineers	**Dates:** 20/01/2016-21/01/2016	**Level:** 82.25 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						64.05	18.20	Open hole drilling. (MADE GROUND) Driller described waste mixed with gravel.	
						63.25	19.00	Open hole drilling. Driller described GRAVEL.	
						60.25	22.00	Open hole describes SAND.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	-	Refer to detail
11.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
29.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 29.0m bgl. 50mm dia. standpipe installed, response zone 1m to 18m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	20/01/2016	13.50m	End of shift
-	21/01/2016	29.00m	End of shift

Equipment & Methods: Deltbase 520

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Drilled By GW
Logged By GW

Borehole No
LG03
Sheet 4 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723751E - 718308N	Rotary
Client: RPS Consulting Engineers	**Dates:** 20/01/2016-21/01/2016	**Level:** 82.25 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole describes SAND.	
					29.00	53.25	29.00	End of Borehole at 29.00 m	

28 29 30 31 32 33 34 35

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	-	Refer to detail
11.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
29.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 29.0m bgl. 50mm dia. standpipe installed, response zone 1m to 18m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	20/01/2016	13.50m	End of shift
-	21/01/2016	29.00m	End of shift

Equipment & Methods: Deltbase 520

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Drilled By AK
Logged By AK

Borehole No **LG04**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723729E - 718362N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 10/02/2016-17/02/2016	**Level:** 81.88 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						80.88	1.00	(MADE GROUND) Driller described waste with plastic.	1
						79.88	2.00	(MADE GROUND) Driller described rubble and waste.	2
						78.88	3.00	(MADE GROUND) Driller described plastic with newspapers.	3
						77.88	4.00	(MADE GROUND) Driller described rubber pipe with plastic.	4
						76.88	5.00	(MADE GROUND) Driller described gravel, waste and plastic.	5
						75.88	6.00	(MADE GROUND) Driller described waste paper.	6
						74.88	7.00	(MADE GROUND) Driller described bags and newspapers.	7
						73.88	8.00	(MADE GROUND) Driller described bags and newspapers.	8
					8.85	73.03	8.85	(MADE GROUND) Driller described paper, waste and timber.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
9.70m	-	-	-	See shift data
12.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.85m	-	200mm
18.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
8.70 to 8.85	0100	Chisel

Remarks: Cable tool borehole complete at 8.85m bgl. Rotary open hole borehole complete at 18.0m bgl. 50mm dia. standpipe installed, response zone 1m to 15m.

Equipment & Methods: Dando 2000, Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/02/0016	8.00m	End of shift
-	11/02/0016	8.85m	End of shift
8.40m	16/02/0016	13.50m	End shift
8.40m	17/02/0016	18.00m	End shift

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Drilled By AK
Logged By AK

Borehole No **LG04**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723729E - 718362N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 10/02/2016-17/02/2016	**Level:** 81.88 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
	▽							MADE GROUND) Open hole drilling, Driller described gravel clay and plastics.	
	▽								
						65.68	16.20	Open hole drilling, Driller described, Gravelly CLAY	
						65.38	16.50	Open hole drilling, Driller described, Sandy GRAVEL.	
					18.00	63.88	18.00	End of Borehole at 18.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
9.70m	-	-	-	See shift data
12.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.85m	-	200mm
18.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
8.70 to 8.85	0100	Chisel

Remarks: Cable tool borehole complete at 8.85m bgl. Rotary open hole borehole complete at 18.0m bgl. 50mm dia. standpipe installed, response zone 1m to 15m.

Equipment & Methods: Dando 2000, Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/02/0016	8.00m	End of shift
-	11/02/0016	8.85m	End of shift
8.40m	16/02/0016	13.50m	End shift
8.40m	17/02/0016	18.00m	End shift

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Drilled By	Borehole No
GW	**LG05**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723787E - 718340N	Rotary
Client: RPS Consulting Engineers	**Dates:** 15/01/2016-19/01/2016	**Level:** 80.14 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. (MADE GROUND) Driller describes Topsoil with sandy and gravel.	
						78.74	1.40	Open hole drilling. (MADE GROUND) Driller describes waste.	
						75.84	4.30	Open hole drilling. (MADE GROUND) Driller describes waste.	
						74.74	5.40	Open hole drilling. (MADE GROUND) Driller describes waste. From 6.20 to 6.70m bgl arisings slightly wet.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed, response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	19/01/2016	25.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Logged By	Borehole No	Sheet
GW	GW	LG05	2 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723787E - 718340N	Rotary
Client: RPS Consulting Engineers	**Dates:** 15/01/2016-19/01/2016	**Level:** 80.14 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. (MADE GROUND) Driller describes waste.	
						64.54	15.60	Open hole drilling. Driller describes SAND.	
						62.54	17.60	Open hole drilling. Driller describes GRAVEL.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed, response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	19/01/2016	25.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**LG05**
Logged By GW	Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723787E - 718340N	Rotary
Client: RPS Consulting Engineers	**Dates:** 15/01/2016-19/01/2016	**Level:** 80.14 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes GRAVEL.	
						59.74	20.40	Open hole drilling . Driller describes slightly sandy, slightly gravelly CLAY.	
						59.14	21.00	Open hole drilling. Driller describes SAND. From 21.0 to 25.5 arisings are wet.	
						57.74	22.40	Open hole drilling. Driller describes sandy GRAVEL.	
					25.50	54.64	25.50	End of Borehole at 25.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed, response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	19/01/2016	25.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**LG06**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723716E - 718432N	Rotary
Client: RPS Consulting Engineers	**Dates:** 20/01/2016	**Level:** 82.68 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. (MADE GROUND) Driller describes topsoil with sand and gravel.	
						81.38	1.30	Open hole drilling. Driller describes waste.	
						76.08	6.60	Open hole drilling. (MADE GROUND) Driller describes timbers.	
						75.28	7.40	Open hole drilling. Driller describes sandy GRAVEL.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
16.60m	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
17.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 17.50m bgl. 50mm dia. standpipe installed, response zone 1m to 6.4m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	20/01/2016	17.50m	Start of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**LG06**
Logged By GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723716E - 718432N	Rotary
Client: RPS Consulting Engineers	**Dates:** 20/01/2016	**Level:** 82.68 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes sandy GRAVEL.	
	▽					66.08	16.60	Open hole drilling. Driller describes GRAVEL. From 16.60m bgl to 17.50m bgl arisings are wet.	
					17.50	65.18	17.50	End of Borehole at 17.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
16.60m	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
17.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 17.50m bgl. 50mm dia. standpipe installed, response zone 1m to 6.4m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	20/01/2016	17.50m	Start of shift

Equipment & Methods: Deltabase 520

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Drilled By	Logged By	Borehole No	Sheet
KL/ AK	KL/ AK	LG07	1 of 2

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723798E - 718405N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 10/02/2016-15/02/2016	**Level:** 74.87 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						73.87	1.00	(MADE GROUND) Driller described black clay and waste	
						72.87	2.00	(MADE GROUND) Driller described black waste with plastic and bags	
						71.87	3.00	(MADE GROUND) Driller described black waste with steel	
						70.87	4.00	(MADE GROUND) Driller described waste with timber and bags	
						69.87	5.00	(MADE GROUND) Driller described steel and plastic	
					5.70	69.17	5.70	(MADE GROUND) Driller described waste plastic and steel ropes	
						65.87	9.00	(MADE GROUND) Open hole drilling Driller described plastic gravel and timber	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
9.30m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.70m	-	200mm
17.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
5.60 to 5.70	0100	Chisel

Remarks: Cable tool borehole complete at 5.70m bgl. Rotary open hole borehole complete at 17.50m bgl. 50mm dia. standpipe installed, response zone 1m to 17.1m.

Equipment & Methods: Dando 2000, Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/02/2016	5.70m	End of shift
-	12/02/2016	12.00m	End of shift
-	15/02/2016	17.50m	End of shift

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Drilled By	Borehole No
KL/ AK	**LG07**
Logged By KL/ AK	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723798E - 718405N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 10/02/2016-15/02/2016	**Level:** 74.87 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
	▽							(MADE GROUND) Open hole drilling Driller described gravel plastic and sand.	
						64.37	10.50	(MADE GROUND) Open hole drilling Driller described sandy gravelly Clay	
						62.87	12.00	(MADE GROUND) Open hole drilling Driller described plastic timber sand.	
						58.37	16.50	(MADE GROUND) Open hole drilling Driller described plastic and metal.	
					17.50	57.37	17.50	End of Borehole at 17.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
9.30m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.70m	-	200mm
17.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
5.60 to 5.70	0100	Chisel

Remarks: Cable tool borehole complete at 5.70m bgl. Rotary open hole borehole complete at 17.50m bgl. 50mm dia. standpipe installed, response zone 1m to 17.1m.

Equipment & Methods: Dando 2000, Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/02/2016	5.70m	End of shift
-	12/02/2016	12.00m	End of shift
-	15/02/2016	17.50m	End of shift

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Drilled By	Borehole No
AK	**LG08**
Logged By AK	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723855E - 718377N	RO
Client: RPS Consulting Engineers	**Dates:** 29/01/2016-01/02/2016	**Level:** 70.77 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND) Open hole drilling. Driller described plastic. timber and metal.	
						69.27	1.50	(MADE GROUND) Open hole drilling. Driller described plastic, timber and metal.	
						67.77	3.00	(MADE GROUND) Open hole drilling. Driller described a granite block.	
						67.27	3.50	(MADE GROUND) Open hole drilling. Driller described plastic, boulders and timber.	
						66.27	4.50	(MADE GROUND) Open hole drilling. Driller described metal, plastic and timber.	
						64.77	6.00	(MADE GROUND) Open hole drilling. Driller described metal, plastic and timber.	
						63.27	7.50	(MADE GROUND) Open hole drilling. Driller described metal, plastic and timber.	
						61.77	9.00		

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed, response zone 1m to 8m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/01/2016	10.50m	End of shift
-	01/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By AK
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Borehole No
LG08

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723855E - 718377N	RO
Client: RPS Consulting Engineers	**Dates:** 29/01/2016-01/02/2016	**Level:** 70.77 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND) Open hole drilling. Driller described metal, plastic and timber.	
						61.07	9.70	Open hole drilling. Driller described gravelly, clay SAND.	
						60.27	10.50	Open hole drilling. Driller described sand GRAVEL.	
						58.77	12.00	Open hole drilling. Driller described SAND.	
						57.27	13.50	Open hole drilling. Driller described sandy GRAVEL.	
						55.77	15.00	Open hole drilling. Driller described SAND.	
						54.27	16.50	Open hole drilling. Driller described SAND.	
						52.77	18.00		

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed, response zone 1m to 8m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/01/2016	10.50m	End of shift
-	01/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By AK

Logged By AK

Borehole No **LG08**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723855E - 718377N	RO
Client: RPS Consulting Engineers	**Dates:** 29/01/2016-01/02/2016	**Level:** 70.77 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described SAND.	
					19.50	51.27	19.50	End of Borehole at 19.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed, response zone 1m to 8m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/01/2016	10.50m	End of shift
-	01/02/2016	19.50m	End of shift

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Drilled By	Borehole No
AK	**LG09**
Logged By AK	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723827E - 718411N	RO
Client: RPS Consulting Engineers	**Dates:** 02/02/2016-03/02/2016	**Level:** 71.06 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described as Clay Gravel	
						69.56	1.50	(MADE GROUND) Open hole drilling. Driller described as plastic timber.	
						68.06	3.00	(MADE GROUND) Open hole drilling. Driller described gravel, timber and plastic.	
						66.56	4.50	(MADE GROUND) Open hole drilling. Driller described blocks timber and plastic.	
						65.06	6.00	(MADE GROUND) Open hole drilling. Driller described blocks, timber and plastic.	
						63.56	7.50	(MADE GROUND) Open hole drilling. Driller described boulders and gravel.	
						62.06	9.00		

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed, response zone 1m to 17m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/02/2016	16.50m	End of shift
-	03/02/2016	25.50m	End of shift

Equipment & Methods: Deltabase520

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Borehole No **LG09**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723827E - 718411N	RO
Client: RPS Consulting Engineers	**Dates:** 02/02/2016-03/02/2016	**Level:** 71.06 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND)Open hole drilling. Driller described boulders and plastic	
						60.56	10.50	(MADE GROUND) Open hole drilling. Driller described boulders, plastic and timber.	
						59.06	12.00	(MADE GROUND) Open hole drilling. Driller described boulders and plastic	
						57.56	13.50	(MADE GROUND) Open hole drilling. Driller described boulders, plastic and timber.	
						56.06	15.00	(MADE GROUND) Open hole drilling. Driller described boulders and timber.	
						54.46	16.60	(MADE GROUND) Open hole drilling. Driller described plastic boulders.	
						53.26	17.80	Open hole drilling. Driller described sandy GRAVEL.	
						53.06	18.00		

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed, response zone 1m to 17m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/02/2016	16.50m	End of shift
-	03/02/2016	25.50m	End of shift

Equipment & Methods: Deltabase520

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Borehole No
LG09

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723827E - 718411N	RO
Client: RPS Consulting Engineers	**Dates:** 02/02/2016-03/02/2016	**Level:** 71.06 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described gravelly SAND.	
						51.56	19.50	Open hole drilling. Driller described SAND.	
					25.50	45.56	25.50	End of Borehole at 25.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.50m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed, response zone 1m to 17m.

Equipment & Methods: Deltabase520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/02/2016	16.50m	End of shift
-	03/02/2016	25.50m	End of shift

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Drilled By AK
Logged By AK

Borehole No **LG10**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723905E - 718400N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 08/02/2016-11/02/2016	**Level:** 66.37 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						65.37	1.00	(MADE GROUND) Driller described clayey GRAVEL.	1
						64.37	2.00	(MADE GROUND) Driller described black gravel and timber and bags.	2
						63.37	3.00	(MADE GROUND) Driller described black bags and timber.	3
						62.37	4.00	(MADE GROUND) Driller described black waste and plastic.	4
						61.37	5.00	(MADE GROUND) Driller described bit of clay with waste.	5
						60.37	6.00	(MADE GROUND) Driller described timber with some gravelly clay.	6
						59.37	7.00	(MADE GROUND) Driller described black clay with plastic.	7
						58.37	8.00	(MADE GROUND) Driller described waste with timber.	8
						57.37	9.00	(MADE GROUND) Driller described timber with steel rope.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
10.70m	-	200mm
21.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
10.60 to 10.70	0100	Chisel

Remarks: Cable tool borehole complete at 10.7m bgl. Rotary open hole borehole complete at 21.0m bgl. 50mm dia. standpipe installed, response zone 1m to 18m.

Equipment & Methods: Dando 2000 Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	4.00m	End of shift
-	09/02/2016	10.70m	End of shift
-	11/02/2016	21.00m	End shift

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Borehole No **LG10**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723905E - 718400N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 08/02/2016-11/02/2016	**Level:** 66.37 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						56.37	10.00	(MADE GROUND) Driller described plastic and metal.	
					10.70	55.67	10.70	(MADE GROUND) Driller described waste and bits of steel.	
						52.87	13.50	(MADE GROUND)Open hole drilling Driller described glass and timber.	
					17.00	51.37	15.00	(MADE GROUND) Open hole drilling Driller described sand and gravel.	
						48.37	18.00	(MADE GROUND) Open hole drilling Driller described plastic, sand gravel and timber.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
10.70m	-	200mm
21.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
10.60 to 10.70	0100	Chisel

Remarks: Cable tool borehole complete at 10.7m bgl. Rotary open hole borehole complete at 21.0m bgl. 50mm dia. standpipe installed, response zone 1m to 18m.

Equipment & Methods: Dando 2000 Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	4.00m	End of shift
-	09/02/2016	10.70m	End of shift
-	11/02/2016	21.00m	End shift

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Drilled By AK
Logged By AK

Borehole No
LG10
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723905E - 718400N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 08/02/2016-11/02/2016	**Level:** 66.37 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling Driller described SAND.	
						45.37	21.00	End of Borehole at 21.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
10.70m	-	200mm
21.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
10.60 to 10.70	0100	Chisel

Remarks: Cable tool borehole complete at 10.7m bgl. Rotary open hole borehole complete at 21.0m bgl. 50mm dia. standpipe installed, response zone 1m to 18m.

Equipment & Methods: Dando 2000 Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	4.00m	End of shift
-	09/02/2016	10.70m	End of shift
-	11/02/2016	21.00m	End shift

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Drilled By GW
Logged By KL/ GW

Borehole No
LG11

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723425E - 718455N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 18/02/2016-22/02/2016	**Level:** 95.37 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
					0.50	94.87	0.50	Open hole drilling. (MADE GROUND) Driller described sandy Clay. 0.5m bored cable tool, boring suspended.	
								(MADE GROUND) Open hole drilling. Driller described waste, concrete, tiles, rubber and steel.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.50m	-	200mm
17.00m	-	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Cable tool borehole complete at 0.5m bgl. Rotary open-hole borehole complete at 20.0m bgl. 50mm dia. standpipe installed, response zone 1m to 13m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	18/02/2016	0.50m	End of shift
-	22/02/2016	17.00m	End of shift

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Drilled By	Borehole No
GW	**LG11**
Logged By KL/ GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723425E - 718455N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 18/02/2016-22/02/2016	**Level:** 95.37 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND) Open hole drilling. Driller described waste, concrete, tiles, rubber and steel.	
						81.37	14.00	Open hole drilling. Driller described SAND.	
					17.00	78.37	17.00	End of Borehole at 17.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.50m	-	200mm
17.00m	-	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Cable tool borehole complete at 0.5m bgl. Rotary open-hole borehole complete at 20.0m bgl. 50mm dia. standpipe installed, response zone 1m to 13m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	18/02/2016	0.50m	End of shift
-	22/02/2016	17.00m	End of shift

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Drilled By	Borehole No
GW	**LG12**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723437E - 718445N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2015	**Level:** 95.96 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. (MADE GROUND) Driller describes gravelly CLAY.	
						94.66	1.30		
								Open hole drilling. (MADE GROUND) Driller describes BOULDERS.	
						93.36	2.60		
								Open hole drilling. (MADE GROUND) Driller describes waste mixed with gravel.	
						88.46	7.50		
								Open hole drilling. (MADE GROUND) Driller describes waste. timber and concrete blocks.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
24.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 24.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/01/2016	12.00m	End of shift
-	27/01/2016	24.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Logged By	Borehole No	Sheet
GW	GW	LG12	2 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723437E - 718445N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2015	**Level:** 95.96 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. (MADE GROUND) Driller describes waste. timber and concrete blocks.	
						82.96	13.00	Open hole drilling. Driller describes SAND.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
24.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 24.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/01/2016	12.00m	End of shift
-	27/01/2016	24.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**LG12**
Logged By GW	Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723437E - 718445N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2015	**Level:** 95.96 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes SAND.	
					24.00	71.96	24.00	End of Borehole at 24.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
24.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 24.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/01/2016	12.00m	End of shift
-	27/01/2016	24.00m	End of shift

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Borehole No
LG13

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723467E - 718464N	RO
Client: RPS Consulting Engineers	**Dates:** 22/02/2016-23/02/2016	**Level:** 96.05 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						95.75	0.30	Open hole drilling. (MADE GROUND) Driller described sandy Clay.	
								(MADE GROUND) Open hole drilling. Driller described concrete blocks.	
						94.15	1.90	(MADE GROUND) Open hole drilling. Driller described waste.	
						87.05	9.00		
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20.0m bgl. 50mm dia. standpipe installed, response zone 1m to 9m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	22/02/2016	9.00m	End of shift
-	23/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
LG13

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723467E - 718464N	RO
Client: RPS Consulting Engineers	**Dates:** 22/02/2016-23/02/2016	**Level:** 96.05 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND) Open hole drilling. Driller described waste.	
						85.55	10.50	Open hole drilling. Driller described GRAVEL.	
						82.45	13.60	Open hole drilling. Driller described sandy GRAVEL.	
								Continued next sheet	

10 11 12 13 14 15 16 17

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20.0m bgl. 50mm dia. standpipe installed, response zone 1m to 9m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	22/02/2016	9.00m	End of shift
-	23/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**LG13**
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Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723467E - 718464N	RO
Client: RPS Consulting Engineers	**Dates:** 22/02/2016-23/02/2016	**Level:** 96.05 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL.	
					20.00	76.05	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20.0m bgl. 50mm dia. standpipe installed, response zone 1m to 9m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	22/02/2016	9.00m	End of shift
-	23/02/2016	20.00m	End of shift

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Drilled By	Borehole No
GW	**LG14**
Logged By GW	Sheet 1 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723041E - 718343N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 15/02/2016-16/02/2016	**Level:** 93.44 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						92.44	1.00	(MADE GROUND) Driller described waste with plastic	
						91.44	2.00	(MADE GROUND) Driller described waste and plastic	
						90.44	3.00	(MADE GROUND) Driller described waste bags	
						89.44	4.00	(MADE GROUND) Driller described waste bags	
						88.44	5.00	(MADE GROUND) Driller described waste bags and rubber	
						87.44	6.00	(MADE GROUND) Driller described bags and rubber	
					6.80	86.64	6.80	(MADE GROUND) Driller described plastic and steel	
								(MADE GROUND) Driller described waste, difficult drilling slow progress. From 6.80m bgl progress slow due to denisty of waste.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
23.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.80m	-	200mm
23.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
6.70 to 6.80	0100	Chisel

Remarks: Cable tool borehole complete at 6.8m bgl. Rotary open hole borehole complete at 23.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/02/2016	5.00m	End of shift
-	16/02/2016	23.00m	End shift
-	16/02/2016	-	End shift

Equipment & Methods: Dando 2000, Deltabase 520

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Drilled By	Borehole No
GW	**LG14**
Logged By GW	Sheet 2 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723041E - 718343N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 15/02/2016-16/02/2016	**Level:** 93.44 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND) Driller described waste, difficult drilling slow progress.	
						80.94	12.50	Open hole drilling, Driller described very fine, wet blowing SAND.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

10 11 12 13 14 15 16 17

Groundwater:

Struck	Rose to	After	Sealed	Comment
23.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.80m	-	200mm
23.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
6.70 to 6.80	0100	Chisel

Remarks: Cable tool borehole complete at 6.8m bgl. Rotary open hole borehole complete at 23.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/02/2016	5.00m	End of shift
-	16/02/2016	23.00m	End shift
-	16/02/2016	-	End shift

Equipment & Methods: Dando 2000, Deltabase 520

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Drilled By GW
Logged By GW

Borehole No
LG14
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723041E - 718343N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 15/02/2016-16/02/2016	**Level:** 93.44 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling, Driller described very fine, wet blowing SAND.	
	▽				23.00	70.44	23.00	End of Borehole at 23.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
23.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.80m	-	200mm
23.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
6.70 to 6.80	0100	Chisel

Remarks: Cable tool borehole complete at 6.8m bgl. Rotary open hole borehole complete at 23.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Equipment & Methods: Dando 2000, Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/02/2016	5.00m	End of shift
-	16/02/2016	23.00m	End shift
-	16/02/2016	-	End shift

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Logged By GW

Borehole No **LG15**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722727E - 718288N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 17/02/2016-19/02/2016	**Level:** 103.97 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						102.97	1.00	(MADE GROUND) Driller described waste and clay	
						101.97	2.00	(MADE GROUND) Driller described waste and some concrete	
						100.97	3.00	(MADE GROUND) Driller described waste with plastic	
						99.97	4.00	(MADE GROUND) Driller described waste and timber	
						98.97	5.00	(MADE GROUND) Driller described plastic bits	
					5.50	98.47	5.50	(MADE GROUND) Driller described metal	
						94.97	9.00	(MADE GROUND) Driller described waste.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.50m	-	200mm
20.00m	-	131mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
1.20	to	2.00	0020	Chisel
5.40		5.50	0100	Chisel

Remarks: Cable tool borehole complete at 5.5m bgl. Rotary open hole borehole complete at 20.0m bgl. 50mm dia. standpipe installed, response zone 1m to 8m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	5.50m	End of shift
-	19/02/2016	20.00m	End shift.

Equipment & Methods: Dando 2000, Deltabase 520

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Borehole No
LG15

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722727E - 718288N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 17/02/2016-19/02/2016	**Level:** 103.97 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling, driller described GRAVEL	
						90.77	13.20	Open hole drilling, driller described fine Sandy GRAVEL	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.50m	-	200mm
20.00m	-	131mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
1.20	to	2.00	0020	Chisel
5.40		5.50	0100	Chisel

Remarks: Cable tool borehole complete at 5.5m bgl. Rotary open hole borehole complete at 20.0m bgl. 50mm dia. standpipe installed, response zone 1m to 8m.

Equipment & Methods: Dando 2000, Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	5.50m	End of shift
-	19/02/2016	20.00m	End shift.

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Drilled By GW
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Borehole No
LG15
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722727E - 718288N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 17/02/2016-19/02/2016	**Level:** 103.97 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling, driller described fine Sandy GRAVEL	
					20.00	83.97	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.50m	-	200mm
20.00m	-	131mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
1.20	to	2.00	0020	Chisel
5.40		5.50	0100	Chisel

Remarks: Cable tool borehole complete at 5.5m bgl. Rotary open hole borehole complete at 20.0m bgl. 50mm dia. standpipe installed, response zone 1m to 8m.

Equipment & Methods: Dando 2000, Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	5.50m	End of shift
-	19/02/2016	20.00m	End shift.

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Borehole No
LG16

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722748E - 718100N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016-05/02/2016	**Level:** 99.52 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
	▽					98.32	1.20	(MADE GROUND) Open hole drilling. Driller described a wet black silty material mixed with waste. Very bad smell.	
						95.02	4.50	Open hole drilling. Driller described dry black SAND.	
						93.52	6.00	Open hole drilling. Driller described SAND. Black but turns brown at 7.5m bgl	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
1.20m	-	-	-	perched.
11.20m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
16.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole completed at 16.0m bgl. 50mm dia. standpipe installed, response zone 1m to 3.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	6.00m	End of shift
-	05/02/2016	16.00m	End of shift

Equipment & Methods: Deltabase520

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Borehole No
LG16

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722748E - 718100N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016-05/02/2016	**Level:** 99.52 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						90.32	9.20	Open hole drilling. Driller described SAND. Black but turns brown at 7.5m bgl	
								Open hole drilling. Driller described GRAVEL.	
	▽					88.52	11.00	Open hole drilling. Driller described gravel and SAND.	
					16.00	83.52	16.00	End of Borehole at 16.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
1.20m	-	-	-	perched.
11.20m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
16.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole completed at 16.0m bgl. 50mm dia. standpipe installed, response zone 1m to 3.5m.

Equipment & Methods: Deltabase520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	6.00m	End of shift
-	05/02/2016	16.00m	End of shift

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Drilled By KL

Logged By KL

Borehole No **LG17**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722707E - 718059N	Cable
Client: RPS Consulting Engineers	**Dates:** 18/02/2016	**Level:** 100.51 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						100.51	0.00	(MADE GROUND) Driller described waste bags.	
						99.51	1.00	(MADE GROUND) Driller described waste and gravel.	
						98.51	2.00	(MADE GROUND) Driller described waste.	
						97.51	3.00	(MADE GROUND) Driller described rubber.	
						96.51	4.00	(MADE GROUND) Driller described waste.	
						95.51	5.00	Driller described Natural Ground.	
					5.50	95.01	5.50	End of Borehole at 5.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.50m	-	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
5.40 to 5.50	0100	Chisel

Remarks: Borehole complete at 5.0m bgl. 50mm diameter stanbdpipe installed response zone 1.0m to 4.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	18/02/2016	5.50m	End of shift

Equipment & Methods: Dando 2000

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Borehole No
LG18

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723040E - 718381N	RO
Client: RPS Consulting Engineers	**Dates:** 15/02/2016-16/02/2016	**Level:** 92.42 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. (MADE GROUND) Driller described sandy Clay.	
						91.62	0.80	(MADE GROUND) Open hole drilling. Driller described waste,concrete, steel, tyres and bricks.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
22.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
22.00m	-	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 22.0m bgl. 50mm dia. standpipe installed, response zone 1m to 10m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/02/2016	9.60m	End of shift
-	16/02/2016	22.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
LG18

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723040E - 718381N	RO
Client: RPS Consulting Engineers	**Dates:** 15/02/2016-16/02/2016	**Level:** 92.42 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						82.82	9.60	(MADE GROUND) Open hole drilling. Driller described waste,concrete, steel, tyres and bricks.	
								(MADE GROUND) Open hole drilling. Driller described waste. From 9.60m bgl Driller described waste as having strong pungent odour.	
						81.42	11.00	Open hole drilling. Driller described sandy GRAVEL.	
						80.32	12.10	Open hole drilling. Driller described wet, fine silty SAND.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

10 11 12 13 14 15 16 17

Groundwater:

Struck	Rose to	After	Sealed	Comment
22.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
22.00m	-	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 22.0m bgl. 50mm dia. standpipe installed, response zone 1m to 10m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/02/2016	9.60m	End of shift
-	16/02/2016	22.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
LG18
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723040E - 718381N	RO
Client: RPS Consulting Engineers	**Dates:** 15/02/2016-16/02/2016	**Level:** 92.42 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described wet, fine silty SAND.	
	▽				22.00	70.42	22.00	End of Borehole at 22.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
22.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
22.00m	-	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 22.0m bgl. 50mm dia. standpipe installed, response zone 1m to 10m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/02/2016	9.60m	End of shift
-	16/02/2016	22.00m	End of shift

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Borehole No
LG19
Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722742E - 718394N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 16/02/2016-18/02/2016	**Level:** 103.90 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Refer to LG19 for overburden details.	
	▽				6.80	97.10	6.80	(MADE GROUND) Open hole drilling. Driller described waste. From 6.80m to 16.0m bgl driller states arisings are wet.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.80m	-	-	-	
26.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.80m	-	200mm
26.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Cable tool borehole complete at 6.8m bgl. Rotary open hole borehole complete at 26.0m bgl. 50mm dia. standpipe installed, response zone 1m to 15m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	16/02/2018	8.60m	End shift
-	18/02/2018	26.00m	End of shift

Equipment & Methods: Dando 2000, Deltabase 520

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Drilled By	Borehole No
GW	**LG19**
Logged By GW	Sheet 2 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722742E - 718394N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 16/02/2016-18/02/2016	**Level:** 103.90 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND) Open hole drilling. Driller described waste.	
						87.90	16.00	Open hole drilling. Driller described GRAVEL. From 16.30 to 17.20m bgl driller states arsisings are wet.	
						86.70	17.20	Open hole drilling. Driller described sandy GRAVEL.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.80m	-	-	-	
26.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.80m	-	200mm
26.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Cable tool borehole complete at 6.8m bgl. Rotary open hole borehole complete at 26.0m bgl. 50mm dia. standpipe installed, response zone 1m to 15m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	16/02/2018	8.60m	End shift
-	18/02/2018	26.00m	End of shift

Equipment & Methods: Dando 2000, Deltabase 520

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Borehole No
LG19
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722742E - 718394N	Cable/Rotary
Client: RPS Consulting Engineers	**Dates:** 16/02/2016-18/02/2016	**Level:** 103.90 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL.	
	▽				26.00	77.90	26.00	End of Borehole at 26.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.80m	-	-	-	
26.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.80m	-	200mm
26.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Cable tool borehole complete at 6.8m bgl. Rotary open hole borehole complete at 26.0m bgl. 50mm dia. standpipe installed, response zone 1m to 15m.

Equipment & Methods: Dando 2000, Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	16/02/2018	8.60m	End shift
-	18/02/2018	26.00m	End of shift

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Drilled By	Logged By	Borehole No	Sheet
GW	GW	LG20	1 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	722761E - 718334N	RO
Client: RPS Consulting Engineers	**Dates:** 10/02/2016	**Level:** 103.82 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. (MADE GROUND) Driller described sandy Clay.	
						103.02	0.80	(MADE GROUND) Open hole drilling. Driller described waste.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
23.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 23.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/02/2016	23.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
LG20

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722761E - 718334N	RO
Client: RPS Consulting Engineers	**Dates:** 10/02/2016	**Level:** 103.82 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								(MADE GROUND) Open hole drilling. Driller described waste.	
						90.82	13.00	Open hole drilling. Driller described sandy, clay GRAVEL.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:
Struck | Rose to | After | Sealed | Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
23.00m	-	131mm

Chiselling:
Depths (m) | Time (hhmm) | Tool
to

Remarks: Borehole complete at 23.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/02/2016	23.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
Logged By GW

Borehole No
LG20
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722761E - 718334N	RO
Client: RPS Consulting Engineers	**Dates:** 10/02/2016	**Level:** 103.82 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clay GRAVEL.	
						83.22	20.60	Open hole drilling. Driller described wet GRAVEL. From 20.60 to 23.0m bgl arisings are wet.	
					23.00	80.82	23.00	End of Borehole at 23.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
23.00m	-	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 23.0m bgl. 50mm dia. standpipe installed, response zone 1m to 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/02/2016	23.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
KL	**LG21**
Logged By KL	Sheet 1 of 1

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722746E - 718046N	Cable
Client: RPS Consulting Engineers	**Dates:** 17/02/2016-18/02/2016	**Level:** 100.58 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						99.58	1.00	(MADE GROUND) Driller described waste paper	
						98.58	2.00	(MADE GROUND) Driller described clothes and waste	
						97.58	3.00	(MADE GROUND) Driller described waste clothes	
						96.58	4.00	(MADE GROUND) Driller described waste plastic	
						95.38	5.20	(MADE GROUND) Driller described sand and GRAVEL	
					5.70	94.88	5.70	(MADE GROUND) Driller described gravel and SAND	
								End of Borehole at 5.70 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.70m	-	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
5.60 to 5.70	0100	Chisel

Remarks: Borehole complete at 5.70m bgl. 50mm diameter stanbdpipe installed response zone 1.0m to 4.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	5.20m	End of shift
-	18/02/2016	5.70m	End of shift

Equipment & Methods: Dando 2000

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Drilled By	Logged By	Borehole No	Sheet
AK	AK	**BH01**	1 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723752E - 718464N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 79.22 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described clayey Gravel.	
						77.72	1.50		
								Open hole drilling. Driller described clayey SAND.	
						76.22	3.00		
								Open hole drilling. Driller described CLAY with boulder content.	
						73.22	6.00		
								Open hole drilling. Driller described clayey SAND with boulder content.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
15.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
21.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm diameter standpipe installed response zone 5m to 21m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	21.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By AK
Logged By AK

Borehole No **BH01**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723752E - 718464N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 79.22 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described clayey SAND with boulder content.	
						68.62	10.60	Open hole drilling. Driller described clay, GRAVEL.	
						65.72	13.50	Open hole drilling. Driller described CLAY with boulder content.	
	▽					64.22	15.00	Open hole drilling. Driller described CLAY	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
15.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
21.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm diameter standpipe installed response zone 5m to 21m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	21.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
AK	**BH01**
Logged By AK	Sheet 3 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723752E - 718464N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 79.22 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described CLAY	
					21.00	58.22	21.00	End of Borehole at 21.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
15.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
21.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm diameter standpipe installed response zone 5m to 21m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	21.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
AV	**BH03**
Logged By AV	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723834E - 718313N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 78.65 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described CLAY.	
						77.15	1.50		
								Open hole drilling. Driller described CLAY with boulder content.	
						75.65	3.00		
								Open hole drilling. Driller described clayey, sandy GRAVEL.	
						74.15	4.50		
								Open hole drilling. Driller described SAND.	
						71.15	7.50		
								Open hole drilling. Driller described sandy GRAVEL.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 4.5m - 19.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
AV	**BH03**
Logged By AV	Sheet 2 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723834E - 718313N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 78.65 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL.	
						63.65	15.00	Open hole drilling. Driller describes SAND.	
						60.65	18.00	Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 4.5m - 19.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By AV

Logged By AV

Borehole No **BH03**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723834E - 718313N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 78.65 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes sandy GRAVEL.	
					19.50	59.15	19.50	End of Borehole at 19.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 4.5m - 19.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
AK	**BH04**
Logged By AK	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723659E - 718160N	RO
Client: RPS Consulting Engineers	**Dates:** 17/02/2016	**Level:** 84.41 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						82.91	1.50	Open hole drilling. Driller described clayey GRAVEL	
						81.41	3.00	Open hole drilling. Driller described gravelly CLAY	
						79.91	4.50	Open hole drilling. Driller described clayey, gravel SAND.	
								Open hole drilling. Driller described sandy GRAVEL	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
18.70m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.40m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed response zone 13m - 25.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	25.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
AK	**BH04**
Logged By AK	Sheet 2 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723659E - 718160N	RO
Client: RPS Consulting Engineers	**Dates:** 17/02/2016	**Level:** 84.41 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL	
						73.91	10.50		
								Open hole drilling. Driller described clayey GRAVEL	
						69.41	15.00		
								Open hole drilling. Driller described sandy GRAVEL	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
18.70m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.40m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed response zone 13m - 25.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	25.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
AK	**BH04**
Logged By AK	Sheet 3 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723659E - 718160N	RO
Client: RPS Consulting Engineers	**Dates:** 17/02/2016	**Level:** 84.41 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
	▽							Open hole drilling. Driller described sandy GRAVEL	
						63.41	21.00	Open hole drilling. Driller described SAND	
					25.50	58.91	25.50	End of Borehole at 25.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
18.70m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
25.40m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 25.50m bgl. 50mm dia. standpipe installed response zone 13m - 25.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	25.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
Logged By GW

Borehole No
BH05

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723382E - 718381N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2016	**Level:** 96.06 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes sandy, clayey GRAVEL.	
						91.16	4.90	Open hole drilling. Driller describes GRAVEL.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
24.00m	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
35.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 35.0m bgl. 50mm dia. standpipe installed response zone 19m - 29m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	27/01/2016	24.00m	End of shift
-	28/01/2016	35.00m	End of shift

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Drilled By	Borehole No
GW	**BH05**
Logged By GW	Sheet 2 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723382E - 718381N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2016	**Level:** 96.06 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes GRAVEL.	
						82.36	13.70	Open hole drilling. Driller describes SAND.	
						78.56	17.50	Open hole drilling. Driller describes SAND.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
24.00m	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
35.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 35.0m bgl. 50mm dia. standpipe installed response zone 19m - 29m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	27/01/2016	24.00m	End of shift
-	28/01/2016	35.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Logged By	Borehole No
GW	GW	**BH05**

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723382E - 718381N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2016	**Level:** 96.06 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes SAND.	
	▽							From 24.0m bgl blowing sands.	
								From 24.0m to 35.0mbgl arisings are wet.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
24.00m	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
35.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 35.0m bgl. 50mm dia. standpipe installed response zone 19m - 29m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	27/01/2016	24.00m	End of shift
-	28/01/2016	35.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH05**
Logged By GW	Sheet 4 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723382E - 718381N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2016	**Level:** 96.06 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes SAND.	
					35.00	61.06	35.00	End of Borehole at 35.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
24.00m	-	-	-	Refer to detail

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
35.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 35.0m bgl. 50mm dia. standpipe installed response zone 19m - 29m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	27/01/2016	24.00m	End of shift
-	28/01/2016	35.00m	End of shift

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Drilled By	Borehole No
GW	**BH06**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723028E - 718310N	RO
Client: RPS Consulting Engineers	**Dates:** 17/02/2016	**Level:** 95.27 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL	
	▽					89.07	6.20	Open hole drilling. Driller described slightly wet, silty, sandy GRAVEL	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14.0m bgl. 50mm dia. standpipe installed response zone 2m - 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Logged By	Borehole No	Sheet
GW	GW	**BH06**	2 of 2

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723028E - 718310N	RO

Client:	Dates:	Level:	Scale
RPS Consulting Engineers	17/02/2016	95.27 mOD	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described slightly wet, silty, sandy GRAVEL	
					14.00	81.27	14.00	End of Borehole at 14.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14.0m bgl. 50mm dia. standpipe installed response zone 2m - 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH07**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722642E - 718220N	RO
Client: RPS Consulting Engineers	**Dates:** 09/02/2016	**Level:** 106.11 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL.	
						102.01	4.10	Open hole drilling. Driller described GRAVEL.	
						100.11	6.00	Open hole drilling. Driller described sandy, clayey GRAVEL.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
21.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 21.0m bgl. 50mm dia. standpipe installed response zone 11m - 21m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/02/2016	21.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Logged By	Borehole No	Sheet
GW	GW	BH07	2 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	722642E - 718220N	RO

Client:	Dates:	Level:	Scale
RPS Consulting Engineers	09/02/2016	106.11 mOD	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL.	
						93.01	13.10	Open hole drilling. Driller described GRAVEL. From 13.10 to 21.0m bgl arisings are wet.	
						88.31	17.80	Open hole drilling. Driller described sandy, gravelly	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
21.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 21.0m bgl. 50mm dia. standpipe installed response zone 11m - 21m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/02/2016	21.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH07**
Logged By GW	Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722642E - 718220N	RO
Client: RPS Consulting Engineers	**Dates:** 09/02/2016	**Level:** 106.11 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								CLAY/SILT.	
					21.00	85.11	21.00	End of Borehole at 21.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
21.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 21.0m bgl. 50mm dia. standpipe installed response zone 11m - 21m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/02/2016	21.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH08**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722753E - 718130N	RO
Client: RPS Consulting Engineers	**Dates:** 09/02/2016	**Level:** 98.80 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL	
						95.90	2.90		
								Open hole drilling. Driller described sandy GRAVEL	
						92.80	6.00		
								Open hole drilling. Driller described SAND	
						92.50	6.30		
								Open hole drilling. Driller described sandy GRAVEL	
						89.80	9.00		
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
13.50m	0.00m	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
13.50m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 13.50m bgl. 50mm dia. standpipe installed response zone 3.5m - 13.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/02/2016	9.00m	End of shift
-	10/02/2016	13.50m	End of shift

Equipment & Methods: Deltabase520

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Drilled By	Borehole No
GW	**BH08**
Logged By GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722753E - 718130N	RO
Client: RPS Consulting Engineers	**Dates:** 09/02/2016	**Level:** 98.80 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL	
	▽				13.50	85.30	13.50	End of Borehole at 13.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
13.50m	0.00m	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
13.50m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 13.50m bgl. 50mm dia. standpipe installed response zone 3.5m - 13.5m.

Equipment & Methods: Deltabase520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/02/2016	9.00m	End of shift
-	10/02/2016	13.50m	End of shift

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Drilled By	Borehole No
GW	**BH09**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722746E - 718179N	RO
Client: RPS Consulting Engineers	**Dates:** 09/02/2016	**Level:** 97.97 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL	
						94.27	3.70	Open hole drilling. Driller described gravelly SAND	
	▽					91.97	6.00	Open hole drilling. Driller described sandy GRAVEL	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
12.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 12.0m bgl. 50mm dia. standpipe installed response zone 2m - 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/02/2016	12.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH09**
Logged By GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722746E - 718179N	RO
Client: RPS Consulting Engineers	**Dates:** 09/02/2016	**Level:** 97.97 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL	
					12.00	85.97	12.00	End of Borehole at 12.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
12.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 12.0m bgl. 50mm dia. standpipe installed response zone 2m - 12m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/02/2016	12.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH10**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722792E - 718279N	RO
Client: RPS Consulting Engineers	**Dates:** 11/02/2016	**Level:** 99.31 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL	
						96.11	3.20	Open hole drilling. Driller described sandy GRAVEL	
						95.01	4.30	Open hole drilling. Driller described SAND	
	▽					93.31	6.00	Open hole drilling. Driller described sandy GRAVEL	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	-	
9.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14.0m bgl. 50mm dia. standpipe installed response zone 4m - 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
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Borehole No
BH10
Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722792E - 718279N	RO
Client: RPS Consulting Engineers	**Dates:** 11/02/2016	**Level:** 99.31 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						90.21	9.10	Open hole drilling. Driller described wet sandy GRAVEL	
						88.81	10.50	Open hole drilling. Driller described sandy, clayey GRAVEL	
					14.00	85.31	14.00	End of Borehole at 14.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	-	
9.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14.0m bgl. 50mm dia. standpipe installed response zone 4m - 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No **BH11**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723803E - 718269N	RO
Client: RPS Consulting Engineers	**Dates:** 24/02/2016	**Level:** 82.65 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						79.35	3.30		
								Open hole drilling. Driller describes sandy GRAVEL.	
						76.25	6.40		
								Open hole drilling. Driller describes GRAVEL.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
33.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 33.0m bgl. 50mm dia. standpipe installed response zone 1m - 33m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	24/02/2016	33.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No **BH11**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723803E - 718269N	RO
Client: RPS Consulting Engineers	**Dates:** 24/02/2016	**Level:** 82.65 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes GRAVEL.	
						70.05	12.60	Open hole drilling. Driller dsescribes sandy GRAVEL.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
33.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 33.0m bgl. 50mm dia. standpipe installed response zone 1m - 33m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	24/02/2016	33.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH11**
Logged By GW	Sheet 3 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723803E - 718269N	RO
Client: RPS Consulting Engineers	**Dates:** 24/02/2016	**Level:** 82.65 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller dsescribes sandy GRAVEL.	
						60.65	22.00	Open hole drilling. Driller describes SAND.	
								Continued next sheet	

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
33.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 33.0m bgl. 50mm dia. standpipe installed response zone 1m - 33m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	24/02/2016	33.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH11**
Logged By GW	Sheet 4 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723803E - 718269N	RO
Client: RPS Consulting Engineers	**Dates:** 24/02/2016	**Level:** 82.65 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes SAND.	
					33.00	49.65	33.00	End of Borehole at 33.00 m	

28 29 30 31 32 33 34 35

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
33.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 33.0m bgl. 50mm dia. standpipe installed response zone 1m - 33m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	24/02/2016	33.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**BH13**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723634E - 718448N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016	**Level:** 87.99 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						86.59	1.40		
								Open hole drilling. Driller described sandy, clayey GRAVEL	
						81.79	6.20		
								Open hole drilling. Driller described SAND	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
11.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole competed at 19.5m bgl. 50mm dia. standpipe installed response zone 4.5m - 19.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase520

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Drilled By	Borehole No
GW	**BH13**
Logged By GW	Sheet 2 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723634E - 718448N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016	**Level:** 87.99 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						78.79	9.20	Open hole drilling. Driller described SAND	
								Open hole drilling. Driller described sandy GRAVEL	
						77.49	10.50	Open hole drilling. Driller described very wet GRAVEL	
	▽					76.89	11.10		
						76.69	11.30	Open hole drilling. Driller described silty, sandy CLAY	
								Open hole drilling. Driller described dry SAND	
						71.49	16.50	Open hole drilling. Driller described sandy GRAVEL	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
11.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole competed at 19.5m bgl. 50mm dia. standpipe installed response zone 4.5m - 19.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase520

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Drilled By	Borehole No
GW	**BH13**
Logged By GW	Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723634E - 718448N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016	**Level:** 87.99 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL	
					19.50	68.49	19.50	End of Borehole at 19.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
11.10m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole competed at 19.5m bgl. 50mm dia. standpipe installed response zone 4.5m - 19.5m.

Equipment & Methods: Deltabase520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/02/2016	19.50m	End of shift

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Drilled By	Borehole No
GW	**G01**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723757E - 718233N	RO
Client: RPS Consulting Engineers	**Dates:** 23/02/2016	**Level:** 84.99 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL.	
						76.89	8.10	Open hole drilling. Driller described GRAVEL.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.30m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.30m bgl. 50mm dia. standpipe installed response zone 1m to 11m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	23/02/2016	19.30m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G01**
Logged By GW	Sheet 2 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723757E - 718233N	RO
Client: RPS Consulting Engineers	**Dates:** 23/02/2016	**Level:** 84.99 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						75.59	9.40	Open hole drilling. Driller described GRAVEL.	
						75.19	9.80	Open hole drilling. Driller described sandy GRAVEL.	
								Open hole drilling. Driller described GRAVEL.	
						67.89	17.10	Open hole drilling. Driller described blowing fine SAND and GRAVEL.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.30m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.30m bgl. 50mm dia. standpipe installed response zone 1m to 11m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	23/02/2016	19.30m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G01**
Logged By GW	Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723757E - 718233N	RO
Client: RPS Consulting Engineers	**Dates:** 23/02/2016	**Level:** 84.99 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described blowing fine SAND and GRAVEL.	
					19.30	65.69	19.30	End of Borehole at 19.30 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.30m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.30m bgl. 50mm dia. standpipe installed response zone 1m to 11m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	23/02/2016	19.30m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By AK
Logged By AK

Borehole No **G02**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723907E - 718312N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016-04/02/2016	**Level:** 72.66 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described CLAY.	
	▽					69.66	3.00	Open hole drilling. Driller described SAND.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
3.20m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 1m to 11.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
3.20m	03/02/2016	13.50m	End of shift
-	04/02/2016	13.50m	Start of shift

Equipment & Methods: Deltabase 520

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Drilled By AK
Logged By AK

Borehole No **G02**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723907E - 718312N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016-04/02/2016	**Level:** 72.66 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described SAND.	
						62.16	10.50	Open hole drilling. Driller described GRAVEL.	
						59.16	13.50	Open hole drilling. Driller described sandy GRAVEL.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
3.20m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 1m to 11.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
3.20m	03/02/2016	13.50m	End of shift
-	04/02/2016	13.50m	Start of shift

Equipment & Methods: Deltabase 520

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Drilled By AK
Logged By AK

Borehole No **G02**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723907E - 718312N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016-04/02/2016	**Level:** 72.66 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL.	
						53.66	19.00	End of Borehole at 19.50 m	
					19.50				

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
3.20m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 1m to 11.5m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
3.20m	03/02/2016	13.50m	End of shift
-	04/02/2016	13.50m	Start of shift

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Borehole No **G03**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723984E - 718344N	RO
Client: RPS Consulting Engineers	**Dates:** 08/02/2016	**Level:** 69.50 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described CLAY.	
						68.00	1.50	Open hole drilling. Driller described clay GRAVEL.	
						66.50	3.00	Open hole drilling. Driller described sandy GRAVEL.	
						62.00	7.50	Open hole drilling. Driller described GRAVEL with boulder content.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 1m to 19.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No **G03**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723984E - 718344N	RO
Client: RPS Consulting Engineers	**Dates:** 08/02/2016	**Level:** 69.50 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described GRAVEL with boulder content.	
						59.00	10.50		
								Open hole drilling. Driller described gravelly SAND with boulder content.	
						57.50	12.00		
								Open hole drilling. Driller described SAND.	
						54.50	15.00		
								Open hole drilling. Driller described GRAVEL.	
						51.50	18.00		
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 1m to 19.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No **G03**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723984E - 718344N	RO
Client: RPS Consulting Engineers	**Dates:** 08/02/2016	**Level:** 69.50 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described SAND.	
					19.50	50.00	19.50	End of Borehole at 19.50 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
19.50m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 19.50m bgl. 50mm dia. standpipe installed response zone 1m to 19.5m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	19.50m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G04**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723641E - 718282N	Rotary
Client: RPS Consulting Engineers	**Dates:** 22/01/2016	**Level:** 85.62 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						85.42	0.20	Topsoil	
								Open hole drilling. Driller describes grey to brown sandy GRAVEL.	
						81.12	4.50	Open hole drilling. Driller describes dark grey sandy, clayey GRAVEL.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		Refer to detail 19.5m

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 2
20.m bgl. 50mm dia. standpipe installed response zone 3m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	22/01/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
Logged By GW

Borehole No **G04**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723641E - 718282N	Rotary
Client: RPS Consulting Engineers	**Dates:** 22/01/2016	**Level:** 85.62 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes dark grey sandy, clayey GRAVEL.	

Continued next sheet

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		Refer to detail 19.5m

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 2
20.m bgl. 50mm dia. standpipe installed response zone 3m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	22/01/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G04**
Logged By GW	Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723641E - 718282N	Rotary
Client: RPS Consulting Engineers	**Dates:** 22/01/2016	**Level:** 85.62 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes dark grey sandy, clayey GRAVEL.	
						66.12	19.50	Open hole drilling. Driller describes GRAVEL. From 19.50 to 20.0m bgl arisings are wet.	
					20.00	65.62	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		Refer to detail 19.5m

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 2
20.m bgl. 50mm dia. standpipe installed response zone 3m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	22/01/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
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Borehole No **G05**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723639E - 718345N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2016	**Level:** 86.72 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL.	
						83.42	3.30	Open hole drilling. Driller describes dark grey sandy, clayey GRAVEL.	
						80.07	6.65	Open hole drilling. Driller describes sandy GRAVEL.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	25/01/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G05**
Logged By GW	Sheet 2 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723639E - 718345N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2016	**Level:** 86.72 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes sandy GRAVEL.	
						76.22	10.50	Open hole drilling. Driller describes SAND.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	25/01/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
Logged By GW

Borehole No **G05**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723639E - 718345N	Rotary
Client: RPS Consulting Engineers	**Dates:** 27/01/2016	**Level:** 86.72 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes SAND.	
					20.00	66.72	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	25/01/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
Logged By GW

Borehole No **G06**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723574E - 718442N	Rotary
Client: RPS Consulting Engineers	**Dates:** 26/01/2016	**Level:** 90.99 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes sandy, clayey GRAVEL.	
						87.09	3.90	Open hole drilling. Driller describes GRAVEL.	
						82.39	8.60	Open hole drilling. Driller describes sandy GRAVEL.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
12.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 12m bgl. 50mm dia. standpipe installed response zone 1m to 11m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/01/2016	12.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G06**
Logged By GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723574E - 718442N	Rotary
Client: RPS Consulting Engineers	**Dates:** 26/01/2016	**Level:** 90.99 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes sandy GRAVEL.	
					12.00	78.99	12.00	End of Borehole at 12.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
12.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 12m bgl. 50mm dia. standpipe installed response zone 1m to 11m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/01/2016	12.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G07**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723368E - 718434N	Rotary
Client: RPS Consulting Engineers	**Dates:** 28/01/2016	**Level:** 93.03 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes sandy CLAY.	
						89.93	3.10	Open hole drilling. Driller describes GRAVEL.	
						84.03	9.00	Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 140m bgl. 50mm dia. standpipe installed respons zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	20/01/2016	14.00m	End of shift
-	28/01/2016	0.00m	Start of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G07**
Logged By GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723368E - 718434N	Rotary
Client: RPS Consulting Engineers	**Dates:** 28/01/2016	**Level:** 93.03 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						83.43	9.60	Open hole drilling. Driller describes sandy GRAVEL.	
								Open hole drilling. Driller describes SAND.	
					14.00	79.03	14.00	End of Borehole at 14.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 140m bgl. 50mm dia. standpipe installed respons zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	20/01/2016	14.00m	End of shift
-	28/01/2016	0.00m	Start of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
Logged By

Borehole No
G08

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723307E - 718326N	RO
Client: RPS Consulting Engineers	**Dates:** 29/01/2016	**Level:** 94.29 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller describes slightly sandy, slightly gravelly CLAY.	
						91.09	3.20	Open hole drilling. Driller desribed GRAVEL.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14.0m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/01/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
Logged By

Borehole No **G08**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723307E - 718326N	RO
Client: RPS Consulting Engineers	**Dates:** 29/01/2016	**Level:** 94.29 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller desribed GRAVEL.	
					14.00	80.29	14.00	End of Borehole at 14.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14.0m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/01/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
Logged By GW

Borehole No
G09

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723094E - 718350N	RO
Client: RPS Consulting Engineers	**Dates:** 17/02/2016	**Level:** 93.56 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY.	
						91.26	2.30	Open hole drilling. Driller described gravelly SAND.	
						84.66	8.90		
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
13.30m	-	-	-	Blowing sand

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
15.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 15.0m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	15.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G09**
Logged By GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723094E - 718350N	RO
Client: RPS Consulting Engineers	**Dates:** 17/02/2016	**Level:** 93.56 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
	▽					80.26	13.30	Open hole drilling. Driller described sandy, clay GRAVEL.	
								Open hole drilling. Driller described blowing SAND.	
					15.00	78.56	15.00	End of Borehole at 15.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
13.30m	-	-	-	Blowing sand

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
15.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 15.0m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	17/02/2016	15.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G10

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723333E - 718172N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 98.86 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sand, clay and GRAVEL.	

Continued next sheet

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
20.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 18.2m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G10

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723333E - 718172N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 98.86 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sand, clay and GRAVEL.	
						82.06	16.80	Open hole drilling. Driller described blowing wet silty SAND.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
20.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 18.2m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G10
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723333E - 718172N	RO
Client: RPS Consulting Engineers	**Dates:** 04/02/2016	**Level:** 98.86 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
	▽				20.00	78.86	20.00	Open hole drilling. Driller described blowing wet silty SAND.	
								End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
20.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 18.2m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G11

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722977E - 718343N	RO
Client: RPS Consulting Engineers	**Dates:** 18/02/2016	**Level:** 97.21 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY.	
						94.11	3.10		
								Open hole drilling. Driller described sandy GRAVEL.	
						91.11	6.10		
								Open hole drilling. Driller described SAND.	
						89.71	7.50		
								Open hole drilling. Driller described sandy GRAVEL.	
						88.31	8.90		
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
12.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
15.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 15m bgl. 50mm dia. standpipe installed response zone 1m to 15m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	18/02/2016	15.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No **G11**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722977E - 718343N	RO
Client: RPS Consulting Engineers	**Dates:** 18/02/2016	**Level:** 97.21 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described wet GRAVEL. Detail 8.90m - 12.00m : From 8.90m bgl arising are wet until 12.0m bgl.	
	▽					85.21	12.00	Open hole drilling. Driller described sandy GRAVEL	
					15.00	82.21	15.00	End of Borehole at 15.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
12.00m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
15.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 15m bgl. 50mm dia. standpipe installed response zone 1m to 15m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	18/02/2016	15.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G12**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722830E - 718346N	RO
Client: RPS Consulting Engineers	**Dates:** 12/02/2016	**Level:** 98.91 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY.	
						96.81	2.10		
								Open hole drilling. Driller described sandy, clayey GRAVEL.	
								Continued next sheet	

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
14.00m	-	-	-	wet sand

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
14.00m	12/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No **G12**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722830E - 718346N	RO
Client: RPS Consulting Engineers	**Dates:** 12/02/2016	**Level:** 98.91 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL.	
						87.61	11.30	Open hole drilling. Driller described sandy GRAVEL. From 11.30 to 14.0m bgl arisings are wet.	
	▽				14.00	84.91	14.00	End of Borehole at 14.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
14.00m	-	-	-	wet sand

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
14.00m	12/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G13**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	724006E - 718058N	RO
Client: RPS Consulting Engineers	**Dates:** 26/02/2016	**Level:** 75.82 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy Clay.	
						72.22	3.60		
								Open hole drilling. Driller described sandy GRAVEL.	
						69.92	5.90		
								Open hole drilling. Driller described SAND.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G13**
Logged By GW	Sheet 2 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	724006E - 718058N	RO
Client: RPS Consulting Engineers	**Dates:** 26/02/2016	**Level:** 75.82 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described SAND.	
						65.42	10.40		
								Open hole drilling. Driller described sandy GRAVEL.	
						63.82	12.00		
								Open hole drilling. Driller described SAND.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G13
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	724006E - 718058N	RO
Client: RPS Consulting Engineers	**Dates:** 26/02/2016	**Level:** 75.82 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described SAND.	
					20.00	55.82	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G14

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722815E - 718240N	RO
Client: RPS Consulting Engineers	**Dates:** 11/02/2016	**Level:** 98.62 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						97.82	0.80	Open hole drilling. Driller described sandy, clay GRAVEL	
	▽				0.00	92.62	6.00	Open hole drilling. Driller described wet GRAVEL From 6.0 to 9.10m bgl arisings are wet.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	0.00m	Wet sand

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/02/2016	14.00m	End of shift

Equipment & Methods: Deltsbase 520

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Borehole No
G14

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722815E - 718240N	RO
Client: RPS Consulting Engineers	**Dates:** 11/02/2016	**Level:** 98.62 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						89.52	9.10	Open hole drilling. Driller described dry silty, sandy CLAY	
					14.00	84.62	14.00	End of Borehole at 14.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.00m	-	-	0.00m	Wet sand

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/02/2016	14.00m	End of shift

Equipment & Methods: Deltsbase 520

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Borehole No
G15
Sheet 1 of 1

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722795E - 718080N	RO
Client: RPS Consulting Engineers	**Dates:** 08/02/2016	**Level:** 99.17 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						98.27	0.90	Open hole drilling. Driller described sandy CLAY	
								Open hole drilling. Driller described GRAVEL	
					6.00	93.17	6.00	End of Borehole at 6.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 6m bgl. 50mm dia. standpipe installed response zone 1m to 6m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	6.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G16**
Logged By GW	Sheet 1 of 1

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722653E - 718074N	RO
Client: RPS Consulting Engineers	**Dates:** 08/02/2016	**Level:** 100.38 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						98.18	2.20	Open hole drilling. Driller described sandy, clay GRAVEL	
					6.00	94.38	6.00	End of Borehole at 6.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 6m bgl. 50mm dia. standpipe installed response zone 1m to 6m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	6.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G17
Sheet 1 of 1

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	722715E - 718133N	RO
Client: RPS Consulting Engineers	**Dates:** 08/02/2016	**Level:** 98.42 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						95.02	3.40	Open hole drilling. Driller described sandy, clay GRAVEL	
					6.00	92.42	6.00	End of Borehole at 6.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 6m bgl. 50mm dia. standpipe installed response zone 1m to 6m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/02/2016	6.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G18**
Logged By GW	Sheet 1 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723511E - 718384N	RO
Client: RPS Consulting Engineers	**Dates:** 01/02/2016	**Level:** 93.73 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						89.23	4.50	Open hole drilling. Driller described GRAVEL	
						85.93	7.80	Open hole drilling. Driller described gravelly SAND	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G18**
Logged By GW	Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723511E - 718384N	RO
Client: RPS Consulting Engineers	**Dates:** 01/02/2016	**Level:** 93.73 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described gravelly SAND	
					14.00	79.73	14.00	End of Borehole at 14.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Logged By GW

Borehole No
G19

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723437E - 718296N	RO
Client: RPS Consulting Engineers	**Dates:** 02/02/2016	**Level:** 98.24 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						93.74	4.50	Open hole drilling. Driller described GRAVEL	
						93.54	4.70	Open hole drilling. Driller described sandy, clay GRAVEL	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By GW
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Borehole No
G19
Sheet 2 of 2

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723437E - 718296N	RO
Client: RPS Consulting Engineers	**Dates:** 02/02/2016	**Level:** 98.24 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						88.94	9.30	Open hole drilling. Driller described sandy, clay GRAVEL	
								Open hole drilling. Driller described slightly wet sandy, clay GRAVEL.	
					14.00	84.24	14.00	End of Borehole at 14.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
14.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 14m bgl. 50mm dia. standpipe installed response zone 1m to 14m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/02/2016	14.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Logged By	Borehole No
GW	GW	**G20**

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723622E - 718200N	RO
Client: RPS Consulting Engineers	**Dates:** 02/02/2016	**Level:** 85.55 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL.	
						78.85	6.70	Open hole drilling. Driller described GRAVEL.	
						78.45	7.10	Open hole drilling. Driller described sandy, clayey GRAVEL	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
27.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 27.0m bgl. 50mm dia. standpipe installed response zone 1m - 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/02/2016	27.00m	End of shift

Equipment & Methods: Deltbase 520

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Borehole No
G20

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723622E - 718200N	RO
Client: RPS Consulting Engineers	**Dates:** 02/02/2016	**Level:** 85.55 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, clayey GRAVEL	
						74.25	11.30	Open hole drilling. Driller described dry SAND.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
27.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 27.0m bgl. 50mm dia. standpipe installed response zone 1m - 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/02/2016	27.00m	End of shift

Equipment & Methods: Deltbase 520

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Drilled By	Borehole No
GW	**G20**
Logged By GW	Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723622E - 718200N	RO
Client: RPS Consulting Engineers	**Dates:** 02/02/2016	**Level:** 85.55 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described dry SAND.	
					27.00	58.55	27.00	End of Borehole at 27.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
27.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 27.0m bgl. 50mm dia. standpipe installed response zone 1m - 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/02/2016	27.00m	End of shift

Equipment & Methods: Deltbase 520

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Borehole No
G21

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723750E - 718164N	RO
Client: RPS Consulting Engineers	**Dates:** 23/02/2016-24/02/2016	**Level:** 86.66 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						83.56	3.10	Open hole drilling. Driller described sandy GRAVEL	
						77.66	9.00	Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 17m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	23/02/2016	9.00m	End of shift
-	24/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G21**
Logged By GW	Sheet 2 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723750E - 718164N	RO
Client: RPS Consulting Engineers	**Dates:** 23/02/2016-24/02/2016	**Level:** 86.66 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						77.36	9.30	Open hole drilling. Driller described sandy GRAVEL	
								Open hole drilling. Driller described SAND.	
						71.46	15.20	Open hole drilling. Driller described blowing SAND and GRAVEL.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 17m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	23/02/2016	9.00m	End of shift
-	24/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G21
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723750E - 718164N	RO
Client: RPS Consulting Engineers	**Dates:** 23/02/2016-24/02/2016	**Level:** 86.66 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described blowing SAND and GRAVEL.	
					20.00	66.66	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 17m.

Equipment & Methods: Deltabase 520

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	23/02/2016	9.00m	End of shift
-	24/02/2016	20.00m	End of shift

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Drilled By	Borehole No
GW	**G22**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	724131E - 717889N	RO
Client: RPS Consulting Engineers	**Dates:** 01/03/2016	**Level:** 63.68 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY	
						62.28	1.40	Open hole drilling. Driller described sandy GRAVEL.	
						61.78	1.90	Open hole drilling. Driller described SAND	
						61.08	2.60	Open hole drilling. Driller described sandy GRAVEL	
						57.38	6.30	Open hole drilling. Driller described dry SAND.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 15m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/03/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G22**
Logged By GW	Sheet 2 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	724131E - 717889N	RO
Client: RPS Consulting Engineers	**Dates:** 01/03/2016	**Level:** 63.68 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described dry SAND.	
						48.98	14.70	Open hole drilling. Driller described wet blowing SAND. Pipe installed at 15.0m bgl due to blowing sand.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 15m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/03/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No **G22**

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	724131E - 717889N	RO
Client: RPS Consulting Engineers	**Dates:** 01/03/2016	**Level:** 63.68 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described wet blowing SAND. Pipe installed at 15.0m bgl due to blowing sand.	
					20.00	43.68	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 15m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/03/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G23**
Logged By GW	Sheet 1 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723934E - 717922N	RO
Client: RPS Consulting Engineers	**Dates:** 29/02/2016	**Level:** 78.95 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						78.05	0.90	Open hole drilling. Driller described sandy CLAY	
						74.25	4.70	Open hole drilling. Driller described sandy, silty, clay GRAVEL.	
								Open hole drilling. Driller described sandy, silty GRAVEL.	
								Continued next sheet	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
19.50m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Borehole No
G23

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723934E - 717922N	RO
Client: RPS Consulting Engineers	**Dates:** 29/02/2016	**Level:** 78.95 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy, silty GRAVEL.	
						62.45	16.50	Open hole drilling. Driller described SAND.	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
19.50m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G23**
Logged By GW	Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723934E - 717922N	RO
Client: RPS Consulting Engineers	**Dates:** 29/02/2016	**Level:** 78.95 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
	▽					59.45	19.50	Open hole drilling. Driller described SAND.	
								Open hole drilling. Driller described SAND. From 19.50 to 20.0m bgl arisings are wet.	
					20.00	58.95	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
19.50m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/02/2016	20.00m	End of shift

Equipment & Methods: Deltabase 520

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Drilled By	Borehole No
GW	**G24**
Logged By GW	Sheet 1 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723786E - 718048N	RO
Client: RPS Consulting Engineers	**Dates:** 25/02/2016	**Level:** 86.83 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL.	
						78.93	7.90	Open hole drilling. Driller described GRAVEL	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	25/02/2016	20.00m	End of shift

Equipment & Methods: Deltsbase 520

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Drilled By	Logged By	Borehole No	Sheet
GW	GW	G24	2 of 3

Project Name:	Project No.	Co-ords:	Hole Type
Fassaroe Historic Landfills	P15180	723786E - 718048N	RO

Client:	Dates:	Level:	Scale
RPS Consulting Engineers	25/02/2016	86.83 mOD	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described GRAVEL	
						73.03	13.80	Open hole drilling. Driller described sandy GRAVEL.	
						69.03	17.80	Open hole drilling. Driller described SAND	
								Continued next sheet	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	25/02/2016	20.00m	End of shift

Equipment & Methods: Deltsbase 520

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Drilled By GW
Logged By GW

Borehole No
G24
Sheet 3 of 3

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723786E - 718048N	RO
Client: RPS Consulting Engineers	**Dates:** 25/02/2016	**Level:** 86.83 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described SAND	
					20.00	66.83	20.00	End of Borehole at 20.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
20.00m	150	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole complete at 20m bgl. 50mm dia. standpipe installed response zone 1m to 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	25/02/2016	20.00m	End of shift

Equipment & Methods: Deltsbase 520

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Drilled By GW
Logged By GW

Borehole No
G25

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723664E - 718399N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016	**Level:** 85.64 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy CLAY.	
						82.24	3.40	Open hole drilling. Driller described sandy. clayey GRAVEL.	
						81.14	4.50	Open hole drilling. Driller described GRAVEL.	
						80.84	4.80	Open hole drilling. Driller described sandy GRAVEL.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	See detail 21m.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
34.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole completed at 34m bgl. 50mm dia. standpipe installed respons zone 1m - 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/02/2016	34.00m	End of shift

Equipment & Methods: Deltabase520

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Drilled By	Borehole No
GW	**G25**
Logged By GW	Sheet 2 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723664E - 718399N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016	**Level:** 85.64 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described sandy GRAVEL.	
						75.04	10.60	Open hole drilling. Driller described GRAVEL.	
						73.64	12.00	Open hole drilling. Driller described sandy GRAVEL.	
								Continued next sheet	

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	See detail 21m.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
34.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole completed at 34m bgl. 50mm dia. standpipe installed respons zone 1m - 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/02/2016	34.00m	End of shift

Equipment & Methods: Deltabase520

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Drilled By	Borehole No
GW	**G25**
Logged By GW	Sheet 3 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723664E - 718399N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016	**Level:** 85.64 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						67.14	18.50	Open hole drilling. Driller described sandy GRAVEL.	
								Open hole drilling. Driller described SAND.	
						64.64	21.00	Open hole drilling. Driller described slightly wet sandy GRAVEL. Gravel wet 21m - 24m.	
						61.64	24.00	Open hole drilling. Driller described dry SAND. Gravel dry below 24m.	

Continued next sheet

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	See detail 21m.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
34.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole completed at 34m bgl. 50mm dia. standpipe installed respons zone 1m - 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/02/2016	34.00m	End of shift

Equipment & Methods: Deltabase520

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Drilled By GW
Logged By GW

Borehole No
G25
Sheet 4 of 4

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Fassaroe Historic Landfills	P15180	723664E - 718399N	RO
Client: RPS Consulting Engineers	**Dates:** 03/02/2016	**Level:** 85.64 mOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole drilling. Driller described dry SAND.	
					34.00	51.64	34.00	End of Borehole at 34.00 m	

Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	See detail 21m.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
34.00m	150	130mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Borehole completed at 34m bgl. 50mm dia. standpipe installed respons zone 1m - 20m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/02/2016	34.00m	End of shift

Equipment & Methods: Deltabase520

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Trial Pit No
TP01
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723682.65 - 718266.99 **Level:** 83.33	**Date** 07/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.40	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.55	82.78		(MADE GROUND) Firm grey gravelly Clay.
				0.80	82.53		(MADE GROUND) Firm blue/grey gravelly Clay with some plastic, concrete, textiles, metals, timber, glass and plastic bottles. Much household waste.
							Engineer noted strong unidentified odour.
	2.70	ES					
▼							*From 3.0m bgl less clay content and arisings are black.*
				4.40	78.93		End of Pit at 4.40m

1
2
3
4
5

Stability: Moderate
Plant: 13 tracked machine
Backfill: Arisings

Groundwater: GW (Possible leachate) Strike at 3.50m bgl. Flowrate: trickle

Remarks: Trial pit terminated at 4.40m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP01**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP01**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP02
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723757.63 - 718269.22 **Level:** 83.07	**Date** 07/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADEGROUND) Topsoil
				0.60	82.47		(MADE GROUND) Soft light grey slightly gravelly Clay.
				0.80	82.27		(MADE GROUND) Waste described as plastic bags and bottles, bricks, textile, aerosol cans, household waste, car tyres within a soft black slightly gravelly Clay matric. *0.8m bgl to 4.50m bgl Engineer noted a strong unidentified odour.*
	3.50	ES					
				4.50	78.57		End of Pit at 4.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP02**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP02**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No **TP03**
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723683.29 - 718342.00 **Level:** 83.58	**Date** 07/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.60	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.70	82.88		(MADE GROUND) Firm light grey gravelly Clay.
				0.90	82.68		(MADE GROUND) Firm blue grey slightly gravelly Clay. Gravel is fine to coarse and sub-angular. High content of household waste described as plastics, glass, metals and rubber.
							From 0.9m bgl strong unidentified odour.
	2.00	ES					
				3.70	79.88		Firm brown slightly sandy, slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse and sub-angular. (Possible natural ground)
	4.20	ES					
				4.60	78.98		End of Pit at 4.60m

Stability: Poor
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.60m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP03**	**Project** **Project No** **Engineer**	**Fassaroe Co. Wicklow** **P15180** **RPS Consulting**	

FASSAROE Trial Pit
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Number:	**TP03**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP04
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723757.61 - 718343.86 **Level:** 81.52	**Date** 07/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.60	80.92		(MADE GROUND) Much plastic bags, paper, timber, glass bottles, metal, boulders, rubber within a gravelly Clay matrix. *0.50m bgl to 4.50m bgl Engineer noted strong unidentified odour.*
	2.00	ES					
				4.50	77.02		End of Pit at 4.50m

1 2 3 4 5

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP04**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP05
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723698.18 - 718417.17 **Level:** 83.95	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.00			Topsoil
				0.50	83.45		Soft brown slightly sandy, slightly gravelly SILT. Sand is fine to coarse. Gravel is fine to coarse and sub-angular.
				2.00	81.95		Firm brown grey slightly sandy, gravelly CLAY with cobble and boulder content. Gravel is fine to coarse. Cobbles and boulders are sub-angular to rounded.
	3.00	ES					
				4.50	79.45		End of Pit at 4.50m

Stability: Good
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP05**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP06
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723755.25 - 718417.29 **Level:** 80.07	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.00	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.60	79.47		(MADE GROUND) Topsoil
	2.00	ES		4.00	76.07		(MADE GROUND) Waste described as plastic refuse, glass bottles, metals, timber, general household waste and and a car door with soft black brown clay. *0.60m bgl to 4.0m bgl Engineer notes strong unidentified odour.* End of Pit at 4.00m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.0m bgl due to obstruction - assumed boulder.

FASSAROE Trial Pit
Photographic Record





Number:	**TP06**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP06**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP07
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723831.84 - 718416.68 **Level:** 70.03	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.60	69.43		(MADE GROUND) Topsoil
	3.00	ES		4.50	65.53		(MADE GROUND) Waste described as rubber tyres, plastic refuse, paper, glass, tin cans, toys, wire and other metals and textiles with soft black brown clay. End of Pit at 4.50m

1
2
3
4
5

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP07**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record



Number:	**TP07**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP08
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723833.74 - 718361.20 **Level:** 73.40	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.60	72.80		(MADE GROUND) Topsoil
							(MADE GROUND) Blue grey silty Sand with waste described as; black refuse bags, metals, paper, timber, tin cans, glass bottles, plastic and textiles.
							From 1.50m bgl waste increases.
	2.00	ES					
				4.50	68.90		End of Pit at 4.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.0m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP08**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record



Number:	**TP08**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP09
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723908.99 - 718418.51 **Level:** 64.87	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.50	64.37		(MADE GROUND) Waste described as plastics, timber, textiles, glass bottles, paper, metals, and general household waste in a matric of soft black clay. *0.50m bgl to 4.50m bgl Engineer notes strong unidentified odour.*
▼	3.00	ES					
				4.50	60.37		End of Pit at 4.50m

1
2
3
4
5

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: GW (Possible leachate) strike @ 1.50m bgl. Flowrate: trickle.

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP09**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP09**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP10
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723909.82 - 718348.09 **Level:** 69.45	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.40	69.04		(MADE GROUND) Soft to firm brown grey very sandy Silt. Sand is fine to coarse.
				0.70	68.74		(MADE GROUND) Waste described as plastics, cardboard, timber, glass, textiles, tin cans in a silty sandy matric. *0.70m bgl to 4.50m bgl Engineer notes strong unidentified odour.*
▼	2.50	ES					
				3.50	65.94		Loose grey slightly gravelly SAND. Gravel is fine to coarse and sub-angular to rounded. Sand is medium to coarse. (Possible natural ground)
	4.00	ES					
				4.50	64.94		End of Pit at 4.50m

1 2 3 4 5

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: GW (Possible leachate) strike @ 1.20 mbgl. Flowrate: slow

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP10**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP10**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP11
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723982.10 - 718386.82 **Level:** 65.94	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUNDTopsoil
				0.60	65.34		(MADE GROUNDFirm grey sandy Silt. Sand is fine to coarse.
				0.80	65.14		*0.60m bgl to 4.50m bgl Engineer noted strong unidentified odour.*
							(MADE GROUND) Waste described as plastics, metals, glass, timber, paper, cardboard, styrofoam, general household waste and car wheel. Waste dated from 1985.
				1.30	64.64		(MADE GROUND) Grey very sandy SILT. Sand is fine to medium.
	2.00	ES		2.00	63.94		(MADE GROUND) Waste described as plastics, metals, glass, timber, paper, cardboard, styrofoam, general household waste and car wheel in a very sandy Silt matrix.
				4.50	61.44		End of Pit at 4.50m

Stability: Good
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP11**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
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Number:	**TP11**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP12
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723414.49 - 718450.11 **Level:** 95.19	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 2.50	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Soft brown sandy Silt. with high content of waste described as concrete, red bricks, steel parts, concrete posts, re-bar and concrete, tarmac, timber and slings
				1.00	94.19		(MADE GROUNDGrey silty Sand.
				1.50	93.69		(MADE GROUND) Soft brown sandy Silt. with high content of waste described as concrete, red bricks, steel parts, concrete posts, re-bar and concrete, tarmac, timber and slings.
	2.50	ES					
				4.50	90.69		End of Pit at 4.50m

Stability: Moderate to poor
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP12**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
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Number:	**TP12**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP13
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723458.97 - 718444.41 **Level:** 96.12	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Soft black slightly sandy , slightly gravelly Silt with some large blocks of concrete up to 1m in size and some red brick.
							Engineer noted slight hydrocarbon odour within the pit.
				1.80	94.32		(MADE GROUND) Waste described as plastics, paper, glass, medical waste, (e.g. syringes) textiles, and polystyrene within a grey silty sandy matrix.
	2.50	ES					
				4.50	91.62		End of Pit at 4.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP13**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP13**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP14
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723414.97 - 718423.27 **Level:** 95.65	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.50 x 2.00	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Waste described as large concrete slabs (approximately 1m in size), polystyrene, red bricks and re-bar within a sandy Silt. Sand is fine to coarse.
				1.50	94.15		(MADE GROUND) Waste described as plastics, glass, metals, tin cans and paper. Waste dated back to 1976.
	3.00	ES					
				4.50	91.15		End of Pit at 4.50m

1 2 3 4 5

Stability: Poor
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP14**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP14**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP15
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723447.72 - 718424.38 **Level:** 96.27	**Date** 08/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.40	95.87		(MADE GROUND) Soft black slightly sandy, slightly gravelly Silt. Sand is fine to coarse. Gravel is fine to coarse and sub-angular.
				0.90	95.37		(MADE GROUND) Soft brown slightly sandy, slightly gravelly Silt. Sand is fine to coarse. Gravel is fine to coarse and sub-angular.
				1.50	94.77		(MADE GROUND) Waste described as plastics, metals, textiles and polystyrene.
	2.00	ES					
				3.00	93.27		Grey slightly gravelly, sandy SILT. Sand is fine to coarse. (Possible natural ground) *3.0m bgl to 4.50m bgl Difficult to determine if material natural as walls of pit were collapsing.*
	4.50	ES		4.50	91.77		End of Pit at 4.50m

Stability: Moderate to poor
Plant: 13t tracked machine
Backfill: Arising

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP15**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
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Number:	**TP15**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP16
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723014.00 - 718380.99 **Level:** 92.17	**Date** 09/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.60	91.57		(MADE GROUND) Soft grey slightly sandy, slightly gravelly Clay. Sand is fine to coarse. Gravel is fine to coarse and sub-angular to sub-rounded. *0.60m bgl to 4.50m bgl Engineer noted strong unidentified odour.*
				1.40	90.77		(MADE GROUND) Waste described as plastics, glass, textiles, household waste, timber, rubber tyres and small amount of steel shavings and small amount of tarmcadam in a dark grey slightly gravelly Clay matrix. Waste dated to 1995.
	3.00	ES					
				4.50	87.67		End of Pit at 4.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP16**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
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Number:	**TP16**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP17
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723040.13 - 718358.27 **Level:** 93.52	**Date** 09/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.60	92.92		(MADE GROUND) Soft grey sandy Clay. *0.60m bgl to 4.500m bgl Engineer notes strong unidentified odour.*
				0.90	92.62		(MADE GROUND) Waste described as household waste, plastics, glass, metals, and timber.
				4.50	89.02		End of Pit at 4.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP17**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
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Number:	**TP17**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP18
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723014.33 - 718340.98 **Level:** 93.96	**Date** 09/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.50 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	93.76		(MADE GROUND) Topsoil
							(MADE GROUND) Firm dark grey gravelly Clay. Gravel is fine to coarse and sub-angular to sub-rounded.
				1.10	92.86		(MADE GROUND) Waste described as plastics, rope, mattress, glass, paper, timber, textiles, household waste, shoes, coins and bones. Waste dated from 1992.
							1.10m bgl to 4.50m bgl Engineer noted strong unidentified odour
	1.50	ES					
				4.50	89.46		End of Pit at 4.50m

1 2 3 4 5

Stability: Good
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None enountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP18**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP18**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP19
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 723059.40 - 718333.16 **Level:** 92.69	**Date** 09/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	92.39		(MADE GROUND) Topsoil
							(MADE GROUND) Firm grey slightly gravelly, sandy Clay. *0.30m bgl to 4.50m bgl Engineer described strong unidentified odour*
				0.90	91.79		(MADE GROUND) Waste described as plastics, household waste, glass, timber, textiles including rugs, rubber tyres and pipes.
	2.00	ES					
				4.50	88.19		End of Pit at 4.50m

1 2 3 4 5

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP19**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
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Number:	**TP19**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP20
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722705.01 - 718384.46 **Level:** 105.13	**Date** 10/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	105.03		(MADE GROUND) Topsoil
							(MADE GROUND) Grey firm slightly gravelly, sandy Silt with occasional plastic fragments. Gravel is fine to coarse and sub-angular. Sand is fine to coarse. *0.10m bgl to 4.50m bgl Engineer notes slight unidentified odour.*
				1.20	103.93		(MADE GROUND) Slightly gravelly, silty Sand. Gravel is fine to coarse and sub-rounded. Sand is fine to coarse.
				2.10	103.03		(MADE GROUND) Waste described as household waste in a sandy Silt matric. Sand is fine to medium. Engineer describes more Silt content than waste content.
	4.00	ES					
				4.50	100.63		End of Pit at 4.50m

Stability: Good
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.5m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP20**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP20**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP21
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722764.01 - 718385.63 **Level:** 103.15	**Date** 10/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Firm dark grey slightly gravelly, sandy Silt. Gravel is fine to coarse and sub-rounded. Sand is fine to coarse.
				1.00	102.15		(MADE GROUND) Firm grey very sandy Silt with occasional plastic fragments. Sand is fine to coarse.
				2.20	100.95		(MADE GROUND) Waste described as rubber, glass, paper and household waste. *2.20m bgl to 4.50m bgl Engineer noted strong unidentified odour*
	3.00	ES					
				4.50	98.65		End of Pit at 4.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP21**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP21**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP22
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722808.05 - 718372.09 **Level:** 102.30	**Date** 10/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.50 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Topsoil
				0.50	101.80		Grey slightly gravelly, very silty Sand. Gravel is fine to coarse and sub-angular to sub-rounded. Sand is fine to medium.
							At 1.10m bgl thin layer of plastics
	1.50	ES					
				2.60	99.70		Soft grey slightly gravelly, very sandy SILT. Gravel is fine to coarse and sub-angular. Sand is fine to coarse.
				3.60	98.70		Soft grey slightly gravelly, very sandy SILT with peat lenses. Gravel is fine to coarse and sub-angular. Sand is fine to coarse.
				4.50	97.80		End of Pit at 4.50m

1 2 3 4 5

Stability: Good
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountere

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP22**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
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Number:	**TP22**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP23
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722761.86 - 718310.22 **Level:** 103.65	**Date** 09/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	103.45		(MADE GROUND) Topsoil
				0.50	103.15		(MADE GROUND) Firm grey gravelly Clay.
				1.00	102.65		(MADE GROUND) Waste described as plastics, paper, metal, textiles, footwear and general household waste with low clay content. *0.50m bgl to 4.50m bgl Engineer noted strong unidentified odour.*
				1.70	101.95		(MADE GROUND) Grey sandy Silt. Sand is fine to coarse.
▼	2.50	ES					(MADE GROUND) Waste described as plastics, paper, metal, textiles, footwear and general household waste.
				4.50	99.15		End of Pit at 4.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: GW (Possible leachate) strike at 4.0m bgl. Flowrate: slow.

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP23**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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FASSAROE Trial Pit
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Number:	**TP23**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP24
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722687.96 - 718312.14 **Level:** 105.53	**Date** 10/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.60	104.93		(MADE GROUND) Waste described as car tyre, plastics, perspex, metals, wire, paper and household waste in a black clay matrix. *0.60m bgl to 4.50m bgl Engineer noted slight unidentified odour*
▼	2.00	ES					
				4.50	101.03		End of Pit at 4.50m

1 2 3 4 5

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: GW (possible leachate) strike @ 3.0m bgl. Flowrate: slow

Remarks: Trial pit terminated at 4.45m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP24**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP24**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

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Trial Pit No
TP25
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722707.43 - 718045.32 **Level:** 100.98	**Date** 10/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20 **Depth:** 4.50	**Scale** 1:25
Client: RPS			**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	100.68		(MADE GROUND) Topsoil
							(MADE GROUND) Firm blue/grey slightly gravelly, sandy Silt. Gravel is fine to coarse and sub-angular. Sand is fine to coarse. *0.30m bgl to 4.50m bgl Engineer noted strong unidentified odour.*
				0.80	100.18		(MADE GROUND) Waste described as household waste, plastics, glass, paper, timber, textiles and footwear with some slightly gravelly very sandy Silt. Waste dates to 1992.
	2.50	ES					
				4.50	96.48		End of Pit at 4.50m

Stability: Good
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP25**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Photographic Record





Number:	**TP25**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP26
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722708.27 - 718080.97 **Level:** 99.72	**Date** 10/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	99.32		(MADE GROUND) Topsoil
				1.20	98.52		(MADE GROUND) Firm grey gravelly Silt.
	2.50	ES		4.50	95.22		(MADE GROUND) Waste described as plastics, household refuse, paper, metals, timber and textiles.
							End of Pit at 4.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP26**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record





Number:	**TP26**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No
TP27
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722758.68 - 718109.21 **Level:** 99.54	**Date** 10/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 4.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	99.14		Topsoil
				0.90	98.64		Grey blue sandy GRAVEL. Gravel is fine to coarse and sub-rounded.
	2.50	ES		4.50	95.04		Brown slightly gravelly SAND. Gravel is fine to coarse and sub-rounded. Sand is fine to medium.
							End of Pit at 4.50m

Stability: Good
Plant: 13t tracked machine
Backfill: Arisings

Groundwater: None encountere

Remarks: Trial pit terminated at 4.50m bgl at the maximum reach of the digger.

FASSAROE Trial Pit
Photographic Record





Number:	**TP27**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

FASSAROE Trial Pit
Photographic Record



Number:	**TP27**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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Trial Pit No **TP28**
Sheet 1 of 1

Project Name: Fassaroe Historic Landfills	**Project No.** P15180	**Co-ords:** 722757.06 - 718081.29 **Level:** 99.58	**Date** 10/12/2015
Location: Co. Wicklow		**Dimensions (m):** 4.00 x 1.20	**Scale** 1:25
Client: RPS		**Depth:** 3.50	**Logged** DM

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							(MADE GROUND) Topsoil
				0.40	99.18		(MADE GROUND) Grey gravelly Clay. Gravel is fine to coarse and sub-angular. *0.40m bgl to 3.50m bgl Engineer noted strong unidentified odour*
				0.70	98.88		(MADE GROUND) Waste described as plastics, paper, household waste, copper, glass and textiles.
	2.00	ES					
				3.50	96.08		End of Pit at 3.50m

Stability: Moderate
Plant: 13t tracked machine
Backfill: Arising

Groundwater: Surface water in field flowed into pit during excavation. Refer to trial pit photograph for details.

Remarks: Trial pit terminated at 3.50m bgl due to surface water that filled pit.

FASSAROE Trial Pit
Photographic Record





Number:	**TP28**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
		Engineer	RPS Consulting	

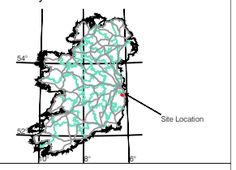
FASSAROE Trial Pit
Photographic Record





Number:	**TP28**	**Project**	Fassaroe Co. Wicklow	
		Project No	P15180	
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FASSAROE Co. Wicklow

Sheet Title:

EXPLORATORY LOCATION LAYOUT

JOB NUMBER:

P15180

DRAWING NUMBER:

P15180-SI-A

DRAWN BY:

Gary Curtin

DATE:

11/12/2015

SCALE:

1:5,000 ON A3

APPROVED:

GH

REVISION:

D01

pgl priority geotechnical

SI-01

SI-02

inset

Site 1

Site 2

Site 3A

Site 3B

Site 3C

Golf Course

Church (in Ruins)

St Kevin's Well

Berryfield

Enniskerry Youth Club Berryfield Park

Sports Ground

Sports Ground (All-weather)

Sports Ground

FASSAROE

Lake

Silo

ASTERY

kerry

Site 1

Site 2

Inset

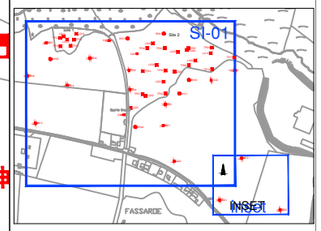
Sports Ground

TP00 Denotes Trial Pit location

BH00 Denotes Borehole location

G00 Denotes Gas monitoring Borehole location

LG00 Denotes Leachate/Gas monitoring Borehole location



JOB NAME:

FASSAROE Co. Wicklow

Sheet Title:

EXPLORATION LOCATION PLAN
Site 1 & 2

JOB NUMBER:

P15180

DRAWING NUMBER:

P15180-SI-01

DRAWN BY:

Gary Curtin

DATE:

11/12/2015

SCALE:

1:2000 ON A3

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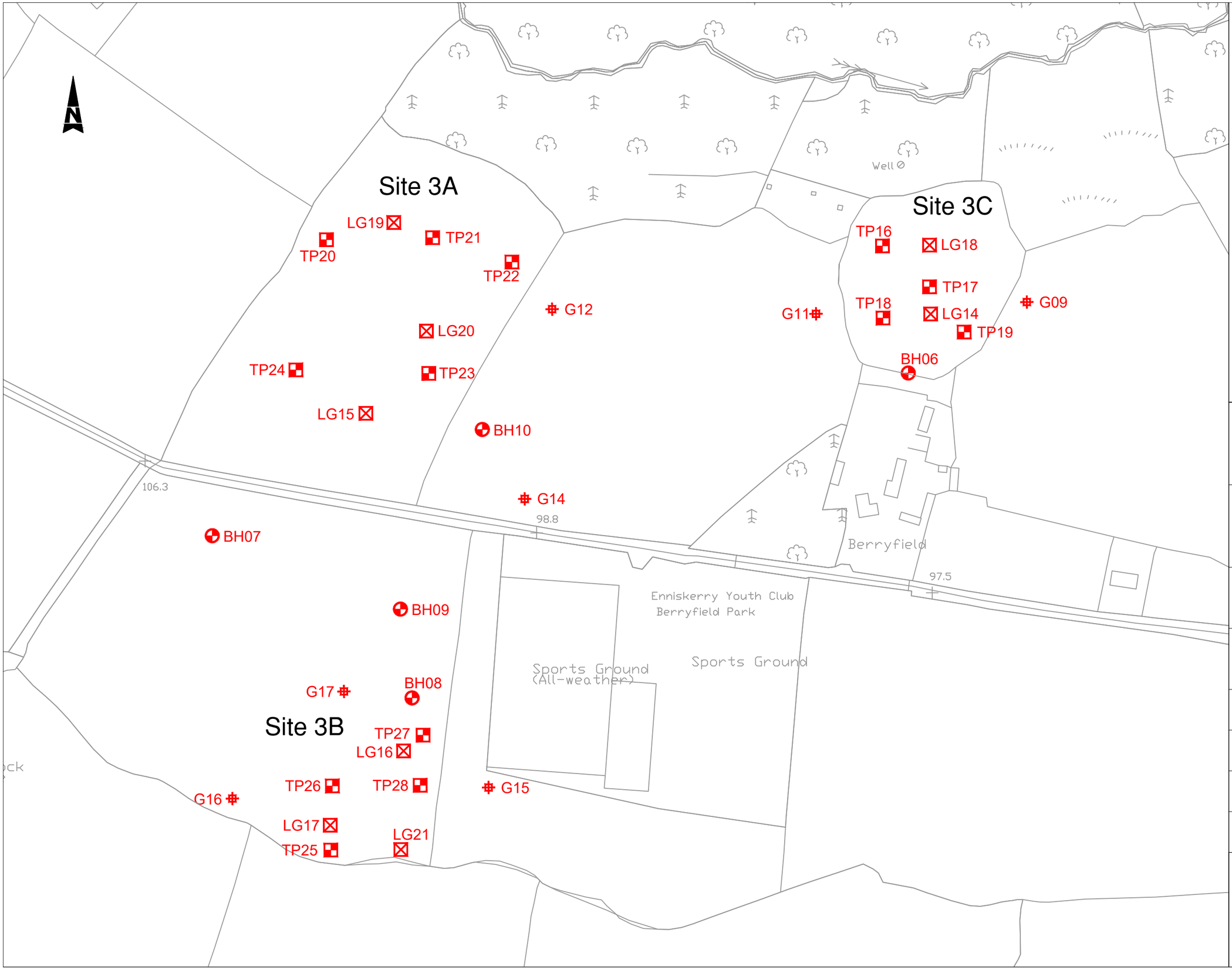
GH

REVISION:

D01

For Here See Inset

pgl priority geotechnical



KEY:

- TP00 Denotes Trial Pit location
- BH00 Denotes Borehole location
- G00 Denotes Gas monitoring Borehole location
- LG00 Denotes Leachate/Gas monitoring Borehole location

JOB NAME:

FASSAROE Co. Wicklow

Sheet Title:

EXPLORATION LOCATION PLAN

JOB NUMBER:

P15180

DRAWING NUMBER:

P15180-SI-02

DRAWN BY:

Gary Curtin

DATE:

11/12/2015

SCALE:	APPROVED:
1:2000 ON A3	GH

REVISION:

D01

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APPENDIX E

Laboratory Correspondence

ROUND 1

The laboratory utilised for analysis of water and leachate samples analysed a number of parameters outside of the sample stability period including the following parameters: aluminium, ammonia, barium, boron, cadmium, calcium, chromium, copper, iron, lead, manganese, nickel, potassium, sodium, vanadium, zinc, total suspended solids (TSS), total organic carbon (TOC), extractible hydrocarbons (EH), volatile organic carbons (VOC), polyaromatic hydrocarbons (PAH) and phenols. The detection limit for the following parameters was affected by interference with an internal standard: metals, naphthalene, PAH, chloromethane. Some parameters were also affected due to the sediment load in the sample including ammonia, chloride, nitrite, TON, phosphate, sulphate, VOC, EH and selenium. The samples affected by these laboratory issues include: BH1, BH5, BH6, BH7, BH8, BH9, BH10, G20, LG01, LG03, LG07, LG09, LG10, LG11, LG14, LG15, LG17, LG19, LG50, MW2, MW4, SP1, SP2, SP3, SP4, SP5, SW1, SW2, SW3, SW4 and SW5. A full description of the laboratory correspondence is presented in in Appendix E).

Ref: QRY 16/37

Mr Gerry Baker
RPS Aquaterra,
West Pier Business Park,
Dun Laoghaire,
Dublin

29th April 2016

Dear Mr. Booker

Reference QRY 16/37: Stability comments for jobs 1263263, 1266038, 1266423, 1268041 and 1268418.

Following your recent query into stability comments, we would like to take this opportunity to apologise for any inconvenience this may have caused you. ALS Environmental has completed an investigation and the findings are summarised below.

Suspended solid stability comments Jobs 1266423 and 1268041

All samples in job 1266423 have stability comments for suspended solids. These samples were analysed within stability, however the analyst entered the results the following day which was passed the stability date. The analyst did not select the correct analysis date when entering the samples, so a stability comment was entered in error. Job 1268041, sample 15193760 has a stability comment for suspended solids. The sample was tested within stability but the analyst repeated the analysis to confirm the result. The repeat was carried out outside of stability and it confirmed the original result. In error the analyst reported the repeat result instead of the original. Job 1266423 will be reissued with the suspended solids stability comments removed. Sample 15193760 will be reissued with the result amended to 1000mg/l and the stability comment removed. To stop this happening again the analyst has been made aware of the errors and reminded of the importance of entering the correct date.

TOC stability comments jobs 1266038, 1266423, 1268041 and 1268418

Samples 15180193 to 196 (job 1266038) was tested within stability times for TOC but these results could not be reported due to quality failure. The samples were repeated but unfortunately the repeat analysis was outside of stability times. Samples 15182886 job 1266423, 15193759 job 1268041 and 15196541 job 1268418 were tested within stability but these results could not be reported as the samples were outside the range of the method. The samples were repeated but these repeats were outside of stability.

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No. 4398
Certificate No. GB97/10269
Environmental Management Systems
Certificate No. FS 67435
Certificate No. OHS 542058

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Before testing the samples the analyst has to select what dilution to carry out on the samples. For these samples the analyst selected the incorrect dilutions. To address this, the analyst has been made aware of the impact of this error.

Ammoniacal Nitrogen stability comments jobs 1266423 and 1268418

Samples 15196538, 39, 40 (job 1268418) and 15182885 (job 1266423) were first tested for Ammoniacal Nitrogen within stability but these samples were over the range for the method they had been booked in for. This triggered analysis via a different method but this second method was carried out, outside of stability. We have three methods for the analysis of Ammoniacal Nitrogen covering different concentration ranges. If a sample is outside the range of the select method testing via a different method, it is automatically triggered. We aim to carry out the trigger analysis within stability but this is not always possible due to the short stability time of Ammoniacal Nitrogen. When requesting Ammoniacal Nitrogen analysis and you have information regarding expected ranges, please can you make your Customer Services Coordinator aware. This will help us select the most suitable method for the sample.

Metals stability comments jobs 1263263, 1266038, 1266423, 1268041 and 1268418

Jobs 1263263, 1266038, 1266423, 1268041 and 1268418 all have some samples with stability comments for some metals determinands. These determinands were tested within stability but could not be reported due to quality failures. The repeat analysis was carried out outside of the stability times. The delays in carrying out the repeat analysis, was due to instrument breakdowns. These issues have now been resolved.

PAH and EH stability comments jobs 1266038, 1266423, 1268041 and 1268418

Samples in jobs 1266038, 1266423, 1268041 and 1268418 have stability comments for PAH. Towards the end of March, we identified some STL 33 bottles were contaminated. This impacted any Naphthalene analysis. The investigation into this issue caused a delay in the extraction of samples and as a result jobs 1266038, 1266423,

1268041 and 1268418 were analysed outside of stability. EH and PAH are extracted together, so the delay also caused jobs 1266038 and 1266423 to be extracted outside of stability times for EH. To address this issue all new batches of PAH bottles will be blank tested before use.

VOC stability comments jobs 1263263, 1266038 and 1266423

Jobs 1266038 and 1266423 were tested outside of stability times for VOCs due to an instrument breakdown, which caused a backlog. This instrument failure was resolved and a new method is being developed to increase capacity and minimise the impact of this type of failure in the future. The samples in job 1263263 were analysed within stability times for VOC but a stability comment has been added in error. Report 1263263 will be reissued with VOC stability comment removed.

Phenol stability comments jobs 1263263, 1268041 and 1268418

Jobs 1263263, 1268041 and 1268418 were tested outside of stability for Phenols due to quality control failures. Analytical quality control failures caused a backlog which resulted in these jobs not being tested within stability times for Phenols. ALS endeavour to test all samples within stability but this is not always possible following quality control failures.

Once again, please accept our sincere apologies for these issues and the inconvenience that it has caused. Please be assured of ALS Environmental's commitment to delivering high quality service at all times. If you have any further queries, please do not hesitate to contact your customer Services Coordinator on 024 7642 1213.

Yours Sincerely,

A I Horobin

Andrew Horobin
Organic Chemistry Operations Manager

APPENDIX F

WAC Results

Contaminant	No. of samples		Range (mg/kg)	No. of samples below detection limit	WAC (mg/kg)		No. of samples exceeding WAC		Location and Depth (mbgl)
pH	28	5	7.4 - 8.7	0	Non- hazardous	>6	28	Site 1	TP12 (2.5); TP13 (2.5); TP14 (3); TP15 (2); TP15 (4.5)
		10						Site 2	TP1 (2.7); TP2 (3.5); TP3 (2); TP3 (4.2); TP5 (3); TP6 (2); TP7 (3); TP8 (2); TP10 (2.5); TP10 (4)
		5						Site 3A	TP20 (4); TP21 (3); TP22 (1.5); TP23 (2.5); TP24 (2)
		4						Site 3B	TP25 (2.5); TP26 (2.5); TP27 (2.5); TP28 (2)
		4						Site 3C	TP16 (3); TP17 (2.5); TP18 (1.5); TP19 (2)
Total Organic Carbon	28	5	<0.2 - 8.6	20	Inert		7	Site 1	TP13 (2.5); TP15 (2)
		10						Site 2	TP3 (2); TP6 (2)
		5						Site 3A	TP23 (2.5)
		4						Site 3B	TP25 (2.5)
		4						Site 3C	TP17 (2.5)
		4		27	Hazardous		1	Site 3C	TP18 (1.5)
Antimony	28	5	<0.01 - 1.0	17	Inert	0.06	9	Site 1	TP15 (4.5)
		10						Site 2	TP2 (3.5); TP7 (3)
		5						Site 3A	TP21 (3); TP23 (2.5)
		4						Site 3B	TP25 (2.5); TP26 (2.5)
		4						Site 3C	TP17 (2.5); TP19 (2.5)
		5		26	Non- hazardous	0.7	2	Site 1	TP13 (2.5)
		4						Site 3C	TP18 (1.5)
Total PCBs (7 Congeners)	28	5	<0.10 - 1.9	27	Inert	1	1	Site 1	TP14 (3)
Sulphate	28	5	10 - 5900	23	Inert	1000	5	Site 1	TP14 (3)
		10						Site 2	TP1 (2.7); TP3 (2); TP8 (2)
		5						Site 3A	TP24 (2)
Molybdenum	28	10	<0.05 - 0.71	21	Inert	0.5	7	Site 2	TP1 (2.7); TP2 (3.5); TP7 (3)
		5						Site 3A	TP21 (3)
		4						Site 3B	TP26 (2.5)
		4						Site 3C	TP16 (3); TP18 (1.5)
Total Dissolved Solids	28	10	610 - 15,000	23	Inert	4000	4	Site 2	TP3 (2); TP8 (2)
		5						Site 3A	TP24 (2)
		4						Site 3C	TP18 (1.5)
Loss on Ignition	28	5	0.93 - 13	27	Hazardous	10	1	Site 3A	TP23 (2.5)
Lead	28	5	<0.010 - 1.8	26	Inert	0.5	2	Site 3A	TP23 (2.5)
		4						Site 3C	TP18 (1.5)
TPH Total WAC (Mineral Oil)	28	5	<10 - 1,200	23	Inert	500	5	Site 3A	TP24 (2)
		4						Site 3B	TP25 (2.5); TP26 (2.5)
		4						Site 3C	TP17 (2.5); TP18 (1.5)
Mercury	28	4	<0.005 - 0.028	27	Inert	0.01	1	Site 3C	TP18 (1.5)
Nickel	28	4	<0.05 - 1.3	27	Inert	0.4	1	Site 3C	TP18 (1.5)
Selenium	28	4	<0.01 - 0.13	27	Inert	0.1	1	Site 3C	TP18 (1.5)
Chloride	28	4	<10 - 3,000	27	Inert	800	1	Site 3C	TP18 (1.5)

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29156								
Chemtest Sample ID:	231389								
Sample Ref:									
Sample ID:	TP12						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	2.50								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.0	3	5	6
Loss On Ignition	2610	U	%			3.7	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			25	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.4	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.079	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.0019	0.0013	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.046	0.022	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00017	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0017	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0042	0.0032	< 0.050	< 0.050	2	50	100
Mercury	1450	U	0.00090	0.00057	0.0018	0.0061	0.01	0.2	2
Molybdenum	1450	U	0.016	0.0097	< 0.050	0.11	0.5	10	30
Nickel	1450	U	0.0016	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0018	0.0011	< 0.010	0.012	0.06	0.7	5
Selenium	1450	U	0.0020	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0031	0.0079	< 0.50	< 0.50	4	50	200
Chloride	1220	U	3.3	1.3	< 10	16	800	15000	25000
Fluoride	1220	U	0.34	0.29	< 1.0	3.0	10	150	500
Sulphate	1220	U	48	8.8	95	140	1000	20000	50000
Total Dissolved Solids	1020	N	190	96	370	1100	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	16	10	< 50	110	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	16

Leachate Test Information	
Leachant volume 1st extract/l	0.317
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.233

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29156						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	231390								
Sample Ref:									
Sample ID:	TP13								
Top Depth(m):	2.50								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			4.1	3	5	6
Loss On Ignition	2610	U	%			8.7	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				7.6	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.013	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.0075	0.0086	< 0.050	0.084	0.5	2	25
Barium	1450	U	0.025	0.011	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.012	0.012	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.015	0.010	< 0.050	0.11	0.5	10	30
Nickel	1450	U	0.0023	0.0022	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	0.0011	0.014	< 0.010	0.13	0.5	10	50
Antimony	1450	U	0.14	0.10	0.27	1.0	0.06	0.7	5
Selenium	1450	U	0.0012	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0072	0.011	< 0.50	< 0.50	4	50	200
Chloride	1220	U	5.1	1.7	< 10	20	800	15000	25000
Fluoride	1220	U	0.23	0.25	< 1.0	2.5	10	150	500
Sulphate	1220	U	44	12	86	150	1000	20000	50000
Total Dissolved Solids	1020	N	210	110	410	1200	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	18	29	< 50	280	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	21

Leachate Test Information	
Leachant volume 1st extract/l	0.304
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.181

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29156								
Chemtest Sample ID:	231391								
Sample Ref:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	TP14								
Top Depth(m):	3.00								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			2.5	3	5	6
Loss On Ignition	2610	U	%			7.0	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			1.9	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			18	100	--	--
pH	2010	U				7.4	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.053	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at l**		
Arsenic	1450	U	0.0032	0.0011	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.067	0.023	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0021	< 0.0010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0094	0.0073	< 0.050	0.075	0.5	10	30
Nickel	1450	U	0.0039	0.0011	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	0.0012	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0073	0.0017	0.014	0.024	0.06	0.7	5
Selenium	1450	U	0.0014	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.044	0.011	< 0.50	< 0.50	4	50	200
Chloride	1220	U	5.7	< 1.0	11	< 10	800	15000	25000
Fluoride	1220	U	0.17	0.24	< 1.0	2.3	10	150	500
Sulphate	1220	U	1100	150	2200	2700	1000	20000	50000
Total Dissolved Solids	1020	N	1000	300	1900	3900	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	19	16	< 50	160	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	20

Leachate Test Information	
Leachant volume 1st extract/l	0.306
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.218

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	232030								
Sample Ref:									
Sample ID:	TP15								
Top Depth(m):	2.00								
Bottom Depth(m):									
Sampling Date:	09-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			3.1	3	5	6
Loss On Ignition	2610	U	%			7.1	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			12	100	--	--
pH	2010	U				8.2	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0018	0.0021	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.034	0.016	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0015	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0051	0.0034	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.021	0.011	< 0.050	0.12	0.5	10	30
Nickel	1450	U	0.0014	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	0.0039	< 0.010	0.034	0.5	10	50
Antimony	1450	U	0.0019	0.0017	< 0.010	0.017	0.06	0.7	5
Selenium	1450	U	0.0013	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0032	0.0049	< 0.50	< 0.50	4	50	200
Chloride	1220	U	3.0	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.42	0.39	< 1.0	3.9	10	150	500
Sulphate	1220	U	26	6.4	51	87	1000	20000	50000
Total Dissolved Solids	1020	N	180	88	350	980	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	10	7.8	< 50	80	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	17

Leachate Test Information	
Leachant volume 1st extract/l	0.314
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.203

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330								
Chemtest Sample ID:	232031								
Sample Ref:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	TP15								
Top Depth(m):	4.50								
Bottom Depth(m):									
Sampling Date:	09-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.60	3	5	6
Loss On Ignition	2610	U	%			2.5	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.036	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0039	0.0035	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.047	0.020	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0019	0.0018	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.040	0.015	0.079	0.19	0.5	10	30
Nickel	1450	U	0.0019	0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0099	0.0077	0.020	0.080	0.06	0.7	5
Selenium	1450	U	0.0013	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0067	0.0019	< 0.50	< 0.50	4	50	200
Chloride	1220	U	2.4	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.13	0.13	< 1.0	1.3	10	150	500
Sulphate	1220	U	150	23	300	420	1000	20000	50000
Total Dissolved Solids	1020	N	300	100	600	1300	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	8.4	5.9	< 50	63	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	11

Leachate Test Information	
Leachant volume 1st extract/l	0.328
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.262

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149								
Chemtest Sample ID:	231348								
Sample Ref:									
Sample ID:	TP1						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	2.70								
Bottom Depth(m):									
Sampling Date:	07-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.4	3	5	6
Loss On Ignition	2610	U	%			4.7	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.022	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.015	0.0067	< 0.050	0.076	0.5	2	25
Barium	1450	U	0.086	0.041	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00033	0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0020	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0049	0.0017	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.16	0.041	0.31	0.54	0.5	10	30
Nickel	1450	U	0.012	0.0049	< 0.050	0.057	0.4	10	40
Lead	1450	U	0.0053	0.0022	0.010	0.025	0.5	10	50
Antimony	1450	U	0.0065	0.0047	0.013	0.049	0.06	0.7	5
Selenium	1450	U	0.0047	0.0018	< 0.010	0.021	0.1	0.5	7
Zinc	1450	U	0.015	0.0068	< 0.50	< 0.50	4	50	200
Chloride	1220	U	45	5.8	88	100	800	15000	25000
Fluoride	1220	U	0.35	0.27	< 1.0	2.8	10	150	500
Sulphate	1220	U	310	80	610	1000	1000	20000	50000
Total Dissolved Solids	1020	N	720	270	1400	3200	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	38	17	75	190	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	17

Leachate Test Information	
Leachant volume 1st extract/l	0.313
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.189

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149								
Chemtest Sample ID:	231350								
Sample Ref:									
Sample ID:	TP2						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	3.50								
Bottom Depth(m):									
Sampling Date:	07-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.69	3	5	6
Loss On Ignition	2610	U	%			4.7	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.2	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.024	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.0094	0.0027	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.061	0.047	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00028	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0018	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.15	0.039	0.30	0.55	0.5	10	30
Nickel	1450	U	0.0075	0.0030	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0085	0.0063	0.017	0.066	0.06	0.7	5
Selenium	1450	U	0.0042	0.0018	< 0.010	0.021	0.1	0.5	7
Zinc	1450	U	0.013	0.0052	< 0.50	< 0.50	4	50	200
Chloride	1220	U	55	5.0	110	120	800	15000	25000
Fluoride	1220	U	0.26	0.21	< 1.0	2.2	10	150	500
Sulphate	1220	U	300	62	600	970	1000	20000	50000
Total Dissolved Solids	1020	N	790	260	1600	3400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	24	13	< 50	150	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	15

Leachate Test Information	
Leachant volume 1st extract/l	0.319
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.253

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149								
Chemtest Sample ID:	231349								
Sample Ref:									
Sample ID:	TP3						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	2.00								
Bottom Depth(m):									
Sampling Date:	07-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			3.5	3	5	6
Loss On Ignition	2610	U	%			7.3	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			27	100	--	--
pH	2010	U				8.4	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.0064	0.0038	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.083	0.10	< 0.50	0.97	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.010	0.0098	< 0.050	0.098	0.5	10	30
Nickel	1450	U	0.027	0.011	0.052	0.13	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0028	0.0028	< 0.010	0.028	0.06	0.7	5
Selenium	1450	U	0.0054	0.0018	0.010	0.023	0.1	0.5	7
Zinc	1450	U	0.045	0.021	< 0.50	< 0.50	4	50	200
Chloride	1220	U	7.3	3.1	14	36	800	15000	25000
Fluoride	1220	U	0.078	0.14	< 1.0	1.3	10	150	500
Sulphate	1220	U	1400	370	2800	5100	1000	20000	50000
Total Dissolved Solids	1020	N	1300	560	2500	6500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	28	20	54	210	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	22

Leachate Test Information	
Leachant volume 1st extract/l	0.302
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.228

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149								
Chemtest Sample ID:	231347								
Sample Ref:									
Sample ID:	TP3						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	4.20								
Bottom Depth(m):									
Sampling Date:	07-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.38	3	5	6
Loss On Ignition	2610	U	%			2.2	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.4	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.026	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.0094	0.0032	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0024	0.0037	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0034	0.0014	< 0.50	< 0.50	4	50	200
Chloride	1220	U	2.3	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.22	0.20	< 1.0	2.0	10	150	500
Sulphate	1220	U	8.6	< 1.0	17	11	1000	20000	50000
Total Dissolved Solids	1020	N	110	54	220	610	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	12	9.2	< 50	95	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	9.8

Leachate Test Information	
Leachant volume 1st extract/l	0.331
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.223

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	231353								
Sample Ref:									
Sample ID:	TP5								
Top Depth(m):	3.00								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.42	3	5	6
Loss On Ignition	2610	U	%			2.8	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			52	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.2	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.045	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.0080	0.0038	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0017	< 0.0010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0014	0.0029	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0040	0.0014	< 0.50	< 0.50	4	50	200
Chloride	1220	U	2.9	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.20	0.22	< 1.0	2.2	10	150	500
Sulphate	1220	U	8.3	< 1.0	16	10	1000	20000	50000
Total Dissolved Solids	1020	N	120	63	240	700	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	15	12	< 50	120	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	15

Leachate Test Information	
Leachant volume 1st extract/l	0.319
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.211

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149								
Chemtest Sample ID:	231354								
Sample Ref:									
Sample ID:	TP6								
Top Depth(m):	2.00								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%			4.8	3	5	6
Loss On Ignition	2610	U	%			8.3	--	--	10
Total BTEX	2760	U	mg/kg			0.014	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			40	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.038	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at l**		
Arsenic	1450	U	0.011	0.0050	< 0.050	0.057	0.5	2	25
Barium	1450	U	0.041	0.022	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00022	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0030	0.0014	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.096	0.025	0.19	0.33	0.5	10	30
Nickel	1450	U	0.015	0.0063	< 0.050	0.073	0.4	10	40
Lead	1450	U	0.0097	0.0050	0.019	0.055	0.5	10	50
Antimony	1450	U	0.0051	0.0046	0.010	0.046	0.06	0.7	5
Selenium	1450	U	0.0029	0.0014	< 0.010	0.016	0.1	0.5	7
Zinc	1450	U	0.016	0.0062	< 0.50	< 0.50	4	50	200
Chloride	1220	U	30	5.1	59	80	800	15000	25000
Fluoride	1220	U	0.46	0.32	< 1.0	3.4	10	150	500
Sulphate	1220	U	260	57	520	810	1000	20000	50000
Total Dissolved Solids	1020	N	680	250	1300	3000	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	42	19	82	220	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	17

Leachate Test Information	
Leachant volume 1st extract/l	0.313
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.208

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	231345								
Sample Ref:									
Sample ID:	TP7								
Top Depth(m):	3.00								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			2.3	3	5	6
Loss On Ignition	2610	U	%			5.7	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			24	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			32	100	--	--
pH	2010	U				8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.031	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.014	0.0056	< 0.050	0.064	0.5	2	25
Barium	1450	U	0.039	0.025	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00044	0.00011	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0020	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0032	0.0016	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.15	0.040	0.30	0.51	0.5	10	30
Nickel	1450	U	0.015	0.0045	< 0.050	0.055	0.4	10	40
Lead	1450	U	0.0017	0.0010	< 0.010	0.011	0.5	10	50
Antimony	1450	U	0.0061	0.0067	0.012	0.066	0.06	0.7	5
Selenium	1450	U	0.0039	0.0030	< 0.010	0.031	0.1	0.5	7
Zinc	1450	U	0.0068	0.0044	< 0.50	< 0.50	4	50	200
Chloride	1220	U	46	7.3	90	110	800	15000	25000
Fluoride	1220	U	0.31	0.21	< 1.0	2.2	10	150	500
Sulphate	1220	U	130	50	260	580	1000	20000	50000
Total Dissolved Solids	1020	N	550	240	1100	2700	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	27	15	53	160	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	17

Leachate Test Information	
Leachant volume 1st extract/l	0.315
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.177

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149								
Chemtest Sample ID:	231346								
Sample Ref:									
Sample ID:	TP8						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	2.00								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.99	3	5	6
Loss On Ignition	2610	U	%			3.1	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.021	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.0057	0.0018	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.081	0.077	< 0.50	0.77	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0015	< 0.0010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.020	0.0060	< 0.050	0.079	0.5	10	30
Nickel	1450	U	0.013	0.0063	< 0.050	0.072	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0025	0.0015	< 0.010	0.016	0.06	0.7	5
Selenium	1450	U	0.0038	0.0010	< 0.010	0.014	0.1	0.5	7
Zinc	1450	U	0.027	0.015	< 0.50	< 0.50	4	50	200
Chloride	1220	U	38	4.4	75	90	800	15000	25000
Fluoride	1220	U	0.16	0.15	< 1.0	1.5	10	150	500
Sulphate	1220	U	820	300	1600	3700	1000	20000	50000
Total Dissolved Solids	1020	N	1200	500	2400	5900	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	41	20	81	230	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	17

Leachate Test Information	
Leachant volume 1st extract/l	0.315
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.240

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149								
Chemtest Sample ID:	231351								
Sample Ref:									
Sample ID:	TP10						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	2.50								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.70	3	5	6
Loss On Ignition	2610	U	%			2.4	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.022	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.018	0.0075	< 0.050	0.088	0.5	2	25
Barium	1450	U	0.030	0.011	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00014	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0011	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0056	0.0026	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.045	0.0094	0.089	0.14	0.5	10	30
Nickel	1450	U	0.012	0.0036	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.012	0.0050	0.024	0.059	0.06	0.7	5
Selenium	1450	U	0.0019	0.0010	< 0.010	0.011	0.1	0.5	7
Zinc	1450	U	0.0046	0.0025	< 0.50	< 0.50	4	50	200
Chloride	1220	U	14	1.8	28	33	800	15000	25000
Fluoride	1220	U	0.29	0.21	< 1.0	2.2	10	150	500
Sulphate	1220	U	64	10	130	170	1000	20000	50000
Total Dissolved Solids	1020	N	290	120	570	1400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	24	11	< 50	130	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	16

Leachate Test Information	
Leachant volume 1st extract/l	0.317
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.221

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29149								
Chemtest Sample ID:	231352								
Sample Ref:									
Sample ID:	TP10						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	4.00								
Bottom Depth(m):									
Sampling Date:	08-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			< 0.20	3	5	6
Loss On Ignition	2610	U	%			0.93	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.013	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**for compliance EN 12457-3 at L**		
Arsenic	1450	U	0.0023	0.0015	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.020	0.0065	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0041	0.0028	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0062	0.0021	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	0.0032	0.0012	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0015	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0017	0.0012	< 0.010	0.013	0.1	0.5	7
Zinc	1450	U	0.0016	0.0013	< 0.50	< 0.50	4	50	200
Chloride	1220	U	1.7	1.1	< 10	12	800	15000	25000
Fluoride	1220	U	0.27	0.14	< 1.0	1.6	10	150	500
Sulphate	1220	U	8.6	< 1.0	17	14	1000	20000	50000
Total Dissolved Solids	1020	N	120	62	240	710	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	13	12	< 50	120	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	5.1

Leachate Test Information	
Leachant volume 1st extract/l	0.341
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.283

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330								
Chemtest Sample ID:	232044								
Sample Ref:									
Sample ID:	TP20						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	4.00								
Bottom Depth(m):									
Sampling Date:	10-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.46	3	5	6
Loss On Ignition	2610	U	%			2.3	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			86	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.031	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0046	0.0025	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.045	0.014	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0017	0.0011	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.026	0.013	0.051	0.15	0.5	10	30
Nickel	1450	U	0.0033	0.0014	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0038	0.0029	< 0.010	0.030	0.06	0.7	5
Selenium	1450	U	0.0014	0.0011	< 0.010	0.011	0.1	0.5	7
Zinc	1450	U	0.0026	< 0.0010	< 0.50	< 0.50	4	50	200
Chloride	1220	U	7.8	< 1.0	15	< 10	800	15000	25000
Fluoride	1220	U	0.17	0.15	< 1.0	1.5	10	150	500
Sulphate	1220	U	54	11	110	160	1000	20000	50000
Total Dissolved Solids	1020	N	250	98	490	1200	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	18	12	< 50	130	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	16

Leachate Test Information	
Leachant volume 1st extract/l	0.317
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.209

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	232043								
Sample Ref:									
Sample ID:	TP21								
Top Depth(m):	3.00								
Bottom Depth(m):									
Sampling Date:	10-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.6	3	5	6
Loss On Ignition	2610	U	%			4.2	--	--	10
Total BTEX	2760	U	mg/kg			0.012	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			290	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.035	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.020	0.0087	< 0.050	0.095	0.5	2	25
Barium	1450	U	0.027	0.028	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00036	0.00015	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0016	0.0011	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0066	0.0060	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.21	0.061	0.42	0.71	0.5	10	30
Nickel	1450	U	0.037	0.013	0.073	0.15	0.4	10	40
Lead	1450	U	0.0068	0.0071	0.014	0.071	0.5	10	50
Antimony	1450	U	0.021	0.012	0.042	0.13	0.06	0.7	5
Selenium	1450	U	0.0066	0.0027	0.013	0.030	0.1	0.5	7
Zinc	1450	U	0.015	0.013	< 0.50	< 0.50	4	50	200
Chloride	1220	U	150	21	290	300	800	15000	25000
Fluoride	1220	U	0.34	0.21	< 1.0	2.2	10	150	500
Sulphate	1220	U	140	57	280	630	1000	20000	50000
Total Dissolved Solids	1020	N	810	300	1600	3300	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	57	13	110	160	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	12

Leachate Test Information	
Leachant volume 1st extract/l	0.327
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.120

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330								
Chemtest Sample ID:	232042								
Sample Ref:									
Sample ID:	TP22						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	1.50								
Bottom Depth(m):									
Sampling Date:	10-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.41	3	5	6
Loss On Ignition	2610	U	%			2.0	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			140	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.023	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0017	0.0013	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.021	0.0087	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0035	0.0025	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0095	0.0071	< 0.050	0.074	0.5	10	30
Nickel	1450	U	0.0014	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	0.0017	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.0020	0.0013	< 0.010	0.014	0.06	0.7	5
Selenium	1450	U	0.0049	0.0019	< 0.010	0.023	0.1	0.5	7
Zinc	1450	U	0.0018	< 0.0010	< 0.50	< 0.50	4	50	200
Chloride	1220	U	2.8	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.15	0.16	< 1.0	1.6	10	150	500
Sulphate	1220	U	9.4	1.3	19	25	1000	20000	50000
Total Dissolved Solids	1020	N	160	73	320	850	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	15	14	< 50	140	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	14

Leachate Test Information	
Leachant volume 1st extract/l	0.323
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.250

Results - 2 Stage WAC

Chemtest Job No:	15-29330						**Landfill Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	232041								
Sample Ref:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	TP23								
Top Depth(m):	2.50								
Bottom Depth(m):									
Sampling Date:	09-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			4.5	3	5	6
Loss On Ignition	2610	U	%			13	--	--	10
Total BTEX	2760	U	mg/kg			0.015	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			3.1	100	--	--
pH	2010	U				7.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.011	0.0055	< 0.050	0.061	0.5	2	25
Barium	1450	U	0.095	0.056	< 0.50	0.60	20	100	300
Cadmium	1450	U	0.00031	0.00028	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.019	0.040	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.095	0.041	0.18	0.47	0.5	10	30
Nickel	1450	U	0.023	0.010	< 0.050	0.11	0.4	10	40
Lead	1450	U	0.033	0.063	0.062	0.59	0.5	10	50
Antimony	1450	U	0.049	0.042	0.092	0.42	0.06	0.7	5
Selenium	1450	U	0.0017	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.071	0.043	< 0.50	< 0.50	4	50	200
Chloride	1220	U	15	1.6	28	31	800	15000	25000
Fluoride	1220	U	0.21	0.23	< 1.0	2.3	10	150	500
Sulphate	1220	U	230	42	440	640	1000	20000	50000
Total Dissolved Solids	1020	N	500	180	940	2200	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	54	34	100	360	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	29

Leachate Test Information	
Leachant volume 1st extract/l	0.280
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.204

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330								
Chemtest Sample ID:	232032								
Sample Ref:									
Sample ID:	TP24						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	2.00								
Bottom Depth(m):									
Sampling Date:	10-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			2.7	3	5	6
Loss On Ignition	2610	U	%			5.9	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			1200	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			4.7	100	--	--
pH	2010	U				8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.039	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.010	0.0027	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.098	0.077	< 0.50	0.79	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0034	0.0017	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.057	0.025	0.11	0.29	0.5	10	30
Nickel	1450	U	0.030	0.0090	0.059	0.12	0.4	10	40
Lead	1450	U	0.0025	0.0026	< 0.010	0.026	0.5	10	50
Antimony	1450	U	0.0033	0.0030	< 0.010	0.030	0.06	0.7	5
Selenium	1450	U	0.0054	0.0013	0.011	0.018	0.1	0.5	7
Zinc	1450	U	0.031	0.016	< 0.50	< 0.50	4	50	200
Chloride	1220	U	71	7.7	140	150	800	15000	25000
Fluoride	1220	U	0.44	0.22	< 1.0	2.5	10	150	500
Sulphate	1220	U	860	230	1700	3000	1000	20000	50000
Total Dissolved Solids	1020	N	1200	440	2400	5300	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	61	21	120	260	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	17

Leachate Test Information	
Leachant volume 1st extract/l	0.313
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.208

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	232035								
Sample Ref:									
Sample ID:	TP25								
Top Depth(m):	2.50								
Bottom Depth(m):									
Sampling Date:	10-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			3.2	3	5	6
Loss On Ignition	2610	U	%			4.4	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			0.13	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			580	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			4.2	100	--	--
pH	2010	U				8.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.037	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.041	0.015	0.081	0.17	0.5	2	25
Barium	1450	U	0.043	0.017	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00069	0.00025	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0031	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.055	0.020	0.11	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.20	0.029	0.40	0.40	0.5	10	30
Nickel	1450	U	0.056	0.012	0.11	0.15	0.4	10	40
Lead	1450	U	0.012	0.015	0.024	0.15	0.5	10	50
Antimony	1450	U	0.058	0.014	0.12	0.17	0.06	0.7	5
Selenium	1450	U	0.012	0.0032	0.024	0.037	0.1	0.5	7
Zinc	1450	U	0.022	0.017	< 0.50	< 0.50	4	50	200
Chloride	1220	U	95	15	190	200	800	15000	25000
Fluoride	1220	U	0.48	0.21	< 1.0	2.3	10	150	500
Sulphate	1220	U	71	18	140	210	1000	20000	50000
Total Dissolved Solids	1020	N	630	190	1200	2200	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	48	16	95	180	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	14

Leachate Test Information	
Leachant volume 1st extract/l	0.322
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.109

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	232036								
Sample Ref:									
Sample ID:	TP26								
Top Depth(m):	2.50								
Bottom Depth(m):									
Sampling Date:	10-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.7	3	5	6
Loss On Ignition	2610	U	%			5.1	--	--	10
Total BTEX	2760	U	mg/kg			0.018	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			0.26	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			1000	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.4	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.035	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.028	0.0077	0.055	0.092	0.5	2	25
Barium	1450	U	0.019	0.020	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00046	0.00026	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0024	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.012	0.010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.17	0.040	0.33	0.50	0.5	10	30
Nickel	1450	U	0.070	0.020	0.14	0.24	0.4	10	40
Lead	1450	U	0.028	0.026	0.055	0.26	0.5	10	50
Antimony	1450	U	0.018	0.011	0.035	0.12	0.06	0.7	5
Selenium	1450	U	0.0035	0.0010	< 0.010	0.012	0.1	0.5	7
Zinc	1450	U	0.031	0.025	< 0.50	< 0.50	4	50	200
Chloride	1220	U	99	17	190	230	800	15000	25000
Fluoride	1220	U	0.36	0.23	< 1.0	2.4	10	150	500
Sulphate	1220	U	130	36	250	430	1000	20000	50000
Total Dissolved Solids	1020	N	810	260	1600	3000	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	75	23	150	270	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	17

Leachate Test Information	
Leachant volume 1st extract/l	0.313
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.133

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330								
Chemtest Sample ID:	232033								
Sample Ref:									
Sample ID:	TP27						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	2.50								
Bottom Depth(m):									
Sampling Date:	10-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			< 0.20	3	5	6
Loss On Ignition	2610	U	%			1.1	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.026	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.030	0.010	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0016	0.0010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0083	0.0056	< 0.050	0.061	0.5	10	30
Nickel	1450	U	0.0013	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0014	< 0.0010	< 0.50	< 0.50	4	50	200
Chloride	1220	U	2.5	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.24	0.17	< 1.0	1.8	10	150	500
Sulphate	1220	U	9.7	< 1.0	19	16	1000	20000	50000
Total Dissolved Solids	1020	N	120	52	240	640	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	8.2	5.4	< 50	59	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	7.7

Leachate Test Information	
Leachant volume 1st extract/l	0.335
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.296

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	232034								
Sample Ref:									
Sample ID:	TP28								
Top Depth(m):	2.00								
Bottom Depth(m):									
Sampling Date:	10-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.9	3	5	6
Loss On Ignition	2610	U	%			4.7	--	--	10
Total BTEX	2760	U	mg/kg			0.42	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			14	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			3.3	100	--	--
pH	2010	U				8.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.020	0.0077	< 0.050	0.093	0.5	2	25
Barium	1450	U	0.038	0.022	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00015	0.00014	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0041	0.0037	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.051	0.016	0.099	0.21	0.5	10	30
Nickel	1450	U	0.0096	0.0036	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	0.0036	0.0048	< 0.010	0.046	0.5	10	50
Antimony	1450	U	0.0038	0.0036	< 0.010	0.036	0.06	0.7	5
Selenium	1450	U	0.0016	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0088	0.0092	< 0.50	< 0.50	4	50	200
Chloride	1220	U	13	1.5	25	30	800	15000	25000
Fluoride	1220	U	0.22	0.19	< 1.0	1.9	10	150	500
Sulphate	1220	U	48	20	93	240	1000	20000	50000
Total Dissolved Solids	1020	N	390	160	760	1900	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	28	16	54	180	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	22

Leachate Test Information	
Leachant volume 1st extract/l	0.300
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.229

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	232040								
Sample Ref:									
Sample ID:	TP16								
Top Depth(m):	3.00								
Bottom Depth(m):									
Sampling Date:	09-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.3	3	5	6
Loss On Ignition	2610	U	%			4.5	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			230	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			3.1	100	--	--
pH	2010	U				7.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.032	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.026	0.0059	0.052	0.079	0.5	2	25
Barium	1450	U	0.054	0.026	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00042	0.00011	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0035	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0096	0.0035	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.22	0.038	0.44	0.56	0.5	10	30
Nickel	1450	U	0.035	0.0076	0.069	0.10	0.4	10	40
Lead	1450	U	0.021	0.0083	0.042	0.095	0.5	10	50
Antimony	1450	U	0.020	0.0080	0.040	0.092	0.06	0.7	5
Selenium	1450	U	0.0068	0.0010	0.014	0.016	0.1	0.5	7
Zinc	1450	U	0.015	0.0041	< 0.50	< 0.50	4	50	200
Chloride	1220	U	75	9.4	150	160	800	15000	25000
Fluoride	1220	U	0.35	0.23	< 1.0	2.4	10	150	500
Sulphate	1220	U	71	25	140	300	1000	20000	50000
Total Dissolved Solids	1020	N	610	210	1200	2500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	48	21	95	240	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	12

Leachate Test Information	
Leachant volume 1st extract/l	0.327
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.172

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330								
Chemtest Sample ID:	232038								
Sample Ref:									
Sample ID:	TP17								
Top Depth(m):	2.50								
Bottom Depth(m):									
Sampling Date:	09-Dec-2015						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			3.1	3	5	6
Loss On Ignition	2610	U	%			7.6	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			570	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				7.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.037	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0069	0.0023	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.13	0.067	< 0.50	0.73	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0021	0.0014	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.037	0.028	0.071	0.29	0.5	10	30
Nickel	1450	U	0.012	0.0049	< 0.050	0.056	0.4	10	40
Lead	1450	U	0.0027	0.0023	< 0.010	0.023	0.5	10	50
Antimony	1450	U	0.0019	0.0079	< 0.010	0.072	0.06	0.7	5
Selenium	1450	U	0.0016	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.013	0.0056	< 0.50	< 0.50	4	50	200
Chloride	1220	U	20	2.2	38	40	800	15000	25000
Fluoride	1220	U	0.35	0.19	< 1.0	2.0	10	150	500
Sulphate	1220	U	290	74	550	950	1000	20000	50000
Total Dissolved Solids	1020	N	570	250	1100	2800	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	27	10	52	120	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	25

Leachate Test Information	
Leachant volume 1st extract/l	0.293
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.178

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	232039								
Sample Ref:									
Sample ID:	TP18								
Top Depth(m):	1.50								
Bottom Depth(m):									
Sampling Date:	09-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			8.6	3	5	6
Loss On Ignition	2610	U	%			2.1	--	--	10
Total BTEX	2760	U	mg/kg			0.058	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			0.36	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			650	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			8.2	100	--	--
pH	2010	U				8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.034	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.058	0.012	0.11	0.34	0.5	2	25
Barium	1450	U	0.063	0.034	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.0030	0.00087	< 0.010	0.019	0.04	1	5
Chromium	1450	U	0.016	0.0056	< 0.050	0.10	0.5	10	70
Copper	1450	U	0.10	0.042	0.19	0.48	2	50	100
Mercury	1450	U	0.0050	0.00077	0.0093	0.028	0.01	0.2	2
Molybdenum	1450	U	0.90	0.18	1.7	5.2	0.5	10	30
Nickel	1450	U	0.22	0.053	0.41	1.3	0.4	10	40
Lead	1450	U	0.26	0.12	0.49	1.8	0.5	10	50
Antimony	1450	U	0.14	0.043	0.26	0.88	0.06	0.7	5
Selenium	1450	U	0.022	0.0046	0.041	0.13	0.1	0.5	7
Zinc	1450	U	0.27	0.11	0.50	1.8	4	50	200
Chloride	1220	U	500	130	930	3000	800	15000	25000
Fluoride	1220	U	1.3	0.41	2.4	8.3	10	150	500
Sulphate	1220	U	1.9	4.2	< 10	31	1000	20000	50000
Total Dissolved Solids	1020	N	2400	700	4500	15000	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	55	38	100	460	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	31

Leachate Test Information	
Leachant volume 1st extract/l	0.272
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.828

Results - 2 Stage WAC

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	15-29330								
Chemtest Sample ID:	232037								
Sample Ref:									
Sample ID:	TP19						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Top Depth(m):	2.00								
Bottom Depth(m):									
Sampling Date:	09-Dec-2015								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			2.3	3	5	6
Loss On Ignition	2610	U	%			6.8	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			0.53	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			420	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			3.6	100	--	--
pH	2010	U				8.2	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.026	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0077	0.0025	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.086	0.051	< 0.50	0.55	20	100	300
Cadmium	1450	U	0.00015	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0023	< 0.0010	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.080	0.028	0.16	0.34	0.5	10	30
Nickel	1450	U	0.016	0.033	< 0.050	0.31	0.4	10	40
Lead	1450	U	0.015	0.0099	0.029	0.11	0.5	10	50
Antimony	1450	U	0.0086	0.010	0.017	0.098	0.06	0.7	5
Selenium	1450	U	0.0021	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.014	0.0077	< 0.50	< 0.50	4	50	200
Chloride	1220	U	36	3.7	70	78	800	15000	25000
Fluoride	1220	U	0.27	0.20	< 1.0	2.1	10	150	500
Sulphate	1220	U	170	67	330	800	1000	20000	50000
Total Dissolved Solids	1020	N	570	230	1100	2700	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	30	12	59	140	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	19

Leachate Test Information	
Leachant volume 1st extract/l	0.309
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.220

APPENDIX G

Leachate Monitoring Results

Customer Sample Ref.	Units	LG11	LG03	LG01	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
Sample Date		26/03/2016	16/03/2016	16/03/2016	23/03/2016	24/03/2016	25/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016
Sample Matrix		Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
Determinand	Unit	LG11	LG03	LG01	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
Aluminium,Total as Al	mg/l	56.7	5.1	9.3	7.1	4.8	5.4	40.3	3.4	9.7	4.3	36	2.9
Arsenic, Ultra-low Total as As	ug/l	165	18	77	205	390	47	202	64	56	49	195	22
Barium, Total as Ba	mg/l	2.53	0.817	0.298	2.73	8.48	0.768	1.39	0.45	0.748	0.601	1.11	0.393
Boron, Total as B	mg/l	<2.30	2.27	<0.23	1.94	1.87	3.9	<2.30	3.91	8.46	3.31	<2.30	<2.30
Cadmium , Total as Cd	mg/l	0.0227	0.0019	0.0036	0.0044	0.0034	0.0017	0.0204	0.0025	<0.0060	0.0012	0.0239	<0.0060
Calcium , Total as Ca	mg/l	954	175	189	138	194	113	988	124	328	336	902	145
Chromium , Total as Cr	mg/l	0.13	0.021	0.025	0.029	0.035	0.02	0.141	0.026	0.044	0.035	0.148	<0.020
Copper, Total as Cu	mg/l	0.143	0.06	0.07	0.122	0.086	0.067	0.15	0.113	0.108	0.016	0.16	<0.090
Iron , Total as Fe	mg/l	190	46.5	39	104	435	47.2	230	21	52.2	87.3	223	50.3
Lead , Total as Pb	mg/l	2.46	0.133	0.126	0.34	0.257	0.089	1.79	0.872	0.534	0.122	1.64	0.101
Manganese , Total as Mn	mg/l	10.2	1.14	2.6	2.46	1.75	1.61	15.4	1.12	4.09	10.3	13.3	2.23
Mercury, Total as Hg	ug/l	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel , Total as Ni	ug/l	197	44.1	83.7	81.3	68.6	53.6	288	109	199	201	334	105
Potassium , Total as K	mg/l	19.6	149	5.26	231	247	308	48.3	306	408	567	309	13.6
Selenium Ultra Low Total as Se	mg/l	<0.0008	0.0108	0.0015	<0.0008	<0.0008	<0.0008	<0.0080	<0.0008	0.0136	<0.0008	0.0086	<0.0008
Sodium , Total as Na	mg/l	14	267	8.55	331	346	471	34	411	839	566	413	19.4
Vanadium , Total as V	mg/l	0.198	0.019	0.051	0.046	0.084	0.029	0.209	0.022	0.055	0.036	0.184	<0.040
Zinc, Total as Zn	mg/l	9.97	0.312	0.29	0.8	0.582	0.169	11.8	1.05	2.27	0.83	8	<0.180
BODS + ATU	mg/l	188	42	56	78	78	65	417	95	191	4851	218	113
COD	mg/l	2790	372	288	927	990	956	3190	907	1460	8140	2200	293
pH	pH units	6.9	6.9	6.6	7.1	7.1	7.1	6.6	6.9	7.2	6.9	7.3	6.3
Conductivity- Electrical 20C	uS/cm	1680	4830	933	7210	6480	7580	1950	6480	10400	11600	9160	1000
Alkalinity as CaCO3	mg/l	1880	2270	642	2820	3000	2930	2960	2850	4350	4640	5290	644
Ammoniacal Nitrogen as N	mg/l	32.4	286	14.7	475	439	496	81.7	454	620	893	663	20.4
Chloride as Cl	mg/l	57.2	483	25	968	866	1190	76.9	631	1400	978	1040	18.9
Nitrite as N	mg/l	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Nitrogen, Total Oxidised as N	mg/l	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	0.8	<0.7	<0.7	<0.7	<0.7	<0.7
Phosphate, Ortho as P	mg/l	<0.6	<0.6	<0.6	4.3	7.8	1.3	<0.6	1.7	1.2	<0.6	1.1	<0.6
Sulphate as SO4	mg/l	119	N/S	68.2	N/S	N/S	N/S	N/S	N/S	5.8	<4.4	N/S	N/S
Sulphate, total as SO4 by I.C.	mg/l	N/S	12.07	N/S	18.13	13.91	16.56	<5.00	<5.00	N/S	N/S	<5.00	17.37
Solids, Tot Dissolved 180 DegC	mg/l	1390	2070	559	3300	2920	3290	1230	2750	4950	7020	3790	600
Total Suspended Solids	mg/l	12200	2330	5440	2690	3290	1870	20000	740	3860	1180	15200	1140
TOC as C	mg/l	22.3	50	<0.7	104	976	111	69	122	209	2500	259	8.2
Cyanide, Total as CN	ug/l	57	<9	<9	<9	<9	<9	9	<9	9	<9	<9	14
Fluoride as F	mg/l	<0.1	0.2	0.1	0.3	0.3	0.3	0.2	0.3	0.7	0.3	0.4	0.2
2 - Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00
2 - Methylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00
2,4 - Dichlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00
2,4 - Dimethylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	1.35	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00
2,4,6 - Trichlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00
3,5-Dimethylphenol	ug/l	<1.00	1.61	<1.00	<1.00	2.55	2.12	<10.00	20.2	13.4	<260	33.1	<10.00
4-Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00
3+4-Methylphenol	ug/l	3.58	1.24	37.9	<1.00	<1.00	2.74	51.1	<10.00	25.9	6120	141	168
Phenol	ug/l	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<50.00	<50.00	<50.00	483	<50.00	<50.00
EH >C6 - C40	ug/l	2230	286	143	1380	258	256	783	796	3150	3000	1510	470
EH >C8 - C8	ug/l	<100	<20	<100	<40	<40	<100	<40	<100	<100	107	<100	<40
EH >C8 - C10	ug/l	<100	<20	<100	<40	<40	<100	71	<100	<100	123	<100	<40
EH >C16 - C24	ug/l	167	96	<100	150	76	102	176	255	475	122	317	162
EH >C24 - C40	ug/l	1930	48	143	1100	65	<100	240	137	2280	1670	247	234
EH >C10 - C16	ug/l	136	141	<100	132	117	153	297	404	391	979	947	73
Acenaphthene	ug/l	3.22	<0.02	<0.10	<0.04	<0.04	3.22	0.805	0.116	0.298	0.114	0.31	0.185
Acenaphthylene	ug/l	<0.10	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Anthracene	ug/l	0.665	<0.02	<0.10	<0.04	<0.04	0.168	0.114	<0.10	<0.10	<0.10	<0.10	<0.04
Benzo (a) anthracene	ug/l	0.233	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Benzo (g,h,i) perylene	ug/l	<0.10	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Benzo (a) pyrene	ug/l	0.175	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Benzo (b) fluoranthene	ug/l	0.16	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Benzo (k) fluoranthene	ug/l	<0.10	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Chrysene	ug/l	0.197	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Dibenz (a,h) anthracene	ug/l	<0.10	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Fluoranthene	ug/l	1.53	<0.02	<0.10	<0.04	<0.04	0.222	0.22	0.135	0.249	<0.10	0.126	0.103
Fluorene	ug/l	1.59	<0.02	<0.10	<0.04	<0.04	1.34	0.473	<0.10	0.31	<0.10	0.157	0.108
Indeno (1,2,3) cd pyrene	ug/l	<0.10	<0.02	<0.10	<0.04	<0.04	<0.10	<0.04	<0.10	<0.10	<0.10	<0.10	<0.04
Naphthalene	ug/l	0.57	<0.02	0.119	<0.04	<0.04	6.34	2.9	<0.10	2.44	<0.36	1.23	1.24
Phenanthrene	ug/l	1.77	<0.02	<0.10	<0.04	<0.04	0.469	0.724	<0.10	0.585	<0.10	0.213	0.14
Pyrene	ug/l	1.09	0.063	<0.10	0.199	0.182	0.15	0.16	0.144	0.345	0.101	0.126	0.092
PAH, Total	ug/l	11	0.063	0.119	0.199	0.182	12	5.4	0.395	4.23	0.215	2.16	1.87
Phenol	ug/l	<1.0	<4.0	1.3	<2.0	<4.0	<2.0	12	<4.0	5.4	604	20.6	<1.0
Bis(2-chloroethyl)ether	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2-Chlorophenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
1,3-Dichlorobenzene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
1,4-Dichlorobenzene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	4.5	<4.0	<10.0	<4.0	<1.0
2-Methylphenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	4.4	<4.0	15.7	<4.0	<1.0
3&4-Methylphenol	ug/l	1.8	<4.0	16.6	<2.0	<4.0	2.6	64.2	<4.0	32.2	5600	159	3.4
Dibenzofuran	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
1,2-Dichlorobenzene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Bis(2-chloroisopropyl)ether	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
n-Nitrosodi-n-propylamine	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Hexachloroethane	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Nitrobenzene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Isophorone	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2,4-Dimethylphenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	4.6	4.6	<10.0	4	<1.0
2-Nitrophenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Bis(2-chloroethoxy)methane	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2,4-Dichlorophenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
1,2,4-Trichlorobenzene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Naphthalene	ug/l	<2.0	<8.0	<2.0	<4.0	<8.0	13	<8.0	<8.0	<8.0	<20.0	<8.0	<2.0
Hexachlorobutadiene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
4-Chloro-3-methylphenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2-Methylnaphthalene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	2.1	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2,4,6-Trichlorophenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2,4,5-Trichlorophenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2-Chloronaphthalene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Dimethylphthalate	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2,6-Dinitrotoluene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Acenaphthylene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Acenaphthene	ug/l	2.6	<4.0	<1.0	<2.0	<4.0	3.1	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
2,4-Dinitrotoluene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Diethylphthalate	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	9.7	<4.0	14.8	<4.0	<1.0
4-Nitrophenol	ug/l	<5.0	<20.0	<5.0	<10.0	<20.0	<10.0	<20.0	<20.0	<20.0	<50.0	<20.0	<5.0
4-Chlorophenyl phenyl ether	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Fluorene	ug/l	1.2	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Diphenylamine	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
4-Bromophenyl Phenyl Ether	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Hexachlorobenzene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Pentachlorophenol	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Phenanthrene	ug/l	1.2	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Anthracene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
di-n-Butylphthalate	ug/l	1	<4.0	<1.0	<2.0	<4.0	2	<4.0	<4.0	<4.0	<10.0	8.8	<1.0

Customer Sample Ref.	Units	LG11	LG03	LG01	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
Sample Date		26/03/2016	16/03/2016	16/03/2016	23/03/2016	24/03/2016	25/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016
Sample Matrix		Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
Determinand	Unit	LG11	LG03	LG01	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
Fluoranthene	ug/l	1.1	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Pyrene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Benzyl Butyl Phthalate	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	7.2	<1.0
Benzo(a)anthracene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Chrysene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Bis(2-ethylhexyl)phthalate	ug/l	<5.0	<20.0	<5.0	<10.0	<20.0	<10.0	<20.0	28.6	23.1	<50.0	30.2	<5.0
Di-n-octylphthalate	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Benzo(b)fluoranthene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Benzo(k)fluoranthene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Benzo(a)pyrene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Indeno(1,2,3-c,d)pyrene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Dibenz(a,h)anthracene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Benzo(g,h,i)perylene	ug/l	<1.0	<4.0	<1.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0	<10.0	<4.0	<1.0
Dichlorodifluoromethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Chloromethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Chloroethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	2.8	<10.0	<10.0	<80.0	<10.0	<1.0
Bromomethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Trichlorofluoromethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,1-Dichloroethene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Dichloromethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	4.9	<10.0	<10.0	<80.0	<10.0	<1.0
1,1-Dichloroethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
cis-1,2-Dichloroethene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	194	<10.0	<10.0	<80.0	<10.0	<1.0
2,2-Dichloropropane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Chloroform	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Bromochloromethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,1,1-Trichloroethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,1-Dichloropropene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,2-Dichloroethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Benzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	4.1	<10.0	<10.0	<80.0	<10.0	2
1,2-Dichloropropane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Trichloroethene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	4.2	<10.0	<10.0	<80.0	<10.0	<1.0
Bromodichloromethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Dibromomethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
cis-1,3-Dichloropropene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Toluene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	19.6	17.5	<10.0	<80.0	<10.0	1.7
trans-1,3-Dichloropropene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,1,2-Trichloroethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Carbon Tetrachloride	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Vinyl Chloride	ug/l	<5.0	<2.0	<0.5	<5.0	<5.0	<5.0	7.4	<5.0	<5.0	<40.0	<5.0	<0.5
1,3-Dichloropropane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Tetrachloroethene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Dibromochloromethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,2-Dibromoethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Chlorobenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	1.8
1,1,1,2-Tetrachloroethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Ethyl Benzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	8.8	12.4	12.2	<80.0	<10.0	7.4
m&p-Xylene	ug/l	<10.0	<4.0	1.5	<10.0	<10.0	<10.0	18.4	23.5	21.9	<80.0	19.4	2.4
o-Xylene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	7.2	<10.0	<10.0	<80.0	<10.0	1.8
Styrene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Bromoform	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Isopropylbenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	1.6
trans-1,2-Dichloroethene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	2	<10.0	<10.0	<80.0	<10.0	<1.0
1,1,2,2-Tetrachloroethane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,2,3-Trichloropropane	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
n-Propylbenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	1.6
Bromobenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
2-Chlorotoluene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,3,5-Trimethylbenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	3	<10.0	<10.0	<80.0	<10.0	<1.0
4-Chlorotoluene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
tert-Butylbenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,2,4-Trimethylbenzene	ug/l	<10.0	13.2	1.6	<10.0	<10.0	<10.0	8.3	11	10.6	<80.0	<10.0	9.5
sec-Butylbenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
p-Isopropyltoluene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	12.3	78.2	23.1	97.5	58.1	<1.0
1,3-Dichlorobenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,4-Dichlorobenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
n-Butylbenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,2-Dichlorobenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
1,2-Dibromo-3-chloropropane	ug/l	<20.0	<8.0	<2.0	<20.0	<20.0	<20.0	<4.0	<20.0	<20.0	<160	<20.0	<2.0
1,2,4-Trichlorobenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Hexachlorobutadiene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
Naphthalene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	10.7	4.5	<10.0	<10.0	<80.0	<10.0	1.9
1,2,3-Trichlorobenzene	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	<2.0	<10.0	<10.0	<80.0	<10.0	<1.0
MTBE	ug/l	<10.0	<4.0	<1.0	<10.0	<10.0	<10.0	13.7	<10.0	<10.0	<80.0	<10.0	<1.0

Customer Sample Ref.	Units	BH5	BH1	G20	BH7	BH9	BH10	BH8	BH6
Sample Date		16/03/2016	16/03/2016	16/03/2016	15/03/2016	15/03/2016	15/03/2016	15/03/2016	15/03/2016
Sample Matrix		Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Determinand	Unit	BH05	BH01	G20	BH07	BH09	BH10	BH08	BH06
Aluminium,Total as Al	mg/l	15.4	29	24.8	a	20.2	25.3	19.9	26.6
Arsenic, Ultra-low Total as As	ug/l	33	29	16	18	24	33	<10.0	41
Barium, Total as Ba	mg/l	0.6	0.753	0.736	a	0.487	1.07	1.15	1.11
Boron, Total as B	mg/l	<2.30	<4.60	<2.30	a	24.5	<23.0	<0.23	28.3
Cadmium , Total as Cd	mg/l	0.0132	<0.0060	<0.0060	a	0.0218	0.0268	0.0428	0.0422
Calcium , Total as Ca	mg/l	622	702	803	a	836	1340	4490	1390
Chromium , Total as Cr	mg/l	0.032	0.063	0.048	a	0.035	0.05	0.027	0.047
Copper, Total as Cu	mg/l	<0.090	<0.180	<0.090	a	<0.090	<0.090	0.013	0.154
Iron , Total as Fe	mg/l	26.8	54	36.3	a	30	42.4	13.3	43.5
Lead , Total as Pb	mg/l	0.084	0.119	<0.060	a	0.151	0.192	0.017	0.273
Manganese , Total as Mn	mg/l	5.71	6.77	7.4	a	10.3	17.8	26.9	24.7
Mercury, Total as Hg	ug/l	0.35	0.37	0.35	<0.10	0.26	<0.10	<0.10	<0.10
Nickel , Total as Ni	ug/l	99.8	154	141	a	218	305	205	531
Potassium , Total as K	mg/l	2.88	4.4	3.81	a	2.36	3.67	26.8	30.9
Selenium Ultra Low Total as Se	mg/l	0.0039	0.0022	0.0023	0.0025	<0.0008	<0.0008	<0.0008	<0.0008
Sodium , Total as Na	mg/l	12.5	7.86	10.2	a	4.64	7.11	9.52	23.7
Vanadium , Total as V	mg/l	<0.040	0.067	0.052	a	<0.040	0.053	0.042	0.056
Zinc, Total as Zn	mg/l	0.713	0.256	0.256	a	1.04	0.625	0.328	0.723
BODS + ATU	mg/l	0	5	5	4	3	4	2	3
COD	mg/l	137	347	98	970	850	1270	1910	1050
pH	pH units	6.8	6.9	7.2	7.4	7.1	7.1	6.7	7.1
Conductivity- Electrical 20C	uS/cm	933	957	594	372	342	470	822	471
Alkalinity as CaCO3	mg/l	3330	2630	1230	<2.8	924	2820	11200	3430
Ammoniacal Nitrogen as N	mg/l	0.27	0.94	0.07	b	<0.41	<0.41	<0.41	<0.41
Chloride as Cl	mg/l	21.6	23.3	20.6	b	16.2	26.1	23.8	30.1
Nitrite as N	mg/l	<0.08	<0.08	<0.08	b	<0.08	<0.08	<0.08	0.09
Nitrogen, Total Oxidised as N	mg/l	9.1	1.4	10.5	b	3.8	12.3	11.9	6.4
Phosphate, Ortho as P	mg/l	<0.6	<0.6	<0.6	b	<0.6	<0.6	<0.6	<0.6
Sulphate as SO4	mg/l	9.8	25.6	<4.4	b	<4.4	9.2	6	16.3
Sulphate, total as SO4 by I.C.	mg/l	0	0	0	0	0	0	0	0
Solids, Tot Dissolved 180 DegC	mg/l	463	600	286	308	338	468	667	452
Total Suspended Solids	mg/l	57800	21300	14800	617000	7650	14900	341000	17500
TOC as C	mg/l	1.3	1.1	<0.7	1.3	<0.7	<0.7	2.1	0.9
Cyanide, Total as CN	ug/l	<9	<9	<9	<9	<9	<9	<9	<9
Fluoride as F	mg/l	<0.1	0.1	0.1	0.2	<0.1	<0.1	<0.1	0.1
2 - Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2 - Methylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dichlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dimethylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4,6 - Trichlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3,5-Dimethylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3+4-Methylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Phenol	ug/l	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
EH >C6 - C40	ug/l	13	<10	<10	<10	<10	<10	<10	<10
EH >C6 - C8	ug/l	<10	<10	<10	<10	<10	<10	<10	<10
EH >C8 - C10	ug/l	<10	<10	<10	<10	<10	<10	<10	<10
EH >C16 - C24	ug/l	<10	<10	<10	<10	<10	<10	<10	<10
EH >C24 - C40	ug/l	13	<10	<10	<10	<10	<10	<10	<10
EH >C10 - C16	ug/l	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Anthracene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (a) anthracene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (g,h,i) perylene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (a) pyrene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (b) fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (k) fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Chrysene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Dibenz (a,h) anthracene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Fluorene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Indeno (1,2,3) cd pyrene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Naphthalene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.10
Phenanthrene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Pyrene	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
PAH, Total	ug/l	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.10
Phenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethyl)ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
3&4-Methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenzofuran	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Nitrosodi-n-propylamine	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isophorone	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitrophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethoxy)methane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hexachlorobutadiene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,6-Trichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chloronaphthalene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,6-Dinitrotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Diethylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Nitrophenol	ug/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Chlorophenyl phenyl ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Diphenylamine	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Bromophenyl Phenyl Ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
di-n-Butylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Customer Sample Ref.	Units	BH5	BH1	G20	BH7	BH9	BH10	BH8	BH6
Sample Date		16/03/2016	16/03/2016	16/03/2016	15/03/2016	15/03/2016	15/03/2016	15/03/2016	15/03/2016
Sample Matrix		Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Determinand	Unit	BH05	BH01	G20	BH07	BH09	BH10	BH08	BH06
Fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzyl Butyl Phthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-ethylhexyl)phthalate	ug/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Di-n-octylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Indeno(1,2,3-c,d)pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dichlorodifluoromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	ug/l	<1.0	<1.0	<1.0	<1.3	<1.6	<2.1	<1.6	<1.0
Chloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,2-Dichloropropane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromochloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloropropene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromomethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,3-Dichloropropene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,3-Dichloropropene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dibromoethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1,2-Tetrachloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
m&p-Xylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Styrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,3-Trichloropropane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Propylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3,5-Trimethylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chlorotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
tert-Butylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trimethylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
sec-Butylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
p-Isopropyltoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Butylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dibromo-3-chloropropane	ug/l	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1,2,4-Trichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobutadiene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,3-Trichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MTBE	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Customer Sample Ref.	Units	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4	SP5
Sample Date		04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016
Sample Matrix		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Determinand	Unit	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4	SP5
Aluminium,Total as Al	mg/l	<0.1	<0.1	0.7	1	2	20.3	1	2.9	<0.1	<0.1
Arsenic, Ultra-low Total as As	ug/l	<1.0	<1.0	2.4	3.6	8.1	709	23	14	127	<1.0
Barium, Total as Ba	mg/l	0.031	0.033	0.041	0.048	0.075	9.42	0.13	0.258	0.506	0.027
Boron, Total as B	mg/l	<0.23	<0.23	<0.23	<0.23	<0.23	<2.30	<0.23	<0.23	<0.23	<0.23
Cadmium , Total as Cd	mg/l	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.0221	<0.0006	0.0008	<0.0006	<0.0006
Calcium , Total as Ca	mg/l	85.8	82.9	71	68	53.9	2320	180	376	147	105
Chromium , Total as Cr	mg/l	<0.002	<0.002	0.003	0.004	0.007	0.03	0.002	0.007	<0.002	<0.002
Copper, Total as Cu	mg/l	<0.009	<0.009	<0.009	<0.009	0.011	0.197	<0.009	0.016	<0.009	<0.009
Iron , Total as Fe	mg/l	<0.23	<0.23	1.29	1.86	3.45	1550	9.45	7.55	54	0.35
Lead , Total as Pb	mg/l	<0.006	<0.006	0.012	0.016	0.02	0.906	0.018	0.32	0.007	0.007
Manganese , Total as Mn	mg/l	0.033	0.034	0.199	0.281	0.618	53.9	3.08	2.09	5.02	0.066
Mercury, Total as Hg	ug/l	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel , Total as Ni	ug/l	<3.00	<3.00	<3.00	4.4	10.6	140	7.7	16.3	7.5	<3.00
Potassium , Total as K	mg/l	1.95	1.93	2.08	2.58	3.26	70.5	1.71	1.21	7.56	0.47
Selenium Ultra Low Total as Se	mg/l	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	0.0042	<0.0008	<0.0008
Sodium , Total as Na	mg/l	13.7	25.9	22.4	35.8	19.3	62.2	20	12.3	25.7	12.2
Vanadium , Total as V	mg/l	<0.004	<0.004	<0.004	<0.004	0.006	0.125	0.004	0.009	<0.004	<0.004
Zinc, Total as Zn	mg/l	<0.018	<0.018	0.03	0.04	0.05	2.28	0.03	0.08	<0.018	<0.018
BODS + ATU	mg/l	<1	<1	3	2	5	298	5	9	2	<2
COD	mg/l	<5	<5	30	44	67	4280	199	798	29	21
pH	pH units	8.3	8.3	8.1	7.9	7.8	7.2	8.2	8.1	7.3	8.2
Conductivity- Electrical 20C	uS/cm	475	529	451	507	397	1410	598	471	776	532
Alkalinity as CaCO3	mg/l	208	201	168	158	136	6630	417	1130	358	214
Ammoniacal Nitrogen as N	mg/l	<0.41	<0.41	<0.41	<0.41	<0.41	25.7	<0.41	<0.41	5.8	<0.41
Chloride as Cl	mg/l	28.6	54.4	45.5	71.2	45.1	109	44.3	21.7	37.8	34
Nitrite as N	mg/l	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.1	<0.08
Nitrogen, Total Oxidised as N	mg/l	3	2.9	2.3	2	1.7	<0.7	<0.7	1.2	1.9	7.9
Phosphate, Ortho as P	mg/l	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.7
Sulphate as SO4	mg/l	19.2	18.6	15.2	15.3	14.4	<4.4	42.4	15.9	12.5	15
Sulphate, total as SO4 by I.C.	mg/l	0	0	0	0	0	0	0	0	0	0
Solids, Tot Dissolved 180 DegC	mg/l	283	336	231	357	208	990	383	305	282	360
Total Suspended Solids	mg/l	11	10	89	144	334	69700	754	2720	235	27
TOC as C	mg/l	1.9	1.8	2.6	3.1	4.9	17.7	4.1	5.7	3.1	2.5
Cyanide, Total as CN	ug/l	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9
Fluoride as F	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
2 - Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2 - Methylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dichlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dimethylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4,6 - Trichlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3,5-Dimethylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3+4-Methylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Phenol	ug/l	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
EH >C6 - C40	ug/l	<10	<10	259	465	294	47	<10	<10	<10	<10
EH >C6 - C8	ug/l	<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
EH >C8 - C10	ug/l	<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
EH >C16 - C24	ug/l	<10	<10	32	37	27	<20	<10	<10	<10	<10
EH >C24 - C40	ug/l	<10	<10	227	428	267	47	<10	<10	<10	<10
EH >C10 - C16	ug/l	<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
Acenaphthene	ug/l	<0.01	<0.01	<0.01	0.012	0.024	<0.04	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01	<0.01	<0.01
Anthracene	ug/l	<0.01	<0.01	<0.01	0.017	0.013	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (a) anthracene	ug/l	<0.01	<0.01	0.053	0.265	0.129	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (g,h,i) perylene	ug/l	<0.01	<0.01	0.081	0.39	0.168	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (a) pyrene	ug/l	<0.01	<0.01	0.084	0.466	0.213	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (b) fluoranthene	ug/l	<0.01	<0.01	0.094	0.466	0.199	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (k) fluoranthene	ug/l	<0.01	<0.01	0.044	0.224	0.097	<0.04	<0.01	<0.01	<0.01	<0.01
Chrysene	ug/l	<0.01	<0.01	0.073	0.315	0.142	<0.04	<0.01	<0.01	<0.01	<0.01
Dibenz (a,h) anthracene	ug/l	<0.01	<0.01	0.016	0.09	0.042	<0.04	<0.01	<0.01	<0.01	<0.01
Fluoranthene	ug/l	<0.01	<0.01	0.104	0.439	0.233	<0.04	<0.01	<0.01	<0.01	<0.01
Fluorene	ug/l	<0.01	<0.01	<0.01	<0.01	0.01	<0.04	<0.01	<0.01	<0.01	<0.01
Indeno (1,2,3) cd pyrene	ug/l	<0.01	<0.01	0.072	0.388	0.165	<0.04	<0.01	<0.01	<0.01	<0.01
Naphthalene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.09	<0.075	<0.25	<0.01
Phenanthrene	ug/l	<0.01	<0.01	0.031	0.097	0.071	<0.04	<0.01	<0.01	<0.01	<0.01
Pyrene	ug/l	<0.01	<0.01	0.106	0.458	0.225	<0.04	<0.01	<0.01	<0.01	<0.01
PAH, Total	ug/l	<0.01	<0.01	0.756	3.63	1.73	<0.04	<0.09	<0.01	<0.01	<0.01
Phenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethyl)ether	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
3&4-Methylphenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Dibenzofuran	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
n-Nitrosodi-n-propylamine	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Hexachloroethane	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Nitrobenzene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Isophorone	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Nitrophenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethoxy)methane	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4-Dichlorophenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trichlorobenzene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l	<2.0	<20.0	<2.0	<2.0	<2.0	<8.0	<2.0	<2.0	<2.0	<2.0
Hexachlorobutadiene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-methylphenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4,6-Trichlorophenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Chloronaphthalene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Dimethylphthalate	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,6-Dinitrotoluene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Diethylphthalate	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
4-Nitrophenol	ug/l	<5.0	<50.0	<5.0	<5.0	<5.0	<20.0	<5.0	<5.0	<5.0	<5.0
4-Chlorophenyl phenyl ether	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Fluorene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Diphenylamine	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
4-Bromophenyl Phenyl Ether	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobenzene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Anthracene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
di-n-Butylphthalate	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	4.8	<1.0	<1.0	<1.0	<1.0

Customer Sample Ref.	Units	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4	SP5
Sample Date		04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016	04/03/2016
Sample Matrix		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Determinand	Unit	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4	SP5
Fluoranthene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Pyrene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzyl Butyl Phthalate	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)anthracene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Chrysene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Bis(2-ethylhexyl)phthalate	ug/l	<5.0	<50.0	<5.0	<5.0	<5.0	<20.0	<5.0	<5.0	<5.0	<5.0
Di-n-octylphthalate	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Indeno(1,2,3-c,d)pyrene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	ug/l	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Dichlorodifluoromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Dichloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
2,2-Dichloropropane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Chloroform	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromochloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloropropene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Benzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Dibromomethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
cis-1,3-Dichloropropene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Toluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
trans-1,3-Dichloropropene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dibromoethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1,1,2-Tetrachloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
m&p-Xylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Styrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromoform	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2,3-Trichloropropane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
n-Propylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
2-Chlorotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,3,5-Trimethylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
4-Chlorotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
tert-Butylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trimethylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
sec-Butylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
p-Isopropyltoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
n-Butylbenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dibromo-3-chloropropane	ug/l	<2.0	<2.0	<2.0	<2.0	<2.0	<20.0	<2.0	<2.0	<2.0	<2.0
1,2,4-Trichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobutadiene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2,3-Trichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
MTBE	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0

Customer Sample Ref.	Units	LG11	LG03	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
Sample Date/Time		31/08/2016	01/09/2016	01/09/2016	01/09/2016	01/09/2016	30/08/2016	30/08/2016	30/08/2016	30/08/2016	31/08/2016	31/08/2016
Sample Matrix		Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
Determinand	Unit	LG11	LG03	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
Aluminium (Dissolved)	ug/l	< 10	14	< 10	< 10	< 10	< 10	11	20	76	14	< 10
Arsenic (Dissolved)	ug/l	4.9	8.9	10	9.7	14	11	19	73	45	33	7.7
Barium (Dissolved)	ug/l	240	500	300	330	350	250	130	270	300	65	240
Boron (Dissolved)	ug/l	1300	3400	3200	2600	4600	980	3600	9500	2300	2700	1100
Cadmium (Dissolved)	ug/l	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Calcium	mg/l	330	130	95	78	69	230	95	68	150	79	200
Chromium (Dissolved)	ug/l	3.8	18	16	15	17	6.5	20	27	34	20	2.9
Copper (Dissolved)	ug/l	< 1.0	3.1	2.9	3.1	3.4	< 1.0	6.9	8.7	5.6	3.8	< 1.0
Iron (Dissolved)	ug/l	660	610	700	530	440	16000	1000	960	14000	900	1200
Lead (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	7	2.9	1	2.2	< 1.0
Manganese (Dissolved)	ug/l	960	290	190	110	390	1100	310	250	630	250	1500
Mercury (Dissolved)	ug/l	< 0.50	0.79	< 0.50	0.71	0.86	< 0.50	0.59	0.68	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	ug/l	3.8	38	59	50	36	6.3	94	200	95	82	10
Potassium	mg/l	32	270	340	310	350	140	550	500	750	550	43
Sodium	mg/l	39	570	670	640	670	120	820	1100	760	760	59
Vanadium (Dissolved)	ug/l	< 1.0	2.8	4.1	3.6	3.5	< 1.0	6	12	12	12	< 1.0
Zinc (Dissolved)	ug/l	5.4	4.8	3.5	4.3	3.1	< 1.0	18	7.6	6.6	6.5	1.2
BODS	mg/l	< 4.0	11	26	21	20	120	< 4.0	63	420	23	19
COD	mg/l	78	430	780	620	790	290	680	730	< 10	800	79
pH	pH units	7.4	7.8	7.9	7.7	7.9	7.6	7.9	8	8.4	8.1	7.2
Conductivity Electrical	uS/cm	2000	6600	8500	7900	8700	2900	10000	11000	12000	9800	1700
Alkalinity as CaCO3	mg/l	1200	2700	3200	3000	2900	1500	3500	4200	6500	4400	1200
Ammoniacal Nitrogen as N	mg/l	29	270	310	280	330	100	590	540	780	0.93	69
Chloride as Cl	mg/l	310	780	1100	1000	1300	190	1100	1700	1400	1100	58
Nitrite as N	mg/l	0.11	0.02	0.025	0.02	0.012	0.061	0.052	0.067	0.011	< 0.010	< 0.010
Nitrogen, Total Oxidised as N	mg/l	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	0.23	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Phosphate as P	mg/l	< 0.020	< 0.020	0.13	0.065	0.036	< 0.020	0.12	0.22	0.17	0.28	< 0.020
Sulphate as SO4	mg/l	170	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.2	< 1.0	14
Solids, Tot Dissolved	mg/l	1200	4000	5100	4700	5200	1700	6100	6400	7300	5900	1000
Total Suspended Solids	mg/l	870	390	460	450	260	1700	500	770	780	3500	880
TOC as C	mg/l	24	71	86	90	120	110	130	220	240	180	90
Cyanide, Total as CN	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluoride as F	mg/l	0.12	0.3	0.38	0.38	0.33	0.16	0.47	0.6	2	0.78	0.23
Dissolved Oxygen	mg O2/l	3.1	9.9	7.8	8.5	9.9	4.1	1.6	3	2.7	0.76	4.6
Dissolved CO2	mg/l	100	85	88	110	78	73	80	76	47	71	160
Dissolved Ethane	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Ethene	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Methane	mg/l	0.94	2.9	1.5	5.9	0.41	5.2	1.8	6.9	12	8.5	1.8
Total Phenols	mg/l	0.077	< 0.030	< 0.030	< 0.030	< 0.030	0.058	0.074	0.053	11	0.15	< 0.030
Total TPH >C6-C40	ug/l	< 10	310	< 10	< 10	390	640	1600	750	2200	1100	< 10
Acenaphthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (g,h,i) perylene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) pyrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (b) fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (k) fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz (a,h) anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno (1,2,3) cd pyrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	5.2	3.7	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
PAH, Total	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	5.2	3.7	< 2.0	< 2.0	< 2.0	< 2.0
Phenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	4.4
1,2-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	2.4	< 0.50
Isophorone	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	18	< 0.50
2,4-Dimethylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.56	< 0.50
Bis(2-Chloroethoxy)Methane	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	1.6	2.6
4-Chloroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	4	< 0.50
2-Methylnaphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.68
Hexachlorocyclopentadiene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Customer Sample Ref.	Units	LG11	LG03	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
Sample Date/Time		31/08/2016	01/09/2016	01/09/2016	01/09/2016	01/09/2016	30/08/2016	30/08/2016	30/08/2016	30/08/2016	31/08/2016	31/08/2016
Sample Matrix		Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
Determinand	Unit	LG11	LG03	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
4-Chlorophenylphenylether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.82	< 0.50
4-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dichlorodifluoromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	6.6	< 1.0	< 1.0	3	< 1.0	< 1.0
Bromomethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.9	< 1.0	1.8	1.1	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Toluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	17	2.8	5.4	700	8.2	< 1.0
Trans-1,3-Dichloropropene	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.9	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	6.7	< 1.0	8.4	6.4	2.6	< 1.0
m & p-Xylene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	17	4.2	9.4	14	6.8	< 1.0
o-Xylene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	6.4	3.5	7.9	5.8	3.9	< 1.0
Styrene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.2	< 1.0	< 1.0	< 1.0
Bromobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.3	< 1.0	2.8	1.7	< 1.0	< 1.0
4-Chlorotoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	5	< 1.0	4.1	3.5	4.8	< 1.0
Sec-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	11	< 1.0	6.5	70	19	< 1.0
1,4-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether (MBTE)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	9.9	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Customer Sample Ref.	Units	BH5	G20	BH1	BH7	BH9	BH10	BH6
Sample Date/Time		31/08/2016	31/08/2016	01/09/2016	30/08/2016	30/08/2016	30/08/2016	31/08/2016
Sample Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Determinand	Unit	BH05	G20	BH01	BH07	BH09	BH10	BH06
Aluminium (Dissolved)	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Arsenic (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.5	< 1.0
Barium (Dissolved)	ug/l	72	28	83	39	31	59	57
Boron (Dissolved)	ug/l	450	530	< 20	< 20	< 20	20	1200
Cadmium (Dissolved)	ug/l	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Calcium	mg/l	160	95	150	110	130	120	140
Chromium (Dissolved)	ug/l	4.2	< 1.0	< 1.0	2.5	3	1	1.2
Copper (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Iron (Dissolved)	ug/l	290	170	340	180	240	400	260
Lead (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Manganese (Dissolved)	ug/l	22	13	23	5.7	3.6	210	1.7
Mercury (Dissolved)	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	ug/l	< 1.0	< 1.0	1.4	< 1.0	< 1.0	4.3	< 1.0
Potassium	mg/l	2.9	1.7	1.7	1.1	0.67	30	31
Sodium	mg/l	13	8.9	16	9.3	8.3	36	13
Vanadium (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	ug/l	2.4	< 1.0	< 1.0	2.3	1.1	< 1.0	< 1.0
BOD5	mg/l	4	< 4.0	< 4.0	5	6	< 4.0	5
COD	mg/l	16	< 10	72	12	< 10	880	12
pH	pH units	7.4	7.9	7.6	8.2	8	8.3	7.7
Conductivity Electrical	uS/cm	770	500	890	410	420	430	820
Alkalinity as CaCO3	mg/l	570	360	530	170	180	190	590
Ammoniacal Nitrogen as N	mg/l	0.34	0.93	2	0.86	3.5	14	0.59
Chloride as Cl	mg/l	170	46	21	28	23	31	22
Nitrite as N	mg/l	< 0.010	0.016	0.017	0.033	0.043	0.091	0.052
Nitrogen, Total Oxidised as N	mg/l	2.9	19	0.47	8.6	5.2	8.6	0.99
Phosphate as P	mg/l	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Sulphate as SO4	mg/l	69	31	25	27	18	24	22
Solids, Tot Dissolved	mg/l	460	300	530	250	250	260	490
Total Suspended Solids	mg/l	840	240	390	4600	390	220	600
TOC as C	mg/l	18	17	9.3	6	4.7	98	8.8
Cyanide, Total as CN	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluoride as F	mg/l	0.097	0.092	0.14	0.12	0.097	0.11	0.11
Dissolved Oxygen	mg O2/l	11	9.5	14	8.7	8.4	9.9	9.3
Dissolved CO2	mg/l	44	9	30	2	3.3	1.7	25
Dissolved Ethane	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Ethene	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Methane	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Total Phenols	mg/l	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030
Total TPH >C6-C40	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Acenaphthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (g,h,i) perylene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) pyrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (b) fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (k) fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz (a,h) anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno (1,2,3) cd pyrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	ug/l	< 0.10	< 0.10	1.9	< 0.10	< 0.10	< 0.10	< 0.10
PAH, Total	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Phenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Isophorone	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Customer Sample Ref.	Units	BH5	G20	BH1	BH7	BH9	BH10	BH6
Sample Date/Time		31/08/2016	31/08/2016	01/09/2016	30/08/2016	30/08/2016	30/08/2016	31/08/2016
Sample Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Determinand	Unit	BH05	G20	BH01	BH07	BH09	BH10	BH06
4-Chlorophenylphenylether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.65
Bis(2-Ethylhexyl)Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dichlorodifluoromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Toluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Sec-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether (MBTE)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Customer Sample Ref.	Units	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4	SP5
Sample Date/Time		24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016
Sample Matrix		Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water
Determinand	Unit	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4	SP5
Aluminium (Dissolved)	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Arsenic (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Barium (Dissolved)	ug/l	27	33	25	22	21	150	25	23	320	81
Boron (Dissolved)	ug/l	47	25	< 20	< 20	< 20	1100	110	< 20	130	52
Cadmium (Dissolved)	ug/l	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Calcium	mg/l	110	110	110	120	120	160	110	120	190	120
Chromium (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Iron (Dissolved)	ug/l	200	250	170	180	160	250	200	180	390	170
Lead (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Manganese (Dissolved)	ug/l	24	2.3	< 1.0	7.5	2.9	560	8.8	690	7400	160
Mercury (Dissolved)	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	0.56	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.6	1.5	< 1.0	4.9	1.9
Potassium	mg/l	1.9	1.8	1.5	1.2	1.4	130	5.4	1.8	11	8
Sodium	mg/l	17	17	16	16	16	120	37	14	41	33
Vanadium (Dissolved)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	ug/l	1.4	< 1.0	< 1.0	< 1.0	1.1	< 1.0	< 1.0	< 1.0	1.2	12
BOD5	mg/l	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	7	< 4.0	< 4.0	< 4.0	< 4.0
COD	mg/l	14	14	13	13	< 10	55	24	26	21	26
pH	pH units	8.1	8.2	8	8	8	7.7	8	8	7.4	7.5
Conductivity Electrical	uS/cm	560	460	570	600	610	1400	730	550	1100	730
Alkalinity as CaCO3	mg/l	250	240	240	260	270	660	290	290	490	310
Ammoniacal Nitrogen as N	mg/l	0.1	0.07	0.063	0.074	0.86	18	0.17	0.25	4.1	0.075
Chloride as Cl	mg/l	29	28	27	25	29	120	46	16	63	49
Nitrite as N	mg/l	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.011	< 0.010	< 0.010	0.033	0.016
Nitrogen, Total Oxidised as N	mg/l	4.1	3.6	3.6	3.8	3.6	< 0.20	0.34	< 0.20	0.68	0.97
Phosphate as P	mg/l	0.021	0.021	< 0.020	0.02	0.022	< 0.020	< 0.020	0.021	< 0.020	< 0.020
Sulphate as SO4	mg/l	24	23	22	23	25	< 1.0	45	< 1.0	15	7.8
Solids, Tot Dissolved	mg/l	340	280	340	360	370	850	440	330	670	440
Total Suspended Solids	mg/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	30000	1500	11000	5100	8300
TOC as C	mg/l	11	6.3	5.8	5.7	5.5	10	11	30	13	8.8
Cyanide, Total as CN	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluoride as F	mg/l	0.13	0.12	0.12	0.12	0.13	0.14	0.12	0.13	0.15	0.12
Dissolved Oxygen	mg O2/l	0	0	0	0	0	0	0	0	0	0
Dissolved CO2	mg/l	0	0	0	0	0	0	0	0	0	0
Dissolved Ethane	mg/l	0	0	0	0	0	0	0	0	0	0
Dissolved Ethene	mg/l	0	0	0	0	0	0	0	0	0	0
Dissolved Methane	mg/l	0	0	0	0	0	0	0	0	0	0
Total Phenols	mg/l	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030
Total TPH >C6-C40	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Acenaphthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (g,h,i) perylene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) pyrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (b) fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (k) fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz (a,h) anthracene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno (1,2,3) cd pyrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	ug/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
PAH, Total	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Phenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Isophorone	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Customer Sample Ref.	Units	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4	SP5
Sample Date/Time		24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016	24/08/2016
Sample Matrix		Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water
Determinand	Unit	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4	SP5
4-Chlorophenylphenylether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitroaniline	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dichlorodifluoromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l	<1.0	<1.0	27	29	36	< 1.0	34	9.9	23	29
Vinyl Chloride	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Toluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Sec-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether (MBTE)	ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Customer Sample Ref.	Unit		LG9	LG10	LG7	LG19	MW4	LG17	LG11	LG15	LG14	MW2
Sample Date/Time			43174	43174	43174	43174	43174	43174	43174	43174	43174	43174
Sample Matrix			Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
	Unit	Compound	LG09	LG10	LG07	LG19	MW4	LG17	LG11	LG15	LG14	MW2
Aluminium,Total as Al	mg/l	Aluminium,Total as Al	4.5	1.7	16.2	1.4	2.8	0.8	0.6	To Follow	To Follow	0.2
Arsenic, Ultra-low Total as As	ug/l	Arsenic, Ultra-low Total as As	45	17	92	30	64	17	10	187	67	31
Barium, Total as Ba	mg/l	Barium, Total as Ba	1.49	0.221	2.19	0.395	0.472	0.135	0.277	To Follow	To Follow	0.193
Boron, Total as B	mg/l	Boron, Total as B	2.61	0.69	2.41	0.53	3.3	<0.23	0.47	To Follow	To Follow	<0.23
Cadmium , Total as Cd	mg/l	Cadmium , Total as Cd	0.003	0.0011	0.0035	0.0014	0.0036	0.0009	<0.0006	To Follow	To Follow	0.001
Calcium , Total as Ca	mg/l	Calcium , Total as Ca	115	174	140	215	139	160	477	To Follow	To Follow	126
Chromium , Total as Cr	mg/l	Chromium , Total as Cr	0.022	0.008	0.026	0.008	0.022	0.005	0.003	To Follow	To Follow	0.002
Copper, Total as Cu	mg/l	Copper, Total as Cu	0.033	0.021	0.212	0.024	0.098	0.013	0.021	To Follow	To Follow	0.009
Iron , Total as Fe	mg/l	Iron , Total as Fe	69.3	31.7	104	61.6	26.6	43.5	18.9	To Follow	To Follow	61.9
Lead , Total as Pb	mg/l	Lead , Total as Pb	0.168	0.029	0.124	0.063	1.01	0.031	0.021	To Follow	To Follow	0.014
Manganese , Total as Mn	mg/l	Manganese , Total as Mn	1.07	1.42	1.26	2.64	1.5	2.02	2.03	To Follow	To Follow	0.981
Mercury, Total as Hg	ug/l	Mercury, Total as Hg	<0.05	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel, Total as Ni	mg/l	Nickel , Total as Ni	0.072	0.027	0.224	0.032	0.096	0.051	0.011	To Follow	To Follow	0.055
Potassium , Total as K	mg/l	Potassium , Total as K	242	51.7	243	29.5	265	25.8	22.9	To Follow	To Follow	3.4
Selenium, trace Total as Se	ug/l	Selenium Ultra Low Total as Se	<0.80	<0.80	<0.80	<0.80	<8.00	<0.80	<0.80	<8.00	<8.00	<0.80
Sodium , Total as Na	mg/l	Sodium , Total as Na	341	62.3	329	25.9	342	32.7	26.3	To Follow	To Follow	10.2
Vanadium , Total as V	mg/l	Vanadium , Total as V	0.035	0.007	0.052	0.007	0.018	0.009	<0.004	To Follow	To Follow	<0.004
Zinc, Total as Zn	mg/l	Zinc, Total as Zn	0.456	0.121	0.522	0.547	0.871	0.808	0.178	To Follow	To Follow	0.05
pH	pH units	pH	7.3	6.9	SEE A/C	SEE A/C	7.1	7	6.9	SEE A/C	SEE A/C	SEE A/C
Conductivity- Electrical 20C	uS/cm	Conductivity- Electrical 20C	6470	1900	6190	1400	5710	1210	2090	8910	6330	660
Alkalinity as CaCO3	mg/l	Alkalinity as CaCO3	SEE A/C	790	SEE A/C	770	SEE A/C	421	529	SEE A/C	SEE A/C	261
Ammoniacal Nitrogen as N	mg/l	Ammoniacal Nitrogen as N	374	67.8	335	33.8	337	29.4	N/S	537	466	N/S
Ammoniacal Nitrogen as N (LL)	mg/l	Ammoniacal Nitrogen as N (LL)	N/S	N/S	N/S	N/S	N/S	N/S	14.3	N/S	N/S	4.88
Chloride as Cl	mg/l	Chloride as Cl	705	115	592	47.8	549	50.7	45.4	1070	580	30
Nitrite as N	mg/l	Nitrite as N	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Nitrogen, Total Oxidised as N	mg/l	Nitrogen, Total Oxidised as N	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Phosphate, Ortho as P	mg/l	Phosphate, Ortho as P	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Phosphates , Total as P	mg/l	Phosphates , Total as P	11	0.84	12	3.7	2.2	0.8	1.1	To Follow	To Follow	0.2
Sulphate as SO4	mg/l	Sulphate as SO4	19	129	27.1	<4.4	N/S	10.6	502	36.6	18.2	29.9
Sulphate, total as SO4 by I.C.	mg/l	Sulphate, total as SO4 by I.C.	N/S	N/S	N/S	N/S	To Follow	N/S	N/S	ND	ND	ND
Solids, Tot Dissolved 180 DegC	mg/l	Solids, Tot Dissolved 180 DegC	2290	888	2490	745	2200	601	1590	3870	2140	386
Total Suspended Solids	mg/l	Total Suspended Solids	1900	SEE A/C	1430	774	1740	SEE A/C	408	SEE A/C	3770	227
BOD + ATU (5 day)	mg/l	BODS + ATU	219	27	36	13	25	60	43	97	104	21
COD (Total)	mg/l	COD	1060	280	442	106	567	264	325	1530	945	43
TOC as C	mg/l	TOC as C	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow
Cyanide, Total as CN	mg/l	Cyanide, Total as CN	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	0.009	<0.009	<0.009
Fluoride as F	mg/l	Fluoride as F	0.3	0.2	0.3	0.2	0.3	0.2	0.1	0.5	0.3	0.2
2 - Chlorophenol	ug/l	2 - Chlorophenol	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<3.00	<3.00	<1.00
2 - Methylphenol	ug/l	2 - Methylphenol	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<3.00	<3.00	<1.00
2,4 - Dichlorophenol	ug/l	2,4 - Dichlorophenol	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<3.00	<3.00	2.18
2,4 - Dimethylphenol	ug/l	2,4 - Dimethylphenol	<1.00	2.49	<1.00	<1.00	<3.00	<1.00	<1.00	4.78	<3.00	<1.00
2,4,6 - Trichlorophenol	ug/l	2,4,6 - Trichlorophenol	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<3.00	<3.00	<1.00
3,5-Dimethylphenol	ug/l	3,5-Dimethylphenol	<1.00	2.11	<1.00	<1.00	15.4	<1.00	<1.00	7.81	24.4	<1.00
4-Chlorophenol	ug/l	4-Chlorophenol	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<3.00	<3.00	<1.00
3+4-Methylphenol	ug/l	3+4-Methylphenol	<1.00	14.6	<1.00	<1.00	<3.00	2.19	<1.00	<3.00	109	<1.00
Phenol	ug/l	Phenol	<5.00	<5.00	<5.00	<5.00	<15.00	<5.00	<5.00	<15.00	<15.00	<5.00
Acenaphthene	ug/l	Acenaphthene	0.469	0.627	0.536	0.122	0.923	0.043	0.278	0.211	0.169	0.23
Acenaphthylene	ug/l	Acenaphthylene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Anthracene	ug/l	Anthracene	<0.10	0.046	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Benzo (a) anthracene	ug/l	Benzo (a) anthracene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Benzo (g,h,i) perylene	ug/l	Benzo (g,h,i) perylene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Benzo (a) pyrene	ug/l	Benzo (a) pyrene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Benzo (b) fluoranthene	ug/l	Benzo (b) fluoranthene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Benzo (k) fluoranthene	ug/l	Benzo (k) fluoranthene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Chrysene	ug/l	Chrysene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Dibenz (a,h) anthracene	ug/l	Dibenz (a,h) anthracene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Fluoranthene	ug/l	Fluoranthene	<0.10	0.066	0.101	<0.04	0.176	<0.04	<0.04	0.163	<0.10	0.035
Fluorene	ug/l	Fluorene	0.235	0.331	0.271	0.059	0.447	0.049	0.098	0.211	<0.10	0.109
Indeno (1,2,3) cd pyrene	ug/l	Indeno (1,2,3) cd pyrene	<0.10	<0.04	<0.04	<0.04	<0.10	<0.04	<0.04	<0.10	<0.10	<0.02
Naphthalene	ug/l	Naphthalene	2.88	0.56	0.152	0.243	0.582	0.399	0.06	3.05	2.02	0.493
Phenanthrene	ug/l	Phenanthrene	0.219	0.119	0.057	<0.04	0.332	0.048	<0.04	0.382	<0.10	0.114
Pyrene	ug/l	Pyrene	0.119	0.065	0.087	<0.04	0.141	<0.04	<0.04	0.195	<0.10	0.027
PAH, Total	ug/l	PAH, Total	3.93	1.81	1.2	0.424	2.6	0.538	0.436	4.22	2.19	1.01
1,1,1,2-Tetrachloroethane	ug/l	1,1,1,2-Tetrachloroethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,1-Trichloroethane	ug/l	1,1,1-Trichloroethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,2,2-Tetrachloroethane	ug/l	1,1,2,2-Tetrachloroethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,2-Trichloroethane	ug/l	1,1,2-Trichloroethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethane	ug/l	1,1-Dichloroethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethene	ug/l	1,1-Dichloroethene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloropropene	ug/l	1,1-Dichloropropene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichlorobenzene	ug/l	1,2,3-Trichlorobenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichloropropane	ug/l	1,2,3-Trichloropropane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,4-Trichlorobenzene	ug/l	1,2,4-Trichlorobenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,4-Trimethylbenzene	ug/l	1,2,4-Trimethylbenzene	1.16	1.95	<1.00	6.48	5.03	1.86	<1.00	7.5	4.13	2.59
1,2-Dibromo-3-chloropropane	ug/l	1,2-Dibromo-3-chloropropane	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
1,2-Dibromoethane	ug/l	1,2-Dibromoethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichlorobenzene	ug/l	1,2-Dichlorobenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloroethane	ug/l	1,2-Dichloroethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloropropane	ug/l	1,2-Dichloropropane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3,5-Trimethylbenzene	ug/l	1,3,5-Trimethylbenzene	<1.00	<1.00	<1.00	1.66	1.5	<1.00	<1.00	1.19	<1.00	<1.00
1,3-Dichlorobenzene	ug/l	1,3-Dichlorobenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3-Dichloropropane	ug/l	1,3-Dichloropropane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,4-Dichlorobenzene	ug/l	1,4-Dichlorobenzene	<1.00	<1.00	<1.00	<1.00	4.44	<1.00	<1.00	<1.00	<1.00	<1.00
2,2-Dichloropropane	ug/l	2,2-Dichloropropane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2-Chlorotoluene	ug/l	2-Chlorotoluene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorotoluene	ug/l	4-Chlorotoluene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Benzene	ug/l	Benzene	1.23	<1.00	<1.00	3.24	1.45	<1.00	1.95	1.36	<1.00	<1.00
Bromobenzene	ug/l	Bromobenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromochloromethane	ug/l	Bromochloromethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromodichloromethane	ug/l	Bromodichloromethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromoform	ug/l	Bromoform	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

Customer Sample Ref.	Unit		LG9	LG10	LG7	LG19	MW4	LG17	LG11	LG15	LG14	MW2
Sample Date/Time			43174	43174	43174	43174	43174	43174	43174	43174	43174	43174
Sample Matrix			Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
	Unit	Compound	LG09	LG10	LG07	LG19	MW4	LG17	LG11	LG15	LG14	MW2
Bromomethane	ug/l	Bromomethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Carbon Tetrachloride	ug/l	Carbon Tetrachloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chlorobenzene	ug/l	Chlorobenzene	1.83	<1.00	<1.00	7.57	1.93	<1.00	<1.00	1.59	<1.00	<1.00
Chloroethane	ug/l	Chloroethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloroform	ug/l	Chloroform	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloromethane	ug/l	Chloromethane	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<10.0
cis-1,2-Dichloroethene	ug/l	cis-1,2-Dichloroethene	<1.00	<1.00	<1.00	5.34	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
cis-1,3-Dichloropropene	ug/l	cis-1,3-Dichloropropene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dibromochloromethane	ug/l	Dibromochloromethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dibromomethane	ug/l	Dibromomethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dichlorodifluoromethane	ug/l	Dichlorodifluoromethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dichloromethane	ug/l	Dichloromethane	<1.00	<1.00	<1.00	1.04	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Ethyl Benzene	ug/l	Ethyl Benzene	<1.00	<1.00	<1.00	6.84	6.76	3.35	<1.00	6.59	2.37	<1.00
Hexachlorobutadiene	ug/l	Hexachlorobutadiene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
iso-Propylbenzene	ug/l	Isopropylbenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
m&p Xylene	ug/l	m&p-Xylene	1.18	<1.00	<1.00	12.8	11.9	6.32	<1.00	13.9	4.93	<1.00
MTBE	ug/l	MTBE	<1.00	<1.00	<1.00	1.95	1.23	<1.00	<1.00	1.72	1.08	<1.00
Naphthalene	ug/l	Naphthalene	5.3	1.93	2.66	1.53	2.25	<1.00	<1.00	3.08	3.48	<1.00
n-butylbenzene	ug/l	n-Butylbenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
n-propylbenzene	ug/l	n-Propylbenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
o-Xylene	ug/l	o-Xylene	1.29	<1.00	<1.00	4.9	5.27	2.84	<1.00	5.13	3.3	<1.00
p-isopropyltoluene	ug/l	p-Isopropyltoluene	<1.00	<1.00	<1.00	6	29.9	20.9	<1.00	6.75	2.79	<1.00
sec-butylbenzene	ug/l	sec-Butylbenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Styrene	ug/l	Styrene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
tert-Butylbenzene	ug/l	tert-Butylbenzene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Tetrachloroethene	ug/l	Tetrachloroethene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Toluene	ug/l	Toluene	<1.00	<1.00	<1.00	11.3	5.37	27.3	<1.00	3.71	3.49	<1.00
trans-1,2-Dichloroethene	ug/l	trans-1,2-Dichloroethene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
trans-1,3-Dichloropropene	ug/l	trans-1,3-Dichloropropene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Trichloroethene	ug/l	Trichloroethene	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Trichlorofluoromethane	ug/l	Trichlorofluoromethane	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Vinyl Chloride	ug/l	Vinyl Chloride	<0.500	<0.500	<0.500	3.72	1.28	<0.500	<0.500	<0.500	<0.500	<0.500
Xylene, Total	ug/l	Xylene, Total	2.47	<1.00	<1.00	17.7	17.1	9.16	<1.00	19.1	8.23	<1.00
SVOC	ug/l	SVOC	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Phenol	ug/l	Phenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Bis(2-chloroethyl)ether	ug/l	Bis(2-chloroethyl)ether	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2-Chlorophenol	ug/l	2-Chlorophenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
1,3-Dichlorobenzene	ug/l	1,3-Dichlorobenzene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
1,4-Dichlorobenzene	ug/l	1,4-Dichlorobenzene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2-Methylphenol	ug/l	2-Methylphenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
3&4-Methylphenol	ug/l	3&4-Methylphenol	<4.0	16.7	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	36.6	<20.0
Dibenzofuran	ug/l	Dibenzofuran	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
1,2-Dichlorobenzene	ug/l	1,2-Dichlorobenzene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Bis(2-chloroisopropyl)ether	ug/l	Bis(2-chloroisopropyl)ether	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
n-Nitrosodi-n-propylamine	ug/l	n-Nitrosodi-n-propylamine	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Hexachloroethane	ug/l	Hexachloroethane	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Nitrobenzene	ug/l	Nitrobenzene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Isophorone	ug/l	Isophorone	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2,4-Dimethylphenol	ug/l	2,4-Dimethylphenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2-Nitrophenol	ug/l	2-Nitrophenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Bis(2-chloroethoxy)methane	ug/l	Bis(2-chloroethoxy)methane	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2,4-Dichlorophenol	ug/l	2,4-Dichlorophenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
1,2,4-Trichlorobenzene	ug/l	1,2,4-Trichlorobenzene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Naphthalene	ug/l	Naphthalene	<8.0	<20.0	<40.0	<20.0	<40.0	<40.0	<4.0	<40.0	<40.0	<40.0
Hexachlorobutadiene	ug/l	Hexachlorobutadiene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
4-Chloro-3-methylphenol	ug/l	4-Chloro-3-methylphenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2-Methylnaphthalene	ug/l	2-Methylnaphthalene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2,4,6-Trichlorophenol	ug/l	2,4,6-Trichlorophenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2,4,5-Trichlorophenol	ug/l	2,4,5-Trichlorophenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2-Chloronaphthalene	ug/l	2-Chloronaphthalene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Dimethylphthalate	ug/l	Dimethylphthalate	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2,6-Dinitrotoluene	ug/l	2,6-Dinitrotoluene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Acenaphthylene	ug/l	Acenaphthylene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Acenaphthene	ug/l	Acenaphthene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2,4-Dinitrotoluene	ug/l	2,4-Dinitrotoluene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Diethylphthalate	ug/l	Diethylphthalate	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
4-Nitrophenol	ug/l	4-Nitrophenol	<20.0	<50.0	<100	<50.0	<100	<100	<10.0	<100	<100	<100
4-Chlorophenyl phenyl ether	ug/l	4-Chlorophenyl phenyl ether	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Fluorene	ug/l	Fluorene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Diphenylamine	ug/l	Diphenylamine	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
4-Bromophenyl Phenyl Ether	ug/l	4-Bromophenyl Phenyl Ether	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Hexachlorobenzene	ug/l	Hexachlorobenzene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Pentachlorophenol	ug/l	Pentachlorophenol	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Phenanthrene	ug/l	Phenanthrene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Anthracene	ug/l	Anthracene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
di-n-Butylphthalate	ug/l	di-n-Butylphthalate	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Fluoranthene	ug/l	Fluoranthene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Pyrene	ug/l	Pyrene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Benzyl Butyl Phthalate	ug/l	Benzyl Butyl Phthalate	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Benzo(a)anthracene	ug/l	Benzo(a)anthracene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Chrysene	ug/l	Chrysene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Bis(2-ethylhexyl)phthalate	ug/l	Bis(2-ethylhexyl)phthalate	<20.0	<50.0	<100	<50.0	<100	<100	<10.0	<100	<100	<100
Di-n-octylphthalate	ug/l	Di-n-octylphthalate	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Benzo(b)fluoranthene	ug/l	Benzo(b)fluoranthene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Benzo(k)fluoranthene	ug/l	Benzo(k)fluoranthene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Benzo(a)pyrene	ug/l	Benzo(a)pyrene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Indeno(1,2,3-c,d)pyrene	ug/l	Indeno(1,2,3-c,d)pyrene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Dibenz(a,h)anthracene	ug/l	Dibenz(a,h)anthracene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
Benzo(g,h,i)perylene	ug/l	Benzo(g,h,i)perylene	<4.0	<10.0	<20.0	<10.0	<20.0	<20.0	<2.0	<20.0	<20.0	<20.0
2-Fluorophenol	%Recovery	2-Fluorophenol	96.3	100	97.5	99.5	102.1	99.8	93.3	98.8	95	93.9
Phenol-d6	%Recovery	Phenol-d6	89.9	99.1	92.8	94.3	101.1	85.2	92.8	98.7	99.5	80.4
Nitrobenzene-d5	%Recovery	Nitrobenzene-d5	90	94.9	90.8	93.5	97.7	95.2	90.6	94.1	95.6	92.1
2-Fluorobiphenyl	%Recovery	2-Fluorobiphenyl	89.2	91.8	86.8	91.3	93	91.7	89.6	90.1	91.3	89.4
2,4,6-Tribromophenol	%Recovery	2,4,6-Tribromophenol	81.5	91.2	91.2	90.6	97.4	94.8	93.1	93.9	96.8	96.3
Terphenyl-d14	%Recovery	Terphenyl-d14	81.1	90.1	100.6	105.2	95.6	94.8	83.2	94	87.7	97.2

Customer Sample Ref.	**Unit**	**BH10**	**BH9**	**BH6**	**G20**	**BH07**	**BH1**	**BH5**
Sample Date/Time		**43173**	**43173**	**43173**	**43174**	**43174**	**43174**	**43174**
Sample Matrix		**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
	Unit	**BH10**	**BH09**	**BH06**	**G20**	**BH07**	**BH01**	**BH05**
Aluminium,Total as Al	mg/l	To Follow	To Follow	To Follow	13.4	50.9	To Follow	<0.1
Arsenic, Ultra-low Total as As	ug/l	24	32	19	<10.0	49	<10.0	<1.0
Barium, Total as Ba	mg/l	To Follow	To Follow	To Follow	2.64	1.51	To Follow	<0.007
Boron, Total as B	mg/l	To Follow	To Follow	To Follow	<4.60	<4.60	To Follow	<0.23
Cadmium , Total as Cd	mg/l	To Follow	To Follow	To Follow	0.0156	0.0347	To Follow	<0.0006
Calcium , Total as Ca	mg/l	To Follow	To Follow	To Follow	5170	2100	To Follow	<0.38
Chromium , Total as Cr	mg/l	To Follow	To Follow	To Follow	<0.040	0.087	To Follow	<0.002
Copper, Total as Cu	mg/l	To Follow	To Follow	To Follow	<0.180	0.226	To Follow	<0.009
Iron , Total as Fe	mg/l	To Follow	To Follow	To Follow	<4.60	58.9	To Follow	<0.23
Lead , Total as Pb	mg/l	To Follow	To Follow	To Follow	<0.120	0.287	To Follow	<0.006
Manganese , Total as Mn	mg/l	To Follow	To Follow	To Follow	40.3	22.7	To Follow	<0.007
Mercury, Total as Hg	ug/l	<0.01	0.07	0.2	0.19	0.1	<0.10	<0.10
Nickel, Total as Ni	mg/l	To Follow	To Follow	To Follow	0.369	0.285	To Follow	<0.003
Potassium , Total as K	mg/l	To Follow	To Follow	To Follow	8.11	7.78	To Follow	<0.18
Selenium, trace Total as Se	ug/l	<8.00	<0.80	<0.80	<8.00	<8.00	<8.00	<0.80
Sodium , Total as Na	mg/l	To Follow	To Follow	To Follow	26.3	9.64	To Follow	<0.30
Vanadium , Total as V	mg/l	To Follow	To Follow	To Follow	<0.080	0.096	To Follow	<0.004
Zinc, Total as Zn	mg/l	To Follow	To Follow	To Follow	1.28	0.737	To Follow	<0.018
pH	pH units	7.3	7.3	7.3	7.6	7.4	SEE A/C	6.3
Conductivity- Electrical 20C	uS/cm	695	451	736	To Follow	To Follow	427	<30.0
Alkalinity as CaCO3	mg/l	430	To Follow	257	481	749	1380	<2.8
Ammoniacal Nitrogen as N	mg/l	0	0	0	N/S	N/S	N/S	N/S
Ammoniacal Nitrogen as N (LL)	mg/l	<0.06	To Follow	<0.06	<0.06	<0.06	<0.06	<0.06
Chloride as Cl	mg/l	24.3	To Follow	19.3	6.6	20.5	36.5	<3.7
Nitrite as N	mg/l	<0.08	To Follow	<0.08	<0.08	<0.08	<0.08	<0.08
Nitrogen, Total Oxidised as N	mg/l	15.6	To Follow	6.9	0.9	7.7	2.5	<0.7
Phosphate, Ortho as P	mg/l	<0.6	To Follow	<0.6	<0.6	<0.6	<0.6	<0.6
Phosphates , Total as P	mg/l	To Follow	To Follow	To Follow	<2.4	4.6	To Follow	<0.120
Sulphate as SO4	mg/l	20.8	To Follow	14.3	7.7	22.7	<4.4	<4.4
Sulphate, total as SO4 by I.C.	mg/l	ND	ND	ND	ND	ND	ND	ND
Solids, Tot Dissolved 180 DegC	mg/l	479	To Follow	408	SEE A/C	345	279	15
Total Suspended Solids	mg/l	To Follow	To Follow	To Follow	SEE A/C	SEE A/C	5220	1
BOD + ATU (5 day)	mg/l	<1	10	9	7	<1	16	2
COD (Total)	mg/l	625	To Follow	33	735	206	1510	<11.0
TOC as C	mg/l	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow
Cyanide, Total as CN	mg/l	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Fluoride as F	mg/l	0.2	To Follow	0.2	0.2	0.2	0.1	<0.1
2 - Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2 - Methylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dichlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	1.15	<1.00
2,4 - Dimethylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4,6 - Trichlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.07
3,5-Dimethylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3+4-Methylphenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Phenol	ug/l	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Acenaphthene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Acenaphthylene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Anthracene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Benzo (a) anthracene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Benzo (g,h,i) perylene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Benzo (a) pyrene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Benzo (b) fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Benzo (k) fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Chrysene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Dibenz (a,h) anthracene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Fluorene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Indeno (1,2,3) cd pyrene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Naphthalene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Phenanthrene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
Pyrene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
PAH, Total	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01
1,1,1,2-Tetrachloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,1-Trichloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,2,2-Tetrachloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,2-Trichloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloropropene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichloropropane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,4-Trichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,4-Trimethylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dibromo-3-chloropropane	ug/l	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
1,2-Dibromoethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloropropane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3,5-Trimethylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3-Dichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3-Dichloropropane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,4-Dichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,2-Dichloropropane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2-Chlorotoluene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorotoluene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Benzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromochloromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromodichloromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	5.69
Bromoform	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

Customer Sample Ref.	Unit	BH10	BH9	BH6	G20	BH07	BH1	BH5
Sample Date/Time		43173	43173	43173	43174	43174	43174	43174
Sample Matrix		Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
	Unit	BH10	BH09	BH06	G20	BH07	BH01	BH05
Bromomethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Carbon Tetrachloride	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloroform	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	16
Chloromethane	ug/l	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
cis-1,2-Dichloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
cis-1,3-Dichloropropene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dibromochloromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.42
Dibromomethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dichlorodifluoromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dichloromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Ethyl Benzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Hexachlorobutadiene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
iso-Propylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
m&p Xylene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
MTBE	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Naphthalene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
n-butylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
n-propylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
o-Xylene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
p-isopropyltoluene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
sec-butylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Styrene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
tert-Butylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Tetrachloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Toluene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
trans-1,2-Dichloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
trans-1,3-Dichloropropene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Trichloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Trichlorofluoromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Vinyl Chloride	ug/l	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
Xylene, Total	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SVOC	ug/l	Y	Y	Y	Y	Y	Y	Y
Phenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Bis(2-chloroethyl)ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2-Chlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
1,3-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
1,4-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2-Methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
3&4-Methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Dibenzofuran	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
1,2-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Bis(2-chloroisopropyl)ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
n-Nitrosodi-n-propylamine	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Hexachloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Nitrobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Isophorone	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2,4-Dimethylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2-Nitrophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Bis(2-chloroethoxy)methane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2,4-Dichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
1,2,4-Trichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Naphthalene	ug/l	<2.0	<2.0	<2.0	<2.0	<2.0	<20.0	<2.0
Hexachlorobutadiene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
4-Chloro-3-methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2-Methylnaphthalene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2,4,6-Trichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2,4,5-Trichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2-Chloronaphthalene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Dimethylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2,6-Dinitrotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Acenaphthylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Acenaphthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2,4-Dinitrotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Diethylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
4-Nitrophenol	ug/l	<5.0	<5.0	<5.0	<5.0	<5.0	<50.0	<5.0
4-Chlorophenyl phenyl ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Fluorene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Diphenylamine	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
4-Bromophenyl Phenyl Ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Hexachlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Pentachlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Phenanthrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
di-n-Butylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Benzyl Butyl Phthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Benzo(a)anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Chrysene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Bis(2-ethylhexyl)phthalate	ug/l	<5.0	<5.0	<5.0	<5.0	<5.0	<50.0	<5.0
Di-n-octylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Benzo(b)fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Benzo(k)fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Benzo(a)pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Indeno(1,2,3-c,d)pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Dibenz(a,h)anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
Benzo(g,h,i)perylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0
2-Fluorophenol	%Recovery	102	99.8	96.3	105.5	97.2	99.2	99.8
Phenol-d6	%Recovery	82.8	78.1	75.2	86.6	81.8	78.1	77.3
Nitrobenzene-d5	%Recovery	91	92.9	87.9	96.4	96.9	92	94.6
2-Fluorobiphenyl	%Recovery	94.1	92.4	89.5	93.7	95.6	89.4	93.4
2,4,6-Tribromophenol	%Recovery	77.2	79.1	77.3	78.5	86.2	82	85.1
Terphenyl-d14	%Recovery	100.4	101.6	95.4	96.2	92	99.6	94.8

Customer Sample Ref.	Unit	SW-1	SP-1	SW-3	SP-2	SW-2	SW-5	SP-5	SP-4	SP-3	SW-4
Sample Date/Time		43172	43172	43172	43172	43172	43172	43172	43172	43172	43172
Sample Matrix		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
	Unit	SW1	SP1	SW3	SP2	SW2	SW5	SP5	SP4	SP3	SW4
Aluminium,Total as Al	mg/l	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	0.2	<0.1
Arsenic, Ultra-low Total as As	ug/l	1.2	<1.0	1.2	1.2	5.5	1.2	125	15	14	<1.0
Barium, Total as Ba	mg/l	0.028	0.042	0.028	0.029	0.09	0.029	0.618	2.55	0.226	0.03
Boron, Total as B	mg/l	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23
Cadmium , Total as Cd	mg/l	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
Calcium , Total as Ca	mg/l	66.9	103	64.1	67.7	198	62.6	180	313	242	63.5
Chromium , Total as Cr	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Copper, Total as Cu	mg/l	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	0.011	<0.009	<0.009
Iron , Total as Fe	mg/l	<0.23	<0.23	<0.23	<0.23	2.28	<0.23	61.3	384	7.23	<0.23
Lead , Total as Pb	mg/l	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.027	0.081	0.209	<0.006
Manganese , Total as Mn	mg/l	0.019	0.01	0.012	0.017	1.24	0.014	4.46	29.4	4.39	0.026
Mercury, Total as Hg	ug/l	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.03	0.01	<0.01
Nickel, Total as Ni	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.008	0.116	0.004	<0.003
Potassium , Total as K	mg/l	2.59	2.04	2.33	2.56	2.41	2.29	7.41	8.13	1.02	1.85
Selenium, trace Total as Se	ug/l	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	0.87	<0.80
Sodium , Total as Na	mg/l	14.2	17.3	13.9	14	23.4	13.9	26.9	30.9	13.2	13.6
Vanadium , Total as V	mg/l	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Zinc, Total as Zn	mg/l	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	0.106	0.03	<0.018
pH	pH units	8.1	8.1	8	8.2	8	7.8	7.4	6.8	7.7	8
Conductivity- Electrical 20C	uS/cm	432	616	420	443	845	398	902	948	538	414
Alkalinity as CaCO3	mg/l	157	172	156	155	274	140	230	497	423	144
Ammoniacal Nitrogen as N	mg/l	0	0	0	0	0	0	0	0	0	0
Ammoniacal Nitrogen as N (LL)	mg/l	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.42	<0.06	0.08	<0.06
Chloride as Cl	mg/l	31.7	33.6	30.6	31.8	36.1	29.2	56.3	70.5	27.6	31
Nitrite as N	mg/l	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.12	<0.08	<0.08
Nitrogen, Total Oxidised as N	mg/l	2.8	4.7	2.6	2.7	1	2.8	1	2.4	<0.7	2.8
Phosphate, Ortho as P	mg/l	<0.6	<0.6	<0.6	<0.6	0.7	<0.6	<0.6	1.2	<0.6	<0.6
Phosphates , Total as P	mg/l	<0.120	<0.120	<0.120	<0.120	<0.120	<0.120	<0.120	<0.120	0.18	<0.120
Sulphate as SO4	mg/l	22.1	28.1	22	22.1	126	20	51.5	20.7	29.6	20.7
Sulphate, total as SO4 by I.C.	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Solids, Tot Dissolved 180 DegC	mg/l	300	395	286	318	590	363	524	627	383	289
Total Suspended Solids	mg/l	6	14	4	9	152	3	296	4440	476	8
BOD + ATU (5 day)	mg/l	<1	1	2	<1	3	<1	2	23	7	<1
COD (Total)	mg/l	24	30	24	30	44	30	35	704	200	13
TOC as C	mg/l	To Follow	To Follow	2.3	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow	To Follow
Cyanide, Total as CN	mg/l	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Fluoride as F	mg/l	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
2 - Chlorophenol	ug/l	<1.00	1.43	1.59	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2 - Methylphenol	ug/l	<1.00	1.22	1.34	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dichlorophenol	ug/l	<1.00	<1.00	1.04	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dimethylphenol	ug/l	<1.00	1.07	1.17	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4,6 - Trichlorophenol	ug/l	<1.00	1.44	1.54	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3,5-Dimethylphenol	ug/l	<1.00	1.01	1.06	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorophenol	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3+4-Methylphenol	ug/l	<1.00	1.97	2.27	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Phenol	ug/l	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Acenaphthene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo (a) anthracene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo (g,h,i) perylene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo (a) pyrene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo (b) fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo (k) fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenz (a,h) anthracene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno (1,2,3) cd pyrene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PAH, Total	ug/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,1-Trichloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,2,2-Tetrachloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,2-Trichloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloropropene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichloropropane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,4-Trichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,4-Trimethylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dibromo-3-chloropropane	ug/l	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
1,2-Dibromoethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloropropane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3,5-Trimethylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3-Dichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3-Dichloropropane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,4-Dichlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,2-Dichloropropane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2-Chlorotoluene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorotoluene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Benzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromochloromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromodichloromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromoform	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

Customer Sample Ref.	Unit	SW-1	SP-1	SW-3	SP-2	SW-2	SW-5	SP-5	SP-4	SP-3	SW-4
Sample Date/Time		43172	43172	43172	43172	43172	43172	43172	43172	43172	43172
Sample Matrix		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
	Unit	SW1	SP1	SW3	SP2	SW2	SW5	SP5	SP4	SP3	SW4
Bromomethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Carbon Tetrachloride	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chlorobenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloroethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloroform	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloromethane	ug/l	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
cis-1,2-Dichloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
cis-1,3-Dichloropropene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dibromochloromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dibromomethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dichlorodifluoromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dichloromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Ethyl Benzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Hexachlorobutadiene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
iso-Propylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
m&p Xylene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
MTBE	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Naphthalene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
n-butylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
n-propylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
o-Xylene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
p-isopropyltoluene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
sec-butylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Styrene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
tert-Butylbenzene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Tetrachloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Toluene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
trans-1,2-Dichloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
trans-1,3-Dichloropropene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Trichloroethene	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Trichlorofluoromethane	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Vinyl Chloride	ug/l	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
Xylene, Total	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SVOC	ug/l	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Phenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethyl)ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
3&4-Methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenzofuran	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Nitrosodi-n-propylamine	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachloroethane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isophorone	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitrophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethoxy)methane	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trichlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hexachlorobutadiene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-methylphenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,6-Trichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chloronaphthalene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,6-Dinitrotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Diethylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Nitrophenol	ug/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Chlorophenyl phenyl ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Diphenylamine	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Bromophenyl Phenyl Ether	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobenzene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
di-n-Butylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzyl Butyl Phthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-ethylhexyl)phthalate	ug/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Di-n-octylphthalate	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Indeno(1,2,3-c,d)pyrene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	ug/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Fluorophenol	%Recovery	99.3	99.7	97.4	97.4	98.9	97	100.3	92.4	95.9	93.7
Phenol-d6	%Recovery	91.3	90.2	86.6	86.8	88.2	88.1	92.1	86	85	85.2
Nitrobenzene-d5	%Recovery	92.2	90.4	88.9	88.6	91.6	88.7	96.8	88.1	88.7	86
2-Fluorobiphenyl	%Recovery	93.5	92.5	90.1	90.7	94.7	92.1	93.4	86.2	91	89.1
2,4,6-Tribromophenol	%Recovery	81.3	79.3	79.1	76.6	80.7	79.3	88.2	81.5	84.6	79
Terphenyl-d14	%Recovery	90.1	99.7	96.2	89.1	97.7	92.2	97.1	85.7	97.3	94.4

APPENDIX H

Groundwater Monitoring Results

Fassaroe Groundwater Monitoring 2016					Site 1	Site 2		Site 3A			Site 3B	Site 3C
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**SW AA EQS**	**15182883**	**15182884**	**15182882**	**15180194**	**15180196**	**15180197**	**15180195**	**15180193**
Customer Sample Ref.					**BH5**	**BH1**	**G20**	**BH7**	**BH9**	**BH10**	**BH8**	**BH6**
Sample Date/Time					**16/03/2016**	**16/03/2016**	**16/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**
Sample Matrix					**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Aluminium,Total as Al	mg/l	0.15	0.2		**15.4**	**29**	**24.8**	*a*	**20.2**	**25.3**	**19.9**	**26.6**
Arsenic, Ultra-low Total as As	ug/l	7.5	10	25	***33***	***29***	**16**	**18**	**24**	***33***	<10.0	***41***
Barium, Total as Ba	mg/l	-	0.1		0.6	0.753	0.736	*a*	0.487	1.07	1.15	1.11
Boron, Total as B	mg/l	0.75	1		<2.30	<4.60	<2.30	*a*	**24.5**	<23.0	<0.23	**28.3**
Cadmium , Total as Cd	mg/l	0.00375	0.005	0.00008	***0.0132***	<0.0060	<0.0060	*a*	***0.0218***	***0.0268***	***0.0428***	***0.0422***
Calcium , Total as Ca	mg/l		200		**622**	**702**	**803**	*a*	**836**	**1340**	**4490**	**1390**
Chromium , Total as Cr	mg/l	0.0375	0.03	0.0034	***0.032***	***0.063***	***0.048***	*a*	***0.035***	***0.05***	*0.027*	***0.047***
Copper, Total as Cu	mg/l	1.5	0.03	0.005	<0.090	<0.180	<0.090	*a*	<0.090	<0.090	*0.013*	*0.154*
Iron , Total as Fe	mg/l		0.2		**26.8**	**54**	**36.3**	*a*	**30**	**42.4**	**13.3**	**43.5**
Lead , Total as Pb	mg/l	0.01875	0.01	0.0072	***0.084***	***0.119***	<0.060	*a*	***0.151***	***0.192***	***0.017***	***0.273***
Manganese , Total as Mn	mg/l		0.05		5.71	6.77	7.4	*a*	10.3	17.8	26.9	24.7
Mercury, Total as Hg	ug/l	0.75	1	0.05	*0.35*	*0.37*	*0.35*	<0.10	*0.26*	<0.10	<0.10	<0.10
Nickel , Total as Ni	ug/l	15	20	20	***99.8***	***154***	***141***	*a*	***218***	***305***	***205***	***531***
Potassium , Total as K	mg/l		5		2.88	4.4	3.81	*a*	2.36	3.67	26.8	30.9
Sodium , Total as Na	mg/l	150	150		12.5	7.86	10.2	*a*	4.64	7.11	9.52	23.7
Vanadium , Total as V	mg/l				<0.040	0.067	0.052	*a*	<0.040	0.053	0.042	0.056
Zinc, Total as Zn	mg/l		0.1	0.008	***0.713***	***0.256***	***0.256***	*a*	***1.04***	***0.625***	***0.328***	***0.723***
Selenium Ultra Low Total as Se	mg/l				0.0039	0.0022	0.0023	0.0025	<0.0008	<0.0008	<0.0008	<0.0008
BOD5 + ATU	mg/l			1.5		*5*	*5*	*4*	*3*	*4*	*2*	*3*
COD	mg/l				137	347	98	970	850	1270	1910	1050
pH	pH units		6.5-9.5	6.0 - 9.0	6.8	6.9	7.2	7.4	7.1	7.1	6.7	7.1
Conductivity- Electrical 20C	uS/cm	800-1875			933	957	594	372	342	470	822	471
Alkalinity as CaCO3	mg/l		NAC		3330	2630	1230	<2.8	924	2820	11200	3430
Ammoniacal Nitrogen as N	mg/l	0.175		0.065	*0.27*	*0.94*	*0.07*	*b*	<0.41	<0.41	<0.41	<0.41
Chloride as Cl	mg/l	187.5	30		21.6	23.3	20.6	*b*	16.2	26.1	23.8	**30.1**
Nitrite as N	mg/l	0.375	0.1		<0.08	<0.08	<0.08	*b*	<0.08	<0.08	<0.08	0.09
Nitrogen, Total Oxidised as N	mg/l		NAC		9.1	1.4	10.5	*b*	3.8	12.3	11.9	6.4
Phosphate, Ortho as P	mg/l		0.03	0.035	<0.6	<0.6	<0.6	*b*	<0.6	<0.6	<0.6	<0.6
Sulphate as SO4	mg/l	150	200		9.8	25.6	<4.4	*b*	<4.4	9.2	6	16.3
Solids, Tot Dissolved 180 DegC	mg/l		1000		463	600	286	308	338	468	667	452
Total Suspended Solids	mg/l				57800	21300	14800	617000	7650	14900	341000	17500
TOC as C	mg/l		NOC		1.3	1.1	<0.7	1.3	<0.7	<0.7	2.1	0.9
Cyanide, Total as CN	ug/l	37.5	0.01	0.01	<9	<9	<9	<9	<9	<9	<9	<9
Fluoride as F	mg/l		1	0.5	<0.1	0.1	0.1	0.2	<0.1	<0.1	<0.1	0.1
2 - Chlorophenol	ug/l		200		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2 - Methylphenol	ug/l				<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dichlorophenol	ug/l				<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dimethylphenol	ug/l				<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4,6 - Trichlorophenol	ug/l				<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3,5-Dimethylphenol	ug/l				<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorophenol	ug/l				<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3+4-Methylphenol	ug/l				<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Phenol	ug/l		0.5	8	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
EH >C6 - C40	ug/l				**13**	<10	<10	<10	<10	<10	<10	<10
EH >C6 - C8	ug/l				<10	<10	<10	<10	<10	<10	<10	<10
EH >C8 - C10	ug/l		Total Hydro-		<10	<10	<10	<10	<10	<10	<10	<10
EH >C16 - C24	ug/l		carbons 10 ug/l		<10	<10	<10	<10	<10	<10	<10	<10
EH >C24 - C40	ug/l				**13**	<10	<10	<10	<10	<10	<10	<10
EH >C10 - C16	ug/l				<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	ug/l				<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	ug/l				<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Anthracene	ug/l		10000	0.1	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (a) anthracene	ug/l				<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (g,h,i) perylene	ug/l		0.05	0.002	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (a) pyrene	ug/l	0.0075	0.01	0.05	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (b) fluoranthene	ug/l		0.5	0.03	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Benzo (k) fluoranthene	ug/l		0.05		<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Chrysene	ug/l				<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Dibenz (a,h) anthracene	ug/l				<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Fluoranthene	ug/l		1	0.1	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Fluorene	ug/l				<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Indeno (1,2,3) cd pyrene	ug/l		0.05	0.002	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Naphthalene	ug/l		1	2.4	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.10
Phenanthrene	ug/l				<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
Pyrene	ug/l				<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01
PAH, Total	ug/l	75	0.1	n/a	<0.01	<0.01	<0.01	<0.10	<0.01	<0.01	<0.01	<0.10

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values

EPA IGV - EPA Interim Guidelines Values for Groundwater (2003)

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average EQS

10 Exceedance above GW Regs TV

10 Exceedance above EPA IGV

10 Exceedance above SW EQS

NAC No Abnormal Change

a Insufficient sample for metals analysis.

b Unable to analyse due to soil sediment in sample

Fassaroe Groundwater Monitoring 2016					Site 1	Site 2		Site 3A			Site 3B	Site 3C
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**SW AA EQS**	**15182883**	**15182884**	**15182882**	**15180194**	**15180196**	**15180197**	**15180195**	**15180193**
Customer Sample Ref.					**BH5**	**BH1**	**G20**	**BH7**	**BH9**	**BH10**	**BH8**	**BH6**
Sample Date/Time					**16/03/2016**	**16/03/2016**	**16/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**
Sample Matrix					**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Phenol	ug/l		0.5	8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethyl)ether	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
3&4-Methylphenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenzofuran	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Nitrosodi-n-propylamine	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachloroethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrobenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isophorone	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitrophenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethoxy)methane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dichlorophenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trichlorobenzene	ug/l			0.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l		1	2.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hexachlorobutadiene	ug/l			0.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-methylphenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,6-Trichlorophenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chloronaphthalene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethylphthalate	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,6-Dinitrotoluene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Diethylphthalate	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Nitrophenol	ug/l				<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Chlorophenyl phenyl ether	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Diphenylamine	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Bromophenyl Phenyl Ether	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobenzene	ug/l			0.01	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	ug/l		2	0.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	ug/l		10000	0.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
di-n-Butylphthalate	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	ug/l		1	0.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzyl Butyl Phthalate	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)anthracene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-ethylhexyl)phthalate	ug/l				<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Di-n-octylphthalate	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	ug/l		0.5	0.03	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	ug/l		0.05	0.03	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	ug/l	0.0075	0.01	0.05	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Indeno(1,2,3-c,d)pyrene	ug/l		0.05		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	ug/l		0.05	0.002	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values

EPA IGV - EPA Interim Guidelines Values for Groundwater (2003)

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average EQS

10 Exceedance above GW Regs TV

10 Exceedance above EPA IGV

10 Exceedance above SW EQS

10 Above Detection Limit

Fassaroe Groundwater Monitoring 2016					Site 1	Site 2		Site 3A			Site 3B	Site 3C
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**SW AA EQS**	**15182883**	**15182884**	**15182882**	**15180194**	**15180196**	**15180197**	**15180195**	**15180193**
Customer Sample Ref.					**BH5**	**BH1**	**G20**	**BH7**	**BH9**	**BH10**	**BH8**	**BH6**
Sample Date/Time					**16/03/2016**	**16/03/2016**	**16/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**	**15/03/2016**
Sample Matrix					**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Dichlorodifluoromethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	ug/l				<1.0	<1.0	<1.0	<1.3	<1.6	<2.1	<1.6	<1.0
Chloroethane	ug/l	0.375			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloromethane	ug/l		10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,2-Dichloropropane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	ug/l		12		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromochloromethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloropropene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	ug/l	2.25	3	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene	ug/l	0.75	1	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	ug/l	7.5	40		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromomethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,3-Dichloropropene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene	ug/l		10	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,3-Dichloropropene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	ug/l				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	ug/l	7.5	40	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dibromoethane	ug/l		0.04		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	ug/l		1	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1,2-Tetrachloroethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	ug/l		10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
m&p-Xylene	ug/l		10	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	ug/l		10	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Styrene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,3-Trichloropropane	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Propylbenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromobenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorotoluene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3,5-Trimethylbenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chlorotoluene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
tert-Butylbenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trimethylbenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
sec-Butylbenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
p-Isopropyltoluene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Butylbenzene	ug/l				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l		10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dibromo-3-chloropropane	ug/l				<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1,2,4-Trichlorobenzene	ug/l		0.4	0.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobutadiene	ug/l		0.1	0.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l		1	2.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,3-Trichlorobenzene	ug/l		0.4	0.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MTBE	ug/l		30		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values — 10 Exceedance above GW Regs TV — 10 Above Detection Limit

EPA IGV - EPA Interim Guidelines Values for Groundwater (2003) — **10** Exceedance above EPA IGV

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average EQS — *10* Exceedance above SW EQS

APPENDIX I

Surface Water Monitoring Results

Fassaroe Surface Water Monitoring 2016			River					Springs				
Laboratory Number	**Units**	**SW AA EQS**	**15160206**	**15160207**	**15160208**	**15160209**	**15160210**	**15160211**	**15160212**	**15160213**	**15160214**	**15160215**
Customer Sample Ref.			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SP1**	**SP2**	**SP3**	**SP4**	**SP5**
Sample Date/Time			**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**
Sample Matrix			**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**
Aluminium,Total as Al	mg/l		<0.1	<0.1	0.7	1	2	20.3	1	2.9	<0.1	<0.1
Arsenic, Ultra-low Total as As	ug/l	25	<1.0	<1.0	2.4	3.6	8.1	709	23	14	127	<1.0
Barium, Total as Ba	mg/l		0.031	0.033	0.041	0.048	0.075	9.42	0.13	0.258	0.506	0.027
Boron, Total as B	mg/l		<0.23	<0.23	<0.23	<0.23	<0.23	<2.30	<0.23	<0.23	<0.23	<0.23
Cadmium , Total as Cd	mg/l	0.00008	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.0221	<0.0006	0.0008	<0.0006	<0.0006
Calcium , Total as Ca	mg/l		85.8	82.9	71	68	53.9	2320	180	376	147	105
Chromium , Total as Cr	mg/l	0.0034	<0.002	<0.002	0.003	0.004	0.007	0.03	0.002	0.007	<0.002	<0.002
Copper, Total as Cu	mg/l	0.005	<0.009	<0.009	<0.009	<0.009	0.011	0.197	<0.009	0.016	<0.009	<0.009
Iron , Total as Fe	mg/l		<0.23	<0.23	1.29	1.86	3.45	1550	9.45	7.55	54	0.35
Lead , Total as Pb	mg/l	0.0072	<0.006	<0.006	0.012	0.016	0.02	0.906	0.018	0.32	0.007	0.007
Manganese , Total as Mn	mg/l		0.033	0.034	0.199	0.281	0.618	53.9	3.08	2.09	5.02	0.066
Mercury, Total as Hg	ug/l	0.05	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel , Total as Ni	ug/l	20	<3.00	<3.00	<3.00	4.4	10.6	140	7.7	16.3	7.5	<3.00
Potassium , Total as K	mg/l		1.95	1.93	2.08	2.58	3.26	70.5	1.71	1.21	7.56	0.47
Sodium , Total as Na	mg/l		13.7	25.9	22.4	35.8	19.3	62.2	20	12.3	25.7	12.2
Vanadium , Total as V	mg/l		<0.004	<0.004	<0.004	<0.004	0.006	0.125	0.004	0.009	<0.004	<0.004
Zinc, Total as Zn	mg/l	0.008	<0.018	<0.018	0.03	0.04	0.05	2.28	0.03	0.08	<0.018	<0.018
Selenium Ultra Low Total as Se	mg/l		<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	0.0042	<0.0008	<0.0008
BODS + ATU	mg/l	1.5	<1	<1	3	2	5	298	5	9	2	<2
COD	mg/l		<5	<5	30	44	67	4280	199	798	29	21
pH	pH units	6.0 - 9.0	8.3	8.3	8.1	7.9	7.8	7.2	8.2	8.1	7.3	8.2
Conductivity- Electrical 20C	uS/cm	1875	475	529	451	507	397	1410	598	471	776	532
Alkalinity as CaCO3	mg/l		208	201	168	158	136	6630	417	1130	358	214
Ammoniacal Nitrogen as N	mg/l	0.065	<0.41	<0.41	<0.41	<0.41	<0.41	25.7	<0.41	<0.41	5.8	<0.41
Chloride as Cl	mg/l		28.6	54.4	45.5	71.2	45.1	109	44.3	21.7	37.8	34
Nitrite as N	mg/l		<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.1	<0.08
Nitrogen, Total Oxidised as N	mg/l		3	2.9	2.3	2	1.7	<0.7	<0.7	1.2	1.9	7.9
Phosphate, Ortho as P	mg/l	0.035	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.7
Sulphate as SO4	mg/l		19.2	18.6	15.2	15.3	14.4	<4.4	42.4	15.9	12.5	15
Solids, Tot Dissolved 180 DegC	mg/l		283	336	231	357	208	990	383	305	282	360
Total Suspended Solids	mg/l		11	10	89	144	334	69700	754	2720	235	27
TOC as C	mg/l		1.9	1.8	2.6	3.1	4.9	17.7	4.1	5.7	3.1	2.5
Cyanide, Total as CN	ug/l	0.01	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9
Fluoride as F	mg/l	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
2 - Chlorophenol	ug/l		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2 - Methylphenol	ug/l		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dichlorophenol	ug/l		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4 - Dimethylphenol	ug/l		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,4,6 - Trichlorophenol	ug/l		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3,5-Dimethylphenol	ug/l		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorophenol	ug/l		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
3+4-Methylphenol	ug/l		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Phenol	ug/l	8	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
EH >C6 - C40	ug/l		<10	<10	259	465	294	47	<10	<10	<10	<10
EH >C6 - C8	ug/l		<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
EH >C8 - C10	ug/l		<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
EH >C16 - C24	ug/l		<10	<10	32	37	27	<20	<10	<10	<10	<10
EH >C24 - C40	ug/l		<10	<10	227	428	267	47	<10	<10	<10	<10
EH >C10 - C16	ug/l		<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
Acenaphthene	ug/l		<0.01	<0.01	<0.01	0.012	0.024	<0.04	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	ug/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01	<0.01	<0.01
Anthracene	ug/l	0.1	<0.01	<0.01	<0.01	0.017	0.013	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (a) anthracene	ug/l		<0.01	<0.01	0.053	0.265	0.129	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (g,h,i) perylene	ug/l	0.002	<0.01	<0.01	0.081	0.39	0.168	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (a) pyrene	ug/l	0.05	<0.01	<0.01	0.084	0.466	0.213	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (b) fluoranthene	ug/l	0.03	<0.01	<0.01	0.094	0.466	0.199	<0.04	<0.01	<0.01	<0.01	<0.01
Benzo (k) fluoranthene	ug/l		<0.01	<0.01	0.044	0.224	0.097	<0.04	<0.01	<0.01	<0.01	<0.01
Chrysene	ug/l		<0.01	<0.01	0.073	0.315	0.142	<0.04	<0.01	<0.01	<0.01	<0.01
Dibenz (a,h) anthracene	ug/l		<0.01	<0.01	0.016	0.09	0.042	<0.04	<0.01	<0.01	<0.01	<0.01
Fluoranthene	ug/l	0.1	<0.01	<0.01	0.104	0.439	0.233	<0.04	<0.01	<0.01	<0.01	<0.01
Fluorene	ug/l		<0.01	<0.01	<0.01	<0.01	0.01	<0.04	<0.01	<0.01	<0.01	<0.01
Indeno (1,2,3) cd pyrene	ug/l	0.002	<0.01	<0.01	0.072	0.388	0.165	<0.04	<0.01	<0.01	<0.01	<0.01
Naphthalene	ug/l	2.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.09	<0.075	<0.25	<0.01
Phenanthrene	ug/l		<0.01	<0.01	0.031	0.097	0.071	<0.04	<0.01	<0.01	<0.01	<0.01
Pyrene	ug/l		<0.01	<0.01	0.106	0.458	0.225	<0.04	<0.01	<0.01	<0.01	<0.01
PAH, Total	ug/l	n/a	<0.01	<0.01	0.756	3.63	1.73	<0.04	<0.09	<0.01	<0.01	<0.01

Legend

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average Environmental Quality Standards

10 Exceedance above SW EQS

Fassaroe Surface Water Monitoring 2016			River					Springs				
Laboratory Number	**Units**	**SW AA EQS**	**15160206**	**15160207**	**15160208**	**15160209**	**15160210**	**15160211**	**15160212**	**15160213**	**15160214**	**15160215**
Customer Sample Ref.			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SP1**	**SP2**	**SP3**	**SP4**	**SP5**
Sample Date/Time			**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**
Sample Matrix			**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**
Phenol	ug/l	8	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethyl)ether	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
3&4-Methylphenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Dibenzofuran	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
n-Nitrosodi-n-propylamine	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Hexachloroethane	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Nitrobenzene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Isophorone	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Nitrophenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroethoxy)methane	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4-Dichlorophenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trichlorobenzene	ug/l	0.4	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l	2.4	<2.0	<20.0	<2.0	<2.0	<2.0	<8.0	<2.0	<2.0	<2.0	<2.0
Hexachlorobutadiene	ug/l	0.1	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-methylphenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4,6-Trichlorophenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2-Chloronaphthalene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Dimethylphthalate	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,6-Dinitrotoluene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Diethylphthalate	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
4-Nitrophenol	ug/l		<5.0	<50.0	<5.0	<5.0	<5.0	<20.0	<5.0	<5.0	<5.0	<5.0
4-Chlorophenyl phenyl ether	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Fluorene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Diphenylamine	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
4-Bromophenyl Phenyl Ether	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobenzene	ug/l	0.01	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	ug/l	0.4	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Anthracene	ug/l	0.1	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
di-n-Butylphthalate	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	4.8	<1.0	<1.0	<1.0	<1.0
Fluoranthene	ug/l	0.1	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Pyrene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzyl Butyl Phthalate	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)anthracene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Chrysene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Bis(2-ethylhexyl)phthalate	ug/l		<5.0	<50.0	<5.0	<5.0	<5.0	<20.0	<5.0	<5.0	<5.0	<5.0
Di-n-octylphthalate	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	ug/l	0.03	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	ug/l	0.03	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	ug/l	0.05	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Indeno(1,2,3-c,d)pyrene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	ug/l		<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	ug/l	0.002	<1.0	<10.0	<1.0	<1.0	<1.0	<4.0	<1.0	<1.0	<1.0	<1.0

Legend

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average Environmental Quality Standards

10 Exceedance above SW EQS

10 Above Detection Limit

Fassaroe Surface Water Monitoring 2016			River					Springs				
Laboratory Number	**Units**	**SW AA EQS**	**15160206**	**15160207**	**15160208**	**15160209**	**15160210**	**15160211**	**15160212**	**15160213**	**15160214**	**15160215**
Customer Sample Ref.			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SP1**	**SP2**	**SP3**	**SP4**	**SP5**
Sample Date/Time			**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**	**04/03/2016**
Sample Matrix			**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**
Dichlorodifluoromethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Dichloromethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
2,2-Dichloropropane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Chloroform	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromochloromethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloropropene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	ug/l	10	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Benzene	ug/l	10	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Dibromomethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
cis-1,3-Dichloropropene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Toluene	ug/l	10	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
trans-1,3-Dichloropropene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	ug/l		<0.5	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	ug/l	10	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dibromoethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	ug/l	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1,1,2-Tetrachloroethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Ethyl Benzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
m&p-Xylene	ug/l	10	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	ug/l	10	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Styrene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromoform	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2,3-Trichloropropane	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
n-Propylbenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Bromobenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
2-Chlorotoluene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,3,5-Trimethylbenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
4-Chlorotoluene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
tert-Butylbenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trimethylbenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
sec-Butylbenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
p-Isopropyltoluene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
n-Butylbenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2-Dibromo-3-chloropropane	ug/l		<2.0	<2.0	<2.0	<2.0	<2.0	<20.0	<2.0	<2.0	<2.0	<2.0
1,2,4-Trichlorobenzene	ug/l	0.4	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobutadiene	ug/l	0.1	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	ug/l	2.4	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
1,2,3-Trichlorobenzene	ug/l	0.4	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0
MTBE	ug/l		<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0

Legend

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average Environmental Quality Standards

10 Exceedance above SW EQS

10 Above Detection Limit

APPENDIX J

Gas Monitoring Data

Day Monday & Tuesday

Date 07/08th March 2016

NOTE: Flow sampling tube is damaged

Weather as per Met Eireann:

Location		Wind		Weather	Temp	Humidity	Rain	Pressure	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Accuweather (Enniskerry)		NNW	15km/h	Mostly cloudy with some rain	3 to 7		1	1004/1005	Monday
Met Eireann (Dub Airport)			9.2	Cloudy			4.1	996	Tuesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady								
									Site 1					
									Onsite					
LG 11		0	1.4	6.2		9.4	0.082	0.0	10.0	32.7	1.7	0.32	13	
LG 12		0	0.0	6.1		12.7	0.022	0.0	0.0	0.0	1	0.25	12	
LG 13		0	2.1	4.7		14.1	0.114	0.0	0.0	47.9	2.1	0.36	9	
									Offsite					
G06	1.8	0.4	16.7	7.6		0.3	0.429	0.0	0.0	>>>	>>	0.21	11	
G07	7.1	6.9	0.0	2.1		17.1	0.011	0.0	0.0	0.0	1	0.2	14	
G08	6.5	6.3	0.0	0.3		19.9	0.011	0.0	0.0	0.0	1	0.26	14	
G10		0	0.0	0.8		19.2	0.011	0.0	0.0	0.0	1	0.12	18	
G18		0	0.0	0.2		19.7	0.014	0.0	0.0	0.0	1	0.13	14	
G19	0.4	0	0.0	0.2		20.0	0.014	0.0	0.0	0.0	1	0.2	14	
BH05		0	0.0	0.0		20.5	0.012	0.0	0.0	0.0	1	0.21	29	
									Site 2					
									Onsite					
LG 01													5	No gas tap
LG 02		0	0.0	0.0		20.0	0.015	0.0	0.0	0.0	1	0.18	9	
LG 03	1.8	0	59.6	20.4		1.0	0.833	0.0	0.0	>>>	>>	0.16	18	
LG 04												0.1	15	Could not open
LG 05	0.9	-4.2	52.9*	23.5		2.3	0.008	0.0	0.0	>>>	>>	0.1	14	Stopped at 5mins
LG 06		0	6.8*	3.6		17.8	0.264	0.0	0.0	>>>	5.3	0.33	6.4	stopped at 6mins
LG 07	0.4	0	9.2*	2.2		16.0	0.003	0.0	10.0	>>>	8		17	stopped at 5mins
LG 08	0.9	0.4	31.4*	16.7		8.6	0.006	0.0	0.0	>>>	>>	0.1	8	Stopped at 5mins
LG 09	1.8	0	0.0	0.1		20.3	0.016	0.0	0.0	0.0	1	0.1	17	
LG 10	0	0	4.8	2.3		18.6	0.213	0.0	0.0	>>>	3.8	0.22	18	Stopped at 5mins
									Offsite					
G01		-3.4	0.0	0.0	20.3	20.2	0.014	0.0	0.0	0.0	1	0.44	17.1	
G02	3.9	0	0.0	0.0	20.3	20.1	0.015	0.0	0.0	0.0	1	ground level	19.5	
G03	1	0	0.0	0.0	20.3	20.2	0.014	0.0	0.0	0.0	1	0.15	19.5	
G04	0.4	0	0.0	1.2		14.2	0.016	0.0	0.0	0.0	1	0.35	20	
G05												0.1	20	No gas tap
G13	3.1	-3.6	0.0	0.0		20.0	0.016	0.0	0.0	0.0	1	0.16	20	
G20		0	0.0	0.0		20.1	0.015	0.0	0.0	0.0	1	0.28	20	
G21	4.6	range -0.5 to -3.4	0.0	0.1	20.3	20.0	0.015	0.0	0.0	0.0	1	0.43	17	
G22	20	19.8	0.0	0.0	20.0	19.8	0.017	0.0	0.0	0.0	1	0.33	15	
G23	-1	-6.3	0.0	0.0		20.0	0.016	0.0	0.0	0.0	1	0.1	20	Gas tap open
G24	1.6	-9.4	0.0	0.0		20.0	0.015	0.0	0.0	0.0	1	0.1	20	
G25	0	-0.1	0.0	0.0		20.0	0.021	0.0	0.0	0.0	1	0.3	20	
BH01		0	0.0	0.0		20.1	0.017	0.0	0.0	0.0	1	0.22	21	
BH03	0	-3.8	0.0	0.0	20.3	20.1	0.014	0.0	0.0	0.0	1	0.1	19.5	
BH04	0.4	-11.7	0.0	0.0		20.1	0.015	0.0	0.0	0.0	1	0.27	25.5	
BH11	3.5	-6.4	0.0	0.0	20.4	20.1	0.015	0.0	0.0	0.0	1	0.12	33	
BH13		0	0.0	0.1		20.0	0.021	0.0	0.0	0.0	1	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady								
Site 3A														
Onsite														
LG 15	6.4	5.8	54.7	23.3		-0.2	0.835	0.0	0.0	>>>	>>	0.2	8	Odour noted
LG 19	45.6	45	69.8	30.4		-0.2	0.989	0.0	0.0	>>>	>>	0.36	15	Odour noted
LG 20	7.6	7.5	51.7	27.3		2.6	0.806	0.0	0.0	>>>	>>	0.49	12	
MW3 (25 dia. Pipe)			69.1	31.3		-0.3	0.981	0.0	0.0	>>>	>>	~0.5	11	No gas tap
MW3 (50 dia. Pipe)			5.6	2.4		18.2	0.236	0.0	0.0	>>>	4.3	1.04	18.1	Gas tap broken - no flow taken
MW4	44.8	43.5	71.5	28.5		-0.3	0.998	0.0	0.0	>>>	>>	1	10	Odour noted
Offsite														
G12	0.4	0	0.0	0.0		20.6	0.016	0.0	0.0	0.0	1	0.2	14	
G14		0	0.0	1.1		18.1	0.014	0.0	0.0	0.0	1	0.38	14	
BH07	1.6	0.6	0.0	1.1		17.9	0.014	0.0	0.0	0.0	1	0.26	21	
BH09	1.9	0	0.0	0.9		16.7	0.015	0.0	0.0	0.0	1	0.19	12	
BH10	2.2	1.6	0.0	0.9		18.4	0.016	0.0	0.0	0.0	1	0.19	14	
Site 3B														
Onsite														
LG 16	3.4	3.3	70.1	29.9		-0.1	0.976	0.0	0.0	>>>	>>	0.24	3.5	
LG 17			65.1	34.2		-0.2	0.931	0.0	10.0	>>>	>>	0.26	3.9	No gas tap therefore no flow taken. Sample taken with cap removed
LG 21			63.0	36.6		-0.2	0.912	0.0	0.0	>>>	>>	0.28	4	No gas tap - no flow. Sample taken with tap off
Offsite														
G15		0	0.0	1.7		18.0	0.014	0.0	0.0	0.0	1	0.28	6	
G16		0	0.0	0.7		19.4	0.015	0.0	0.0	0.0	1	0.34	6	
G17		0	0.0	0.8		18.4	0.015	0.0	0.0	0.0	1	0.37	6	
BH08		0	0.0	3.1		16.1	0.018	0.0	0.0	0.0	1	0.8	13.5	
Site 3C														
Onsite														
MW2			25.8	12.3		12.4	0.542	0.0	0.0	>>>	>>	0.75	5	Old coroded gas tap. Rubber bung taken off when monitoring. Odour noted
LG 14	2.8	0.6	73.0	26.3		-0.1	0.997	0.0	0.0	>>>	>>	0.37	12	Flow still fluctuating. Odour noted
LG 18	2.1	1	68.2	31.9		-0.2	0.971	25.0	0.0	>>>	>>	0.38	10	Tap open - closed and left for 10mins and then measurements taken. Odour noted
Offsite														
G09	0.3	0	12.9	8.1		2.4	0.374	0.0	0.0	>>>	>>	0.42	14	
G11		0	0.0	0.1		20.1	0.013	0.0	0.0	0.0	1	0.27	15	
BH06		0	12.8	12.9		4.5	0.373	0.0	0.0	>>>	>>	ground level	14	

Day Tuesday & Wednesday
Date 15/16th March 2016
Weather as per Met Eireann:

Location		Wind		Weather	Temp	Humidity	Rain	Pressure (measured on site)		
								Morning	Evening	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)		
Accuweather (Enniskerry)		E	10mph	cloudy, mild, dry	9.00	62	0	1018		Tuesday
Met Eireann (Dublin Airport)		NE	12Kts	Cloudy	8	81	0	1020	1020	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11		0	0.0	0.7	20.1	19.2	0.021	0.0	0.0	0.0	1	11.77	0.32	13	
LG 12		0	0.0	1.9	18.9	18.7	0.012	0.0	0.0	0.0	1	dry	0.25	12	
LG 13		0	0.6	2.4	19.9	16.8	0.049	0.0	0.0	14.6	1.2	9.47	0.36	9	
Offsite															
G06	0.9	0	14.1	8.1		-0.3	0.389	0.0	0.0	>>>	>>	dry	0.21	11	silty
G07	0	-0.3 to -0.7	0.0	0.0		20.2	0.014	0.0	0.0	0.0	1	dry	0.2	14	
G08		-3.1	0.0	0.1		20.2	0.013	0.0	0.0	0.0	1	dry	0.26	14	sand
G10		0	0.0	0.9		18.8	0.013	0.0	0.0	0.0	1	9.22	0.12	18	
G18		0	0.0	0.3		19.8	0.013	0.0	0.0	0.0	1	dry	0.13	14	
G19		0	0.0	0.5		19.4	0.013	0.0	0.0	0.0	1	7.94	0.2	14	
BH05	1.6	0	0.0	0.0		20.2	0.014	0.0	0.0	0.0	1	20.43	0.21	29	
Site 2															
Onsite															
LG 01	0.1	0	15.3	8.8	19.1	3.1	0.407	0.0	0.0	>>>	>>	4.23		5	
LG 02	2.8	2.4	51.3	21.1		1.5	0.794	0.0	0.0	>>>	>>	8.1	0.18	9	
LG 03	4	4	62.9	19.6		0.4	0.902	0.0	0.0	>>>	>>	12.93	0.16	18	
LG 04		0	5.0	5.1		13.4	0.218	0.0	10.0	>>>	3.9	11.92	0.1	15	
LG 05	6.5	6.3	66.1	27.1		-0.2	0.929	0.0	0.0	>>>	>>	13.91	0.1	14	
LG 06	2.8	2.7	56.7	26.9	17.7	1.7	0.846	0.0	0.0	>>>	>>	cap stuck - no wl reading	0.33	6.4	
LG 07	2.1	1.5/1.6 (fluctuating)	22.2	7.3		11.6	0.492	0.0	0.0	>>>	>>	~10.4		17	leachate - reading inconsistent
LG 08	4.3	4	42.4	22.8		3.5	0.701	0.0	0.0	>>>	>>	~7.73	0.1	8	leachate - reading inconsistent
LG 09	0.9	0	1.9	1.9		18.3	0.108	0.0	0.0	45.2	1	~9.75	0.1	17	leachate - reading inconsistent
LG 10	3.9	3.5	52.4	23.4	17.3	0.1	0.804	0.0	0.0	>>>	>>	~12.2	0.22	18	leachate - reading inconsistent
Offsite															
G01		0	0.0	0.2	20.3	19.9	0.014	0.0	0.0	0.0	1	dry	0.44	17.1	sand on probe
G02	3.3	3.2	0.0	2.1 (still rising)	19.7	16.9	0.013	0.0	0.0	0.0	1	dry	ground level	19.5	
G03	4.2	4	0.2	3.4	16.4	12.4	0.038	0.0	0.0	5.2	1	dry	0.15	19.5	
G04	0.1	0	0.0	1.7		11.8	0.014	0.0	0.0	0.0	1	8.76	0.35	20	
G05		0	0.0	0.1		20.4	0.018	0.0	0.0	0.0	1	16.06	0.1	20	
G13	5.8	5.6	0.0	0.2	20.2	19.9	0.014	0.0	0.0	0.0	1	dry	0.16	20	
G20		0	0.0	0.1		20.2	0.014	0.0	0.0	0.0	1	14.43	0.28	20	
G21		0	0.0	0.4	20.0	19.8	0.015	0.0	0.0	0.0	1	dry	0.43	17	
G22		0	0.0	0.5	19.9	19.1	0.013	0.0	0.0	0.0	1		0.33	15	gas tap stuck
G23	3.5	3.4	0.0	0.5	20.0	19.6	0.012	0.0	0.0	0.0	1		0.1	20	gas tap stuck
G24	7.9	7.4	0.0	0.9		18.3	0.012	0.0	0.0	0.0	1	dry	0.1	20	
G25		0	13.4	2.6		14.1	0.378	0.0	0.0	0.0	1	dry	0.3	20	
BH01		0	0.0	0.0		20.1	0.014	0.0	0.0	0.0	1	14.38	0.22	21	
BH03	6	5.8	1.0	1.6	18.8	17.5	6.400	0.0	0.0	23.8	1.5	dry	0.1	19.5	
BH04	0	-3.3	0.0	0.0		20.1	0.015	0.0	0.0	0.0	1	dry	0.27	25.5	probe silty
BH11	6.9	6.3	16.3	13.3	12.4	3.0	0.420	0.0	0.0	>>>	>>	dry	0.12	33	
BH13	2.4	1.5	19.2	7.4		-0.3	0.456	0.0	0.0	>>>	>>	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	3.3	1.5	54.5	24.6		-0.3	0.826	0.0	0.0	>>>	>>	7.08	0.2	8	
LG 19	31.3	29.4	70.1	30.2		-0.3	0.989	0.0	0.0	>>>	>>	14.48	0.36	15	
LG 20	4.2	4	61.7	31.1		-0.1	0.892	0.0	0.0	>>>	>>	dry	0.49	12	
MW3 (25 dia. Pipe)			69.6	30.7		-0.3	0.980	25.0	0.0	>>>	>>		~0.5	11	unable to take flow measurement due to sample tube not long enough
MW3 (50 dia. Pipe)													1.04	18.1	not sampled
MW4	29.2	26.9	71.0	29.3		-0.3	0.992	25.0	0.0	>>>	>>	7.63	1	10	
Offsite															
G12		0	0.0	0.0	20.3	20.2	0.013	0.0	0.0	0.0	1	10.13	0.2	14	
G14		0	0.0	0.8		18.7	0.012	0.0	0.0	0.0	1	7.53	0.38	14	
BH07		-0.1	0.0	0.0		20.0	0.015	0.0	0.0	0.0	1	13.71	0.26	21	
BH09		0	0.0	0.5		18.8	0.013	0.0	0.0	0.0	1	6.43	0.19	12	
BH10		0	0.0	0.1	20.1	20.0	0.013	0.0	0.0	0.0	1	8.43	0.19	14	
Site 3B															
Onsite															
LG 16	1.3	0.6/0.7	69.8	30.3		-0.1	0.963	0.0	0.0	>>>	>>	3.33	0.24	3.5	
LG 17													0.26	3.9	not sampled
LG 21													0.28	4	not sampled
Offsite															
G15		0	0.0	2.0		17.4	0.013	0.0	0.0	0.0	1	5.41	0.28	6	fence posts damaged by cattle in field
G16		0	0.0	1.1		18.4	0.012	0.0	0.0	0.0	1	4.08	0.34	6	
G17		0	0.0	1.4		15.9	0.013	0.0	0.0	0.0	1	dry	0.37	6	silty
BH08		0	0.0	1.8		17.5	0.012	0.0	0.0	0.0	1	6.61	0.8	13.5	
Site 3C															
Onsite															
MW2		0	26.5	18.2		10.0	0.540	40.0	0.0	>>>	>>	5	0.75	5	replaced old seized tap - left for 10 mins and sampled
LG 14	1.6	1	74.0	26.2		-0.3	1.016	25.0	0.0	>>>	>>	9.66	0.37	12	flow fluctuating
LG 18	1.3	0/0.1	67.8	32.4		-0.3	0.966	30.0	0.0	>>>	>>	10	0.38	10	silty
Offsite															
G09		0	0.0	0.4		19.8	0.023	0.0	0.0	0.0	1	12.3	0.42	14	
G11		0	0.0	0.9		17.4	0.013	0.0	0.0	0.0	1	9.83	0.27	15	
BH06		0	12.9	10.7		7.2	0.370	0.0	0.0	>>>	>>	5.53	ground level	14	

Day Tuesday & Wednesday
Date 22/23rd March 2016
Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured on site)		
								Morning	Evening	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)		
Dublin airport (met eireann)		E	4	Cloudy	8.00	69	0	1005	1003	Tuesday
Dublin airport (met eireann)		SW	13	Fair	10	68	0	1003	1005	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11	0	0	1.7	5.6	20.0	11.8	0.095	0.0	0.0	39.6	1.8	11.91	0.32	13	
LG 12	0	0	1.5	13.4	19.3	4.1	0.086	0.0	0.0	34.7	1.7	Dry	0.25	12	
LG 13	0	0	6.9	14.7	19.2	4.7	0.265	0.0	0.0	100+	5.4	9.4	0.36	9	
Offsite															
G06	3.1	3	13.8	7.9	18.0	-0.2	0.388	0.0	0.0	>>>	>>	Dry	0.21	11	
G07	3.1	3	0.0	3.3	20.1	15.7	0.014	0.0	0.0	0.0	1	dry	0.2	14	
G08	4.2	4.1	0.0	0.0		20.2	0.015	0.0	0.0	0.0	1	dry	0.26	14	
G10	0.1	0	0.0	1.5	19.6	18.2	0.012	0.0	0.0	0.0	1	9.24	0.12	18	
G18	0.4	0.3	0.0	0.8	19.7	18.1	0.013	0.0	0.0	0.0	1	dry	0.13	14	
G19	0	0	0.0	1.0	19.8	17.9	0.013	0.0	0.0	0.0	1	7.97	0.2	14	
BH05	0	0	0.0	0.3		19.9	0.015	0.0	0.0	0.0	1	20.07	0.21	29	
Site 2															
Onsite															
LG 01	1.3	0.7	33.1	11.8		-0.3	0.616	0.0	0.0	>>>	>>	4.35		5	
LG 02	0.6	0.1	54.4	22.0	18.0	2.0	0.829	0.0	0.0	>>>	>>	8.17	0.18	9	
LG 03	4.3	4.2	65.6	21.5	16.4	-0.2	0.931	0.0	0.0	>>>	>>	~15	0.16	18	water level reading approx due to presence of leachate
LG 04	0	0	21.7	11.8	17.7	10.0	0.490	0.0	0.0	>>>	>>	11.97	0.1	15	
LG 05	7.1	7	65.5	27.5	11.5	-0.3	0.929	0.0	0.0	>>>	>>	13.78	0.1	14	
LG 06	3.4	0	64.0	28.5	18.1	-0.1	0.918	0.0	0.0	>>>	>>	6.62	0.33	6.4	
LG 07	3.3	3.3	63.1	25.1	15.4	-0.1	0.909	0.0	0.0	>>>	>>	~10		17	water level reading approx due to presence of leachate
LG 08	4.9	4.6	57.9	29.3	14.9	-0.2	0.863	0.0	0.0	>>>	>>	~7.8	0.1	8	water level reading approx due to presence of leachate
LG 09	3.4	3	61.6	23.5	15.6	-0.1	0.896	0.0	0.0	>>>	>>	10.98	0.1	17	water level reading approx due to presence of leachate
LG 10	3.9	0	58.7	24.4	18.5	-0.3	0.870	0.0	0.0	>>>	>>	17.5	0.22	18	water level reading approx due to presence of leachate
Offsite															
G01	3.9	3.8	0.0	4.9	17.0	11.8	0.010	0.0	0.0	0.0	1	dry	0.44	17.1	
G02	2.4	1.8	0.0	6.8	18.1	8.7	0.011	0.0	0.0	0.0	1	Dry	ground level	19.5	
G03	4.3	4.2	4.5	10.5		1.1	0.204	0.0	0.0	>>>	3.8		0.15	19.5	
G04	0	0	0.0	1.6	19.1	11.6	0.014	0.0	0.0	0.0	1	9.05	0.35	20	
G05	0.4	0.1	12.7	2.0	17.9	12.2	0.370	0.0	0.0	>>>	>>	16.16	0.1	20	
G13	6.7	6.4	0.0	0.7	20.1	19.1	0.011	0.0	0.0	0.0	1	dry	0.16	20	
G20	3	2.8	0.0	0.8	17.8	15.7	0.013	0.0	0.0	0.0	1	14.41	0.28	20	
G21	3.7	3.4	0.0	1.6	19.5	17.0	0.009	0.0	0.0	0.0	1	dry	0.43	17	
G22	0	0	0.0	0.7	20.2	18.9	0.012	0.0	0.0	0.0	1		0.33	15	gas tap stuck
G23	0.1	0	0.0	0.8	19.9	19.3	0.012	0.0	0.0	0.0	1		0.1	20	gas tap stuck
G24	8.4	8.4	0.0	1.0	18.8	17.0	0.011	0.0	0.0	0.0	1	dry	0.1	20	
G25	1.2	0.9	30.7	7.3	17.0	5.0	0.593	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	1	0.7	0.0	2.2	20.2	14.1	0.012	0.0	0.0	0.0	1	14.14	0.22	21	
BH03	5.8	5	8.6	7.1	16.8	8.0	0.300	0.0	0.0	>>>	7.3	dry	0.1	19.5	
BH04	11.4	10.8	0.0	1.8	12.7	7.2	0.013	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11	7.5	6.7	5.2	12.6	12.9	2.3	0.224	0.0	0.0	>>>	4	dry	0.12	33	
BH13	2.2	1.5	18.0	7.7	16.0	0.0	0.445	0.0	0.0	>>>	>>	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	4.3	4.2	52.9	26.8		-0.2	0.814	0.0	0.0	>>>	>>	7.13	0.2	8	
LG 19	35.1	33.7	70.4	29.7	6.5	-0.2	0.991	0.0	0.0	>>>	>>	~14.27	0.36	15	water level reading approx due to presence of leachate
LG 20	3.1	3	46.7	26.7	19.2	-0.2	0.751	0.0	10.0	>>>	>>	dry	0.49	12	
MW3 (25 dia. Pipe)			69.6	30.5		-0.1	0.984	25.0	0.0	>>>	>>	~9.5	~0.5	11	water level reading approx due to presence of leachate
MW3 (50 dia. Pipe)	0.6	0	13.8	5.7		12.7	0.387	0.0	0.0	>>>	>>	15.96	1.04	18.1	not sampled
MW4	34	31.8	68.3	31.9	7.0	-0.2	0.976	30.0	0.0	>>>	>>	~7.71	1	10	water level reading approx due to presence of leachate
Offsite															
G12	0	0	0.0	0.6	19.5	19.2	0.016	0.0	0.0	0.0	1	10.29	0.2	14	muddy water on dip meter probe
G14	0	0	0.0	0.8	19.9	18.7	0.014	0.0	0.0	0.0	1	7.63	0.38	14	
BH07	1.5	0.6	0.0	1.0	19.6	18.6	0.013	0.0	0.0	0.0	1	13.76	0.26	21	
BH09	0	0	0.0	0.9	20.1	18.9	0.013	0.0	0.0	0.0	1	6.57	0.19	12	
BH10	0	0	0.0	0.6	20.3	19.2	0.015	0.0	0.0	0.0	1	8.5	0.19	14	
Site 3B															
Onsite															
LG 16	3.3	3.2	67.9	31.7	17.3	0.0	0.951	0.0	0.0	>>>	>>	3.33	0.24	3.5	
LG 17	4.6	4.5	67.0	33.2	17+	-0.2	0.960	0.0	0.0	>>>	>>	3.61	0.26	3.9	not sampled
LG 21	0.7	0.4	63.5	36.6	16.7	-0.2	0.922	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	0	0	0.0	2.3	19.5	16.6	0.012	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	0.8	20.0	19.6	0.015	0.0	0.0	0.0	1	4.11	0.34	6	
G17	0	0	0.0	1.5	19.5	16.2	0.013	0.0	0.0	0.0	1	dry	0.37	6	
BH08	0	0	0.0	2.4	19.6	16.4	0.012	0.0	0.0	0.0	1	6.92	0.8	13.5	
Site 3C															
Onsite															
MW2	3.5	1.6	69.5	30.3	17.7	0.0	0.973	25.0	0.0	>>>	>>	5.17	0.75	5	
LG 14	2.2	1.9	74.1	26.1	20.0	-0.2	1.017	40.0	0.0	>>>	>>	9.67	0.37	12	
LG 18	1	0.9	68.1	32.1	17.7	-0.2	0.970	40.0	0.0	>>>	>>	~10	0.38	10	water level reading approx due to presence of leachate
Offsite															
G09	0	0	9.2	7.9	18.6	2.2	0.311	0.0	0.0	>>>	8	12.38	0.42	14	
G11	0	0	0.0	0.9		18.8	0.015	0.0	0.0	0.0	1	9.87	0.27	15	
BH06	0	0	18.1	16.6	17.8	1.1	0.446	0.0	0.0	>>>	>>	5.57	ground level	14	

Day Tuesday & Wednesday
Date 29/30th March 2016
Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured on site)		
								Morning	Evening	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)		
Dublin airport (met eireann)		SW	6	Fine	3	80	0	987	983	Tuesday
Dublin airport (met eireann)		NW	13 gust 30	Rain Shower	6	83	1.2	991	996	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11	0	0	0.0	0.8		19.3	0.026	0.0	0.0	0.0	1	11.79	0.32	13	
LG 12	0	0	0.0	4.5	20.3	16.2	0.011	0.0	0.0	0.0	1	dry	0.25	12	
LG 13	0	0	1.7	6.2		13.4	0.096	0.0	0.0	39.6	1.8	9.48	0.36	9	
Offsite															
G06	1	0.4	22.2	7.2	19.3	0.6	0.501	0.0	0.0	>>>	>>	dry	0.21	11	
G07	0	0	0.0	0.0		20.4	0.012	0.0	0.0	0.0	1	dry	0.2	14	
G08	0	0	0.0	0.1	20.4	20.2	0.013	0.0	0.0	0.0	1	dry	0.26	14	
G10	0	0	0.0	0.3		20.1	0.012	0.0	0.0	0.0	1	9.27	0.12	18	
G18	0	0	0.0	0.5		19.5	0.012	0.0	0.0	0.0	1	7.97	0.13	14	
G19	0	0	0.0	0.2		20.0	0.014	0.0	0.0	0.0	1	dry	0.2	14	
BH05	0	0	0.0	0.8	20.2	19.4	0.010	0.0	0.0	0.0	1	20.1	0.21	29	
Site 2															
Onsite															
LG 01	0	0	18.6	6.8	17.4	8.3	0.456	0.0	0.0	>>>	>>	4.5	0.22	5	
LG 02	0	0	36.4	15.1		7.7	0.654	0.0	0.0	>>>	>>	8.21	0.18	9	
LG 03		-1	26.6	11.7	19.8	11.0	0.554	0.0	0.0	>>>	>>	13.19	0.16	18	fluctuating -1.9 to -0.7
LG 04	0	0	0.0	0.0		20.3	0.016	0.0	0.0	0.0	1	12.13	0.1	15	
LG 05	0	-0.4	45.2	19.9	19.4	5.7	0.740	0.0	0.0	>>>	>>	13.73	0.1	14	
LG 06	0.9	0	31.8	15.2	19.6	9.7	0.609	0.0	0.0	>>>	>>	6.59	0.33	6.4	
LG 07	0	0	67.8	24.1	19.9	0.5	0.956	0.0	0.0	>>>	>>	11		17	
LG 08	-1.3	0	0.0	0.0	20.4	20.3	0.014	0.0	0.0	0.0	1	7.78	0.1	8	
LG 09	0	0	0.0	0.0		20.2	0.017	0.0	0.0	0.0	1	10.83	0.1	17	
LG 10	0	0	17.0	7.4	20.2	14.7	0.437	0.0	0.0	>>>	>>	~13.58	0.22	18	water level reading approx due to presence of leachate
Offsite															
G01		-9	0.0	0.0	20.4	20.2	0.015	0.0	0.0	0.0	0.1	dry	0.44	17.1	
G02	0	-3.3	0.0	0.0		20.1	0.015	0.0	0.0	0.0	1	dry	ground level	19.5	
G03		-4.2	0.0	0.0		20.2	0.013	0.0	0.0	0.0	1	dry	0.15	19.5	
G04	0	0	0.0	1.7	19.5	10.3	0.014	0.0	0.0	0.0	1	9.48	0.35	20	
G05	0	0	0.0	0.0		20.3	0.014	0.0	0.0	0.0	1	16.23	0.1	20	
G13	0	-6.2	0.0	0.0		20.2	0.014	0.0	0.0	0.0	1	dry	0.16	20	
G20	0	-0.9	0.0	0.0		20.1	0.014	0.0	0.0	0.0	1	14.45	0.28	20	
G21		-7.6	0.0	0.2	20.3	20.0	0.015	0.0	0.0	0.0	1	dry	0.43	17	
G22	0	0	0.0	0.1		20.1	0.014	0.0	0.0	0.0	1	gas tap stuck	0.33	15	
G23		-1.3	0.0	0.0	20.4	20.2	0.014	0.0	0.0	0.0	1	gas tap stuck	0.1	20	
G24		-13.7	0.0	0.0		20.2	0.015	0.0	0.0	0.0	1	dry	0.1	20	
G25	0	0	12.4	2.0	19.7	14.3	0.369	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	0.1	-0.4	0.0	0.0		20.2	0.016	0.0	0.0	0.0	1	14.49	0.22	21	
BH03		-9	0.0	0.5	20.3	19.5	0.033	0.0	0.0	0.0	1	dry	0.1	19.5	
BH04		-17.8	0.0	0.0		20.2	0.016	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11		-14.1	0.0	0.0		20.1	0.014	0.0	0.0	0.0	1	dry	0.12	33	
BH13	2.2	1.9	9.9	3.3	19.0	11.6	0.326	0.0	0.0	>>>	8.8	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	0.1	0	47.5	20.1		2.3	0.763	0.0	0.0	>>>	>>	7.06	0.2	8	
LG 19	21	20.1	70.4	29.7	9.0	-0.2	0.988	0.0	0.0	>>>	>>	~14.33	0.36	15	
LG 20	0	-1.3	22.6	12.3	19.7	12.7	0.503	0.0	0.0	>>>	>>	dry	0.49	12	
MW3 (25 dia. Pipe)	no cap		10.4	5.6		17.5	0.334	0.0	0.0	>>>	9.5	10.36	~0.5	11	
MW3 (50 dia. Pipe)	0	0	8.4	3.1	19.1%	12.9	0.297	0.0	0.0	>>>	7.1	16.13	1.04	18.1	not sampled
MW4	27	25.8	69.0	31.1	9.0	-0.2	0.979	40.0	0.0	>>>	>>	7.32	1	10	
Offsite															
G12	0	0	0.0	0.0		20.4	0.014	0.0	0.0	0.0	1	10.44	0.2	14	
G14	1.2	0	0.0	1.3	19.1	18.2	0.012	0.0	0.0	0.0	1	7.75	0.38	14	
BH07	0	0	0.0	0.5	20.1	19.6	0.013	0.0	0.0	0.0	1	13.81	0.26	21	
BH09	0	0	0.0	0.4		19.8	0.014	0.0	0.0	0.0	1	6.75	0.19	12	
BH10	0	0	0.0	1.6	19.8	18.6	0.012	0.0	0.0	0.0	1	8.61	0.19	14	
Site 3B															
Onsite															
LG 16	0	0	42.2	22.3	18.9	5.7	0.707	0.0	0.0	>>>	>>	3.34	0.24	3.5	
LG 17	0	0	67.7	31.6	19.9	0.3	0.954	0.0	0.0	>>>	>>	3.66	0.26	3.9	not sampled
LG 21	0	0	25.8	17.2	18.3	10.9	0.543	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	0.1	0	0.0	0.9	20.1	18.4	0.013	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	1.8	19.4	18.0	0.012	0.0	0.0	0.0	1	4.18	0.34	6	
G17	0	0	0.0	0.5	19.8	19.6	0.015	0.0	0.0	0.0	1	dry	0.37	6	
BH08	0	0	0.0	3.9	18.9	15.2	0.014	0.0	0.0	0.0	1	7.09	0.8	13.5	
Site 3C															
Onsite															
MW2	0	0	63.9	31.2	17.5	1.1	0.921	0.0	0.0	>>>	>>	4.81	0.75	5	
LG 14	0.7	0	72.6	27.5	18.0	-0.2	1.001	40.0	0.0	>>>	>>	9.99	0.37	12	
LG 18	3	0	67.8	32.3	18.9	-0.2	0.969	40.0	0.0	>>>	>>	10.02	0.38	10	
Offsite															
G09	0	0	0.0	0.1		20.3	0.014	0.0	0.0	0.0	1	12.47	0.42	14	
G11	3.4	0	0.0	0.0		20.3	0.011	0.0	0.0	0.0	1	10	0.27	15	
BH06	1.8	0	21.2	17.1	19.6	1.1	0.488	0.0	0.0	>>>	>>	5.65	ground level	14	

Day Tuesday & Wednesday

Date 5/6th April 2016

Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured on site)		
								Morning	Evening	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)		
Dublin Airport		W	13	Fair	11	57	0	999	995	Tuesday
Dublin airport (met eireann)		W	23 Gust 35	Hail Showers	7	76	0.1	990	991	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11	0.0	0.0	0.0	0.1		20.3	0.0	0.0	0.0	0.0	1.0	11.7	0.32	13	
LG 12	0.0	0.0	0.0	0.1		20.3	0.0	0.0	0.0	0.0	1.0	dry	0.25	12	
LG 13	0.0	0.0	1.5	6.5	20.2	12.5	0.1	0.0	0.0	34.6	1.7	9.4	0.36	9	
Offsite															
G06	0.6	0.0	21.1	8.1	16.8	-0.3	0.5	0.0	0.0	>>>	>>	dry	0.21	11	
G07	0	0	0.0	0.0		20.3	0.013	0.0	0.0	0.0	1	dry	0.2	14	
G08	0	-2.1	0.0	0.0		20.4	0.013	0.0	0.0	0.0	1	dry	0.26	14	
G10	0	0	0.0	0.3		20.2	0.011	0.0	0.0	0.0	1	9.32	0.12	18	
G18	0	0	0.0	0.1		20.2	0.013	0.0	0.0	0.0	1	dry	0.13	14	
G19	0	0	0.0	0.3		20.1	0.013	0.0	0.0	0.0	1	8.03	0.2	14	
BH05	0	0	0.0	1.3	19.2%	18.8	0.011	0.0	0.0	0.0	1	20.06	0.21	29	
Site 2															
Onsite															
LG 01	0	0	37.9	10.9	19.8%	2.5	0.666	0.0	0.0	>>>	>>	4.27		5	
LG 02	0.9	0.1	5.4	2.4	19.6	18.3	0.231	0.0	10.0	>>>	4.2	8.42	0.18	9	
LG 03	0	0	49.5	20.6		3.6	0.783	0.0	0.0	>>>	>>	16.34	0.16	18	
LG 04	0	-1.2	0.0	0.0		20.5	0.012	0.0	0.0	0.0	1	12.16	0.1	15	
LG 05	0.1	0	0.0	0.0		20.5	0.011	0.0	0.0	0.0	1	13.84	0.1	14	
LG 06	2.8	0.9	30.5	15.7	19.1	9.5	0.593	0.0	0.0	>>>	>>	6.55	0.33	6.4	
LG 07	0	0	59.1	21.7	20.2	2.8	0.877	0.0	0.0	>>>	>>	9.15		17	
LG 08	0	-3.1	0.0	0.1	20.4	20.2	0.018	0.0	0.0	0.0	1	dry	0.1	8	
LG 09	0	-1.6	0.0	0.3	20.3	20.1	0.033	0.0	0.0	0.0	1	~9.44	0.1	17	
LG 10	0	0	9.4	4.7	20.2	17.1	0.310	0.0	0.0	>>>	7.9	~17.14	0.22	18	
Offsite															
G01	0	-9.1	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.44	17.1	
G02	0	-2.5	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	ground level	19.5	
G03	0	-5.3	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.15	19.5	
G04	0	0	0.0	1.5	19.9	12.4	0.013	0.0	0.0	0.0	1	7.75	0.35	20	
G05	0	0	0.0	0.0	20.4	20.3	0.014	0.0	0.0	0.0	1	16.36	0.1	20	
G13	0	-8.2	0.0	0.0		20.2	0.013	0.0	0.0	0.0	1	dry	0.16	20	
G20	0	-0.4	0.0	0.3	20.2	19.8	0.016	0.0	0.0	0.0	1	14.49	0.28	20	
G21	0	-7.3	0.0	1.3	20.1	15.6	0.011	0.0	0.0	0.0	1	dry	0.43	17	
G22	1.5	0	0.0	0.1		20.2	0.013	0.0	0.0	0.0	1		0.33	15	Gas tap stuck - no water level taken
G23	0	-10.3	0.0	0.0		20.3	0.013	0.0	0.0	0.0	1	17	0.1	20	
G24	0	-15.9	0.0	0.0		20.3	0.013	0.0	0.0	0.0	1	dry	0.1	20	
G25	0	0	12.5	2.2		14.2	0.368	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	0	-0.1	0.0	0.0		20.4	0.014	0.0	0.0	0.0	1	14.65	0.22	21	
BH03	0	-9.3	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.1	19.5	
BH04	0	-18.6	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11	0	-12.6	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.12	33	
BH13	0	0	3.4	1.4	19.8	17.2	0.166	0.0	0.0	77.3	3.5	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	0.7	0	53.4	21.8		0.1	0.824	0.0	0.0	>>>	>>	6.64	0.2	8	
LG 19	31.7	29.6	71.7	28.5	6.7	-0.3	1.001	30.0	0.0	>>>	>>	14.44	0.36	15	
LG 20	9.1	Fluctuating ~3.4	63.2	31.8	19.2	-0.2	0.916	0.0	0.0	>>>	>>		0.49	12	wind affecting steady flow reading
MW3 (25 dia. Pipe)	no cap		34.4	14.6	19.8%	6.4 (after falling to almost 0 started to increase)	0.634	0.0	0.0	>>>	>>	10.16	~0.5	11	
MW3 (50 dia. Pipe)	3	0	8.7	2.9		12.5	0.304	0.0	0.0	>>>	7.4	16.2	1.04	18.1	not sampled
MW4	25.1	23.1	68.7	31.5	8.2	-0.3	0.978	30.0	0.0	>>>	>>	7.05	1	10	
Offsite															
G12	0	0	0.0	0.1		20.1	0.014	0.0	0.0	0.0	1	10.55	0.2	14	
G14	4	~0	0.0	1.8		16.9	0.012	0.0	0.0	0.0	1	7.81	0.38	14	
BH07	5.9	fluctuating ~1.9	0.0	0.0		20.3	0.013	0.0	0.0	0.0	1	13.88	0.26	21	wind affecting steady flow reading
BH09	0	0	0.0	0.9	18.9	14.4	0.013	0.0	0.0	0.0	1	6.85	0.19	12	
BH10	4.2	~1.5	0.0	1.1	19.4	18.7	0.012	0.0	0.0	0.0	1	8.63	0.19	14	wind affecting steady flow reading
Site 3B															
Onsite															
LG 16	4.3	0	39.4	19.5	18.7	7.4	0.682	0.0	0.0	>>>	>>	3.32	0.24	3.5	
LG 17	0	0	67.7	32.4	19.8	-0.2	0.967	0.0	0.0	>>>	>>	3.6	0.26	3.9	not sampled
LG 21	3.1	0	59.9	35.7	19.8	0.0	0.886	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	3.1	0	0.0	2.3	19.7	16.4	0.013	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	2.3	20.1	16.7	0.012	0.0	0.0	0.0	1	4.27	0.34	6	
G17	0	0	0.0	1.1	19.3	17.3	0.013	0.0	0.0	0.0	1	dry	0.37	6	
BH08	0.1	0	0.0	3.9	19.8	15.0	0.012	0.0	0.0	0.0	1	7.26	0.8	13.5	
Site 3C															
Onsite															
MW2	1.2	fluctuating 0	48.9	7.3	18.6	7.3	0.770	0.0	0.0	>>>	>>	4.5	0.75	5	wind affecting steady flow reading
LG 14	2.5	fluctuating 1.2	72.0	28.0	19.1	0.0	0.991	50.0	0.0	>>>	>>	10.5	0.37	12	wind affecting steady flow reading
LG 18	3.3	fluctuating ~1	67.7	32.5	16.3	-0.2	0.970	40.0	0.0	>>>	>>	9.88	0.38	10	wind affecting steady flow reading
Offsite															
G09	2.7	0.4	12.5	12.1	18.0	1.7	0.369	0.0	0.0	>>>	>>	12.6	0.42	14	
G11	0.1	0	0.0	0.1	20.0%	20.0	0.014	0.0	0.0	0.0	1	10.05	0.27	15	
BH06	3.4	0.3	22.2	17.0	18.0	1.3	0.500	0.0	0.0	>>>	>>	5.74	ground level	14	

Day Tuesday & Wednesday
Date 12/13th April 2016
Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured on site)		
								Morning	Evening	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)		
Dublin Airport			4.5				0.6	996	991	Tuesday
Dublin airport (met eireann)								993	994	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11	0.0	0.0	0.0	3.3	19.8	15.0	0.0	0.0	0.0	2.1	1.0	11.5	0.32	13	
LG 12	0.0	0.0	0.0	7.9	19.6	12.5	0.012	0.0	0.0	0.0	1.0	dry	0.25	12	
LG 13	0.0	0.0	2.2	8.4	17.9	10.0	0.1	0.0	0.0	51.8	2.3	9.07	0.36	9	
Offsite															
G06	2.5	2.2	21.7	7.5		-0.2	0.5	0.0	0.0	>>>	>>	dry	0.21	11	
G07	0	0	0.0	1.2	20.2	18.9	0.010	0.0	0.0	0.0	1	19.99	0.2	14	
G08	1.5	1.2	0.0	0.7	20.0%	19.0	0.011	0.0	0.0	0.0	1	dry	0.26	14	
G10	0	0	0.0	1.4	19.6	18.7	0.010	0.0	0.0	0.0	1	9.23	0.12	18	
G18	0	0	0.0	1.1	19.4	13.9	0.010	0.0	0.0	0.0	1	dry	0.13	14	
G19	0.1	0	0.0	0.8	19.6	18.1	0.011	0.0	0.0	0.0	1	7.93	0.2	14	
BH05	1.3	1	0.0	2.3	19.8%	16.7	0.009	0.0	0.0	0.0	1	dry	0.21	29	
Site 2															
Onsite															
LG 01	1.6	0.9	49.6	13.3	17.8%	-0.3	0.786	0.0	0.0	>>>	>>	4.13		5	
LG 02	3.3	3	67.4	27.4	19.8	0.0	0.950	0.0	0.0	>>>	>>	8.43	0.18	9	
LG 03	4.5	4.3	68.2	22.1	16.4	-0.2	0.958	0.0	0.0	>>>	>>	15.32	0.16	18	strong odour
LG 04	3.3	3.1	48.2	19.4	16.7	-0.2	0.770	0.0	0.0	>>>	>>	12.29	0.1	15	
LG 05	6	5.8	67.8	28.5	11.7	-0.3	0.954	0.0	0.0	>>>	>>	12.62	0.1	14	
LG 06	2.5	2.2	48.3	23.4	18.1	4.0	0.772	0.0	0.0	>>>	>>	6.62	0.33	6.4	
LG 07	3.9	3.9	73.7	24.8	17.9	-0.3	1.003	0.0	0.0	>>>	>>	2.21		17	
LG 08	4.3	4.3	40.1	24.3		-0.3	0.690	0.0	14.0	>>>	>>	7.82	0.1	8	
LG 09	3.9	3.9	60.1	24.0	18.2	0.0	0.888	0.0	0.0	>>>	>>	11.54	0.1	17	
LG 10	4.7	4.5	57.9	24.7	13.0	-0.3	0.866	0.0	0.0	>>>	>>	16.48	0.22	18	strong odour
Offsite															
G01	3.9	3.6	0.0	1.9	18.8	16.6	0.011	0.0	0.0	0.0	1	dry	0.44	17.1	
G02	0	0	0.0	3.8		14.6	0.011	0.0	0.0	0.0	1	dry	ground level	19.5	
G03	2.8	2.5	0.9	9.3	15.2%	1.5	0.062	0.0	0.0	22.5	1.4	dry	0.15	19.5	
G04	0	0	0.0	0.6	18.3	17.9	0.012	0.0	0.0	0.0	1	2.19	0.35	20	
G05	0.6	0.1	37.1	6.2	17.2	0.4	0.659	0.0	0.0	>>>	>>	16.45	0.1	20	
G13	3.4	3.3	0.0	0.6	19.9	17.6	0.012	0.0	0.0	0.0	1	dry	0.16	20	
G20	5.8	5.5	0.0	0.5		20.0	0.012	0.0	0.0	0.0	1	14.53	0.28	20	
G21	3.4	3.3	0.0	1.8	19.4	16.1	0.012	0.0	0.0	0.0	1	dry	0.43	17	
G22	0	-0.6	0.0	0.6		18.5	0.013	0.0	0.0	0.0	1	9.27	0.33	15	
G23	1.9	1.8	0.0	0.9	19.8	18.4	0.012	0.0	0.0	0.0	1	17.05	0.1	20	
G24	5.5	5.4	0.0	1.1	19.3	17.3	0.012	0.0	0.0	0.0	1	dry	0.1	20	
G25	3.8	3.7	52.4	6.2	16.2	-0.1	0.813	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	1	0.7	0.0	2.1	19.6	13.1	0.014	0.0	0.0	0.0	1	14.71	0.22	21	
BH03	1.2	1	1.5	5.0	18.6	12.7	0.085	0.0	0.0	34.2	1.7	dry	0.1	19.5	
BH04	7.2	7.2	0.0	1.5	15.2	9.6	0.011	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11	5	4.8	4.6	13.2	14.1	2.5	0.209	0.0	0.0	>>>	3.8	dry	0.12	33	
BH13	0.6	0	20.7	7.3	14.7	-0.3	0.481	0.0	0.0	>>>	>>	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	0	0	55.0	19.4	20.1%	0.0	0.839	0.0	10.0	>>>	>>	6.63	0.2	8	
LG 19	27.7	27.6	70.1	30.1	10.5	-0.2	0.985	0.0	0.0	>>>	>>	9.3	0.36	15	
LG 20	1	0.4	68.9	33.1	19.5	-0.2	0.937	0.0	0.0	>>>	>>	dry	0.49	12	
MW3 (25 dia. Pipe)	0	0	69.1	31.0	19.8%	-0.2	0.995	25.0	0.0	>>>	>>	10.02	~0.5	11	
MW3 (50 dia. Pipe)	0	0	7.6	2.9	19.6%	11.0	0.283	0.0	0.0	>>>	6.2	16.38	1.04	18.1	not sampled
MW4	30.3	30.1	71.2	28.9	6.6	-0.2	0.990	30.0	0.0	>>>	>>	6.97	1	10	
Offsite															
G12	0	0	0.0	0.1	21.7	20.8	0.013	0.0	0.0	0.0	1	10.64	0.2	14	
G14	0	0	0.0	0.9	20.3	18.6	0.011	0.0	0.0	0.0	1	7.87	0.38	14	
BH07	0	0	0.0	0.9	19.3	18.6	0.012	0.0	0.0	0.0	1	13.97	0.26	21	
BH09	0	0	0.0	0.1	20.4	20.4	0.012	0.0	0.0	0.0	1	6.88	0.19	12	
BH10	0	0	0.0	1.8	20.2	17.0	0.011	0.0	0.0	0.0	1	8.71	0.19	14	
Site 3B															
Onsite															
LG 16	0.6	0	70.4	28.8	19.6	-0.1	0.976	0.0	0.0	>>>	>>	3.33	0.24	3.5	
LG 17	0	0	67.7	32.1	3.4	0.1	0.950	0.0	0.0	>>>	>>	3.6	0.26	3.9	not sampled
LG 21	2.7	2.5	66.2	33.9	18.1	-0.2	0.956	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	0	0	0.0	2.7	19.4	15.5	0.010	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	2.1	20.1	16.5	0.012	0.0	0.0	0.0	1	4.27	0.34	6	
G17	0	0	0.0	1.5	19.4	16.6	0.012	0.0	0.0	0.0	1	4.4	0.37	6	
BH08	0	0	0.0	4.2	20.0	14.7	0.011	0.0	0.0	0.0	1	7.35	0.8	13.5	
Site 3C															
Onsite															
MW2	19.5	11.7	83.5	14.0	9.6	-0.2	1.096	40.0	0.0	>>>	>>	4.18	0.75	5	strong odour
LG 14	1	0.9	72.3	27.5	19.3	-0.2	0.993	25.0	0.0	>>>	>>	9.54	0.37	12	strong odour
LG 18	0.4	0.3	68.1	32.0	18.5	-0.2	0.963	40.0	0.0	>>>	>>	9.99	0.38	10	strong odour
Offsite															
G09	0	0	18.6	13.5	19.5	-0.2	0.456	0.0	0.0	>>>	>>	12.65	0.42	14	
G11	0	0	0.0	0.1	20.8%	20.3	0.012	0.0	10.0	0.0	1	10.13	0.27	15	
BH06	0	0	10.4	8.5	19.0	6.6	0.335	0.0	0.0	>>>	9.5	5.7	ground level	14	

Day Wednesday & Thursday

Date 20/21st April 2016

Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured on site)		
								Morning	Evening	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)		
Dublin Airport			7.4		13.5			1022	1016	Wednesday
Dublin airport (met eireann)		E	14	Fair	13	44	0	1010	1012	Thursday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11	0.0	0.0	0.0	0.9	20.4	18.9	0.0	0.0	0.0	0.0	1.0	10.6	0.32	13	water level reading approx due to presence of leachate
LG 12	0.0	0.0	0.0	2.9	19.4	18.5	0.006	0.0	0.0	0.0	1.0	dry	0.25	12	
LG 13	0.0	0.0	0.0	4.3	20.2	14.3	0.0	0.0	0.0	0.0	1.0	8.84	0.36	9	
Offsite															
G06	0.0	0.0	21.8	7.3	19.5	-0.1	0.5	0.0	0.0	>>>	>>	dry	0.21	11	
G07	0	0	0.0	0.4		20.3	0.008	0.0	0.0	0.0	1	dry	0.2	14	
G08	0	0	0.0	1.7	19.7	16.5	0.007	0.0	0.0	0.0	1	dry	0.26	14	
G10	0	0	0.0	1.9	19.3	18.4	0.008	0.0	0.0	0.0	1	9.24	0.12	18	
G18	0	0	0.0	1.4	19.8	11.7	0.007	0.0	0.0	0.0	1	dry	0.13	14	
G19	0	0	0.0	0.8	20.2	17.5	0.007	0.0	0.0	0.0	1	7.9	0.2	14	
BH05	0	0	0.0	1.3	20.2	18.9	0.004	0.0	0.0	0.0	1	19.95	0.21	29	
Site 2															
Onsite															
LG 01	0	0	32.2	11.6	19.3	-0.2	0.603	0.0	0.0	>>>	>>	4.1		5	
LG 02	3.3	3.1	45.1	18.4	17.0	5.1	0.731	0.0	0.0	>>>	>>	8.55	0.18	9	
LG 03	4.3	4.2	67.5	22.5	17.2	0.0	0.943	0.0	0.0	>>>	>>	15.95	0.16	18	water level reading approx due to presence of leachate
LG 04	0.4	0	2.5	6.3	17.7	8.4	0.138	0.0	10.0	59.0	2.7	12.17	0.1	15	
LG 05	4.3	4.1	69.5	28.2	14.5	-0.1	0.959	0.0	0.0	>>>	>>	13.9	0.1	14	
LG 06	3.4	3.3	55.1	25.3	16.7	2.2	0.832	0.0	0.0	>>>	>>	6.58	0.33	6.4	
LG 07	1.5	0.4	71.6	25.2	18.6	-0.1	0.976	0.0	0.0	>>>	>>	10.98		17	water level reading approx due to presence of leachate
LG 08	0	0	34.4	19.4	19.8	5.3	0.624	0.0	0.0	>>>	>>	dry	0.1	8	
LG 09	0	0	3.1	1.6	19.8	19.0	0.158	0.0	0.0	72.6	3.5	9.81	0.1	17	water level reading approx due to presence of leachate
LG 10	3.3	3.1	71.3	23.5	18.6	0.4	0.974	0.0	0.0	>>>	>>	17.47	0.22	18	water level reading approx due to presence of leachate
Offsite															
G01	0	0	0.0	0.1	20.5	20.3	0.009	0.0	0.0	0.0	1	dry	0.44	17.1	
G02	0	0	0.0	0.0	20.7	20.5	0.008	0.0	0.0	0.0	1	dry	ground level	19.5	
G03	0	-0.3	0.0	0.0		20.5	0.007	0.0	0.0	0.0	1	dry	0.15	19.5	
G04	0	0	0.0	1.7	18.6	12.3	0.009	0.0	0.0	0.0	1	6.46	0.35	20	
G05	5.5	5.3	36.4	6.1	12.2	2.5	0.644	0.0	0.0	>>>	>>	16.46	0.1	20	
G13	0	-0.3	0.0	0.7	19.7	15.4	0.012	0.0	0.0	0.0	1	dry	0.16	20	
G20	3.4	3	0.0	0.0		20.7	0.009	0.0	0.0	0.0	1	16.57	0.28	20	
G21	0	0	0.0	2.2	20.1	15.6	0.009	0.0	0.0	0.0	1	dry	0.43	17	
G22	0	0	0.0	0.0		19.9	0.014	0.0	0.0	0.0	1	9.38	0.33	15	
G23	0	0	0.0	0.0		20.0	0.012	0.0	0.0	0.0	1	dry	0.1	20	
G24	0	-1.1	0.0	0.1	20.3	20.0	0.011	0.0	0.0	0.0	1	dry	0.1	20	
G25	7	6.9	53.9	6.7	14.4	-0.3	0.820	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	1.2	0.3	0.0	0.0		20.7	0.010	0.0	0.0	0.0	1	14.86	0.22	21	
BH03	0	-0.3	0.0	0.0		20.5	0.008	0.0	0.0	0.0	1	dry	0.1	19.5	
BH04	0	-3.2	0.0	0.0	20.4	20.4	0.009	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11	0	-0.4	0.0	0.5	20.4	19.9	0.031	0.0	0.0	0.0	1	dry	0.12	33	
BH13	3.1	3	21.7	5.3	17.2	1.3	0.487	0.0	0.0	>>>	>>	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	3.6	3.6	51.5	26.1	14.1%	-0.1	0.798	0.0	0.0	>>>	>>	6.72	0.2	8	water level reading approx due to presence of leachate
LG 19	31.1	30	70.4	29.7	8.0	-0.1	0.981	0.0	0.0	>>>	>>	6.47	0.36	15	
LG 20	4.4	4.1	55.6	31.0	17.5	-0.2	0.837	0.0	0.0	>>>	>>	dry	0.49	12	
MW3 (25 dia. Pipe)	no cap		69.7	30.4	20.4	-0.1	0.974	25.0	0.0	>>>	>>	16.46	~0.5	11	
MW3 (50 dia. Pipe)	0	0	9.8	4.0	18.7	9.5	0.320	0.0	0.0	>>>	8.7	7.19	1.04	18.1	not sampled
MW4	25.3	24.3	69.0	31.0	20.3	-0.1	0.969	25.0	0.0	>>>	>>	7.39	1	10	
Offsite															
G12	0	0	0.0	0.0	20.5	20.4	0.009	0.0	0.0	0.0	1	10.73	0.2	14	
G14	0	0	0.0	1.4	19.7	17.7	0.008	0.0	0.0	0.0	1	7.91	0.38	14	
BH07	0	0	0.0	0.2		20.2	0.012	0.0	0.0	0.0	1	14.09	0.26	21	
BH09	0	0	0.0	1.1	20.0	15.3	0.009	0.0	0.0	0.0	1	6.94	0.19	12	
BH10	0	0	0.0	1.9	19.7	17.0	0.008	0.0	0.0	0.0	1	8.7	0.19	14	
Site 3B															
Onsite															
LG 16	1.5	1	67.5	32.7	17.6	-0.2	0.949	0.0	0.0	>>>	>>	3.4	0.24	3.5	
LG 17	0	0	67.5	32.6	19.5	-0.1	0.960	0.0	0.0	>>>	>>	3.51	0.26	3.9	not sampled
LG 21	2.7	1.8	66.1	34.0	17.9	-0.2	0.952	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	0	0	0.0	3.3	18.9	14.2	0.009	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	2.5	19.7	15.6	0.010	0.0	0.0	0.0	1	4.31	0.34	6	
G17	0	0	0.0	1.8	19.6	14.3	0.009	0.0	0.0	0.0	1	dry	0.37	6	
BH08	0	0	0.0	2.9	18.9	15.8	0.009	0.0	0.0	0.0	1	7.47	0.8	13.5	
Site 3C															
Onsite															
MW2	0.3	0	68.8	28.5	18.9	0.6	0.955	50.0	0.0	>>>	>>	4.95	0.75	5	
LG 14	1.3	0.1	72.0	28.2	18.8	-0.2	0.984	30.0	0.0	>>>	>>	10.2	0.37	12	
LG 18	0	0	67.7	32.4	19.2	-0.2	0.961	40.0	0.0	>>>	>>	9.98	0.38	10	
Offsite															
G09	0	0	0.0	0.0		20.6	0.009	0.0	0.0	0.0	1	12.74	0.42	14	
G11	0	0	0.0	2.4	19.9	15.7	0.006	0.0	0.0	0.0	1	10.17	0.27	15	
BH06	0	0	21.3	16.0	19.3	2.0	0.484	0.0	0.0	>>>	>>	5.75	ground level	14	

Day Tuesday & Wednesday
Date 26/27th April 2016
Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured on site)		
								Morning	Evening	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)		
Dublin Airport		NW	23 gust 35	showers (hail)	7.00	57	0.1	1003	1002	Tuesday
Dublin airport (met eireann)		N	14 gust 25	hail shower	5.00	71	0.2	1003	1001	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Flow		Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady						Peak	Steady				
Site 1																	
Onsite																	
LG 11	0.0	0.0	0.6	2.2	19.0	17.0	0.051	0.0	0.0	15.5	1.2	0.0	0.0	11.3	0.32	13	
LG 12	0.0	0.0	0.0	5.5	19.5	13.7	0.023	0.0	0.0	0.0	1.0	0.0	0.0	dry	0.25	12	
LG 13	3.0	0.0	8.0	17.2	19.5	2.4	0.288	0.0	0.0	>>>	6.6	3.0	0.0	9.12	0.36	9	
Offsite																	
G06	6.6	3.5	21.3	7.4	17.8	-0.2	0.486	0.0	0.0	>>>	>>	6.6	3.5	dry (wet sand)	0.21	11	
G07	3.1	1.8	0.0	1.2	19.9	19.0	0.009	0.0	0.0	0.0	1	3.1	1.8	dry	0.2	14	
G08	3.1	1	0.0	1.2	19.9	17.3	0.010	0.0	0.0	0.0	1	3.1	1	dry	0.26	14	
G10	0	0	0.0	1.8	19.5	17.1	0.010	0.0	0.0	0.0	1	0	0	9.26	0.12	18	
G18	0.3	0	0.0	1.7	19.5	12.8	0.010	0.0	0.0	0.0	1	0.3	0	dry	0.13	14	
G19	0.6	0	0.0	0.9	19.4	16.8	0.010	0.0	0.0	0.0	1	0.6	0	7.92	0.2	14	
BH05	0	0	0.0	0.6	19.7	19.6	0.010	0.0	0.0	0.0	1	0	0	20	0.21	29	
Site 2																	
Onsite																	
LG 01	3.1	2.5	37.3	11.7	18.0	0.7	0.657	0.0	0.0	>>>	>>	3.1	2.5	4.21		5	
LG 02	5.2	4.7	65.3	27.9	17.5	0.1	0.929	0.0	0.0	>>>	>>	5.2	4.7	8.48	0.18	9	
LG 03	4.6	3.7	58.4	23.7	15.3	0.5	0.869	0.0	0.0	>>>	>>	4.6	3.7	~14.89	0.16	18	
LG 04	0	-0.6	1.9	1.1	19.7	19.4	0.104	0.0	0.0	43.6	1.9	0	-0.6	12.45	0.1	15	
LG 05	6.7	6.4	68.1	28.4	14.6	-0.1	0.953	0.0	0.0	>>>	>>	6.7	6.4	13.74	0.1	14	
LG 06	7.3	3	60.6	27.4	14.0	0.8	0.889	0.0	0.0	>>>	>>	7.3	3	6.56	0.33	6.4	
LG 07	0	0	68.9	25.1	18.9	0.3	0.960	0.0	0.0	>>>	>>	0	0	11.46		17	
LG 08	4.2	3.5	52.7	28.6	17.5	1.0	0.813	0.0	0.0	>>>	>>	4.2	3.5	~7.65	0.1	8	
LG 09	4	~3.5	60.2	21.3	17.6	1.0	0.885	0.0	0.0	>>>	>>	4	~3.5	11.11	0.1	17	
LG 10	5.5	4.8	63.1	24.9	15.1	0.0	0.910	0.0	0.0	>>>	>>	5.5	4.8	~17.46	0.22	18	
Offsite																	
G01	0.1	0	0.0	3.1	20.0	15.3	0.011	0.0	0.0	0.0	1	0.1	0	dry	0.44	17.1	
G02	0	0	0.0	0.0		20.2	0.013	0.0	0.0	0.0	1	0	0	dry	ground level	19.5	
G03	0.6	0	3.5	10.6	19.4	1.6	0.172	0.0	0.0	81.4	3.6	0.6	0	dry	0.15	19.5	
G04	0.3	0	0.0	2.1	17.2	9.1	0.011	0.0	0.0	0.0	1	0.3	0	8.23	0.35	20	
G05	6.5	6.3	42.4	6.7	12.3	1.9	0.706	0.0	0.0	>>>	>>	6.5	6.3	16.46	0.1	20	
G13	1.5	0	0.0	0.8	20.0	18.1	0.010	0.0	0.0	0.0	1	1.5	0	dry	0.16	20	
G20	4.3	3.9	0.0	0.7	19.6	17.1	0.011	0.0	0.0	0.0	1	4.3	3.9	14.57	0.28	20	
G21	3.3	2.1	0.0	1.8	19.7	16.7	0.012	0.0	0.0	0.0	1	3.3	2.1	dry	0.43	17	
G22	0	0	0.0	0.9	20.1	18.5	0.011	0.0	0.0	0.0	1	0	0	9.42	0.33	15	
G23	0	-3	0.0	0.0		20.4	0.011	0.0	0.0	0.0	1	0	-3	17.24	0.1	20	
G24	0	0	0.0	0.6		18.7	0.012	0.0	0.0	0.0	1	0	0	dry	0.1	20	
G25	9.3	9	55.3	6.3		0.0	0.839	0.0	0.0	>>>	>>	9.3	9	dry	0.3	20	
BH01	3.2	1.8	0.0	0.1		20.1	0.013	0.0	0.0	0.0	1	3.2	1.8	14.82	0.22	21	
BH03	0	-3.4	0.0	0.1	20.4	20.0	0.016	0.0	0.0	0.0	1	0	-3.4	dry	0.1	19.5	
BH04	0	0	0.0	0.0		20.2	0.013	0.0	0.0	0.0	1	0	0	dry	0.27	25.5	
BH11	0.1	-3.3	0.0	0.4		19.9	0.014	0.0	0.0	0.0	1	0.1	-3.3	dry	0.12	33	
BH13	5.2	4.7	19.8	7.6	15.5	-0.2	0.469	0.0	0.0	>>>	>>	5.2	4.7	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Flow		Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady						Peak	Steady				
Site 3A																	
Onsite																	
LG 15	4.4	4	50.4	26.1	18.5	-0.1	0.791	0.0	0.0	>>>	>>	4.4	4	6.85	0.2	8	
LG 19	31.4	30.7	71.2	29.0	7.3	-0.3	0.992	30.0	0.0	>>>	>>	31.4	30.7	14.58	0.36	15	
LG 20	4.8	4.6	51.6	29.3	18.5	-0.2	0.803	0.0	0.0	>>>	>>	4.8	4.6	dry	0.49	12	
MW3 (25 dia. Pipe)	no cap	no cap	69.6	30.5		-0.2	0.977	0.0	0.0	>>>	>>	no cap		10.44	~0.5	11	
MW3 (50 dia. Pipe)	3.3	3.2	26.7	8.3	19.5	3.1	0.551	0.0	0.0	>>>	>>	3.3	3.2	16.55	not sampled	18.1	
MW4	30.4	29.8	67.8	32.4	7.6	-0.3	0.968	25.0	0.0	>>>	>>	30.4	29.8	7.72	1	10	
Offsite																	
G12	0	0	0.0	1.1	19.9	17.7	0.009	0.0	0.0	0.0	1	0	0	10.75	0.2	14	
G14	0.6	0	0.0	1.8	19.6	17.0	0.010	0.0	0.0	0.0	1	0.6	0	7.94	0.38	14	
BH07	2.4	1.6	0.0	1.3	18.9	17.3	0.011	0.0	0.0	0.0	1	2.4	1.6	14.13	0.26	21	
BH09	0	0	0.0	2.1	18.5	12.2	0.010	0.0	0.0	0.0	1	0	0	6.96	0.19	12	
BH10	0	0	0.0	1.7	20.0	17.3	0.009	0.0	0.0	0.0	1	0	0	8.73	0.19	14	
Site 3B																	
Onsite																	
LG 16	1.5	1	66.8	33.3	18.2	-0.1	0.944	0.0	0.0	>>>	>>	1.5	1	3.34	0.24	3.5	
LG 17	3	1.3	65.0	35.1	12.2	-0.2	0.944	0.0	0.0	>>>	>>	3	1.3	3.61	not sampled	3.9	
LG 21	0	0	51.6	27.8	20.0	3.2	0.803	0.0	0.0	>>>	>>	0	0	dry	not sampled	4	
Offsite																	
G15	0.9	0	0.0	3.4	18.8	14.6	0.010	0.0	0.0	0.0	1	0.9	0	dry	0.28	6	
G16	0	0	0.0	1.9	19.7	18.3	0.009	0.0	0.0	0.0	1	0	0	4.35	0.34	6	
G17	0	0	0.0	1.9	18.5	14.4	0.009	0.0	0.0	0.0	1	0	0	dry	0.37	6	
BH08	0	-1	0.0	3.5	19.9	15.5	0.012	0.0	0.0	0.0	1	0	-1	7.62	0.8	13.5	
Site 3C																	
Onsite																	
MW2	2.8	0	70.0	30.2	16.3	-0.2	0.980	60.0	0.0	>>>	>>	2.8	0	5.21	0.75	5	
LG 14	2.2	0.6	72.1	28.0	17.8	-0.2	0.988	30.0	0.0	>>>	>>	2.2	0.6	10.21	0.37	12	
LG 18	1.9	0.6	67.8	32.3	18.5	-0.2	0.966	30.0	0.0	>>>	>>	1.9	0.6	9.99	0.38	10	
Offsite																	
G09	0	0	3.1	4.2	19.8	15.0	0.157	0.0	0.0	71.3	3.5	0	0	12.78	0.42	14	
G11	0.6	0	0.0	0.6	19.8	19.4	0.011	0.0	0.0	0.0	1	0.6	0	10.18	0.27	15	
BH06	0	0	19.0	17.0	19.1	0.6	0.459	0.0	0.0	>>>	>>	0	0	5.78	ground level	14	

APPENDIX K

Soil Results

Table 1: Summary of Soil Chemical Laboratory Analysis Results - Site 1, Capping Materials

Determinand	Units	No. of Samples	Result	Screening Value	No. of Exceedances above Screening Value	Location of Exceedances
Metals and Inorganics						
Asbestos Identification	-	1	No Asbestos Detected	n/a	-	-
pH	pH Units	1	9.2	-	-	-
Arsenic	mg/kg	1	21	170*	0	-
Cadmium	mg/kg	1	0.89	560*	0	-
Chromium	mg/kg	1	18	33,000*	0	-
Copper	mg/kg	1	24	44,000*	0	-
Mercury	mg/kg	1	0.21	240*	0	-
Nickel	mg/kg	1	25	3,400*	0	-
Lead	mg/kg	1	140	1,300^	0	-
Selenium	mg/kg	1	< 0.20	1,800*	0	-
Vanadium	mg/kg	1	21	5,000*	0	-
Zinc	mg/kg	1	90	170,000*	0	-
Total petroleum hydrocarbons (TPH) and BTEX						
Aliphatic TPH >C5-C6	mg/kg	1	< 1.0	95,000**	0	-
Aliphatic TPH >C6-C8	mg/kg	1	< 1.0	150,000**	0	-
Aliphatic TPH >C8-C10	mg/kg	1	< 1.0	14,000**	0	-
Aliphatic TPH >C10-C12	mg/kg	1	< 1.0	21,000**	0	-
Aliphatic TPH >C12-C16	mg/kg	1	< 1.0	25,000**	0	-
Aliphatic TPH >C16-C21	mg/kg	1	< 1.0	450,000**	0	-
Aliphatic TPH >C21-C35	mg/kg	1	< 1.0	450,000**	0	-
Aliphatic TPH >C35-C44	mg/kg	1	< 1.0	450,000**	0	-
Total Aliphatic Hydrocarbons	mg/kg	1	< 5.0	-	-	-
Aromatic TPH >C5-C7	mg/kg	1	< 1.0	76,000**	0	-
Aromatic TPH >C7-C8	mg/kg	1	< 1.0	87,000**	0	-
Aromatic TPH >C8-C10	mg/kg	1	< 1.0	7,200**	0	-
Aromatic TPH >C10-C12	mg/kg	1	< 1.0	9,200**	0	-
Aromatic TPH >C12-C16	mg/kg	1	< 1.0	10,000**	0	-
Aromatic TPH >C16-C21	mg/kg	1	< 1.0	7,600**	0	-
Aromatic TPH >C21-C35	mg/kg	1	< 1.0	7,800**	0	-
Aromatic TPH >C35-C44	mg/kg	1	< 1.0	7,800**	0	-
Total Aromatic Hydrocarbons	mg/kg	1	< 5.0	-	-	-
Benzene	µg/kg	1	Below LoD	90 mg/kg **	0	-
Toluene	µg/kg	1	Below LoD	87,000 mg/kg **	0	-
Ethylbenzene	µg/kg	1	1.8	17,000 mg/kg **	0	-
m & p-Xylene	µg/kg	1	3.5	17,000 mg/kg **	0	-
o-Xylene	µg/kg	1	1.2	17,000 mg/kg **	0	-
Polycyclic aromatic hydrocarbons (PAH)						
Naphthalene	mg/kg	1	0.44	1,200 **	0	-
Acenaphthylene	mg/kg	1	< 0.10	29,000**	0	-
Acenaphthene	mg/kg	1	0.12	29,000**	0	-
Fluorene	mg/kg	1	0.1	20,000**	0	-
Phenanthrene	mg/kg	1	0.88	6,200**	0	-
Anthracene	mg/kg	1	0.23	150,000**	0	-
Fluoranthene	mg/kg	1	1.2	6,300**	0	-
Pyrene	mg/kg	1	1.2	15,000**	0	-
Benzo[a]anthracene	mg/kg	1	0.74	49	0	-
Chrysene	mg/kg	1	0.63	93	0	-
Benzo[b]fluoranthene	mg/kg	1	0.7	13	0	-
Benzo[k]fluoranthene	mg/kg	1	0.73	370	0	-
Benzo[a]pyrene	mg/kg	1	0.81	11	0	-
Indeno(1,2,3-c,d)Pyrene	mg/kg	1	0.81	150	0	-
Dibenz(a,h)Anthracene	mg/kg	1	< 0.10	1.1	0	-
Benzo[g,h,i]perylene	mg/kg	1	0.87	1,400**	0	-
VOC, SVOC and Phenols						
VOCs	µg/kg	1	Below LoD	-	-	-
SVOCs	mg/kg	1	Below LoD	-	-	-
Total Phenols	mg/kg	1	< 0.30	440	N	-

* Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario

** Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario assuming 1% Soil Organic Matter (SOM) content

^ Category 4 Screening Level (C4SL) for Public Open Space (parks) scenario

Table 2: Summary of Soil Chemical Laboratory Analysis Results - Site 1, Landfill Materials

Determinand	Units	No. of Samples	Minimum Concentration	Maximum Concentration	95% UCL (incl. outliers)	No. Outliers	Screening Value	Does 95% UCL Exceed Screening Value?	Number of Outliers Exceeding Screening Value	Location of Outliers Exceeding Screening Value
Metals and Inorganics										
Asbestos Identification	-	12	-	Cement Amosite Chrysotile TP13, 2.5 m	-	-	n/a	-	-	-
pH	pH Units	8	8	8.6	-	-	-	-	-	-
Arsenic	mg/kg	8	14	44	-	-	170*	-	-	-
Cadmium	mg/kg	8	0.8	2.2	-	-	560*	-	-	-
Chromium	mg/kg	8	18	48	-	-	33,000*	-	-	-
Copper	mg/kg	8	35	270	-	-	44,000*	-	-	-
Mercury	mg/kg	8	0.14	0.42	-	-	240*	-	-	-
Nickel	mg/kg	8	25	110	-	-	3,400*	-	-	-
Lead	mg/kg	8	55	330	-	-	1,300^	-	-	-
Selenium	mg/kg	8	< 0.20	0.37	-	-	1,800*	-	-	-
Vanadium	mg/kg	8	15	36	-	-	5,000*	-	-	-
Zinc	mg/kg	8	120	830	-	-	170,000*	-	-	-
Total petroleum hydrocarbons (TPH) and BTEX										
Aliphatic TPH >C5-C6	mg/kg	8	< 1.0	0	-	-	95,000**	-	-	-
Aliphatic TPH >C6-C8	mg/kg	8	< 1.0	0	-	-	150,000**	-	-	-
Aliphatic TPH >C8-C10	mg/kg	8	< 1.0	100	-	-	14,000**	-	-	-
Aliphatic TPH >C10-C12	mg/kg	8	< 1.0	120	-	-	21,000**	-	-	-
Aliphatic TPH >C12-C16	mg/kg	8	< 1.0	110	-	-	25,000**	-	-	-
Aliphatic TPH >C16-C21	mg/kg	8	< 1.0	140	-	-	450,000**	-	-	-
Aliphatic TPH >C21-C35	mg/kg	8	< 1.0	970	-	-	450,000**	-	-	-
Aliphatic TPH >C35-C44	mg/kg	8	< 1.0	280	-	-	450,000**	-	-	-
Total Aliphatic Hydrocarbons	mg/kg	8	< 5.0	1500	-	-	-	-	-	-
Aromatic TPH >C5-C7	mg/kg	8	< 1.0	0	-	-	76,000**	-	-	-
Aromatic TPH >C7-C8	mg/kg	8	< 1.0	4.5	-	-	87,000**	-	-	-
Aromatic TPH >C8-C10	mg/kg	8	< 1.0	88	-	-	7,200**	-	-	-
Aromatic TPH >C10-C12	mg/kg	8	< 1.0	60	-	-	9,200**	-	-	-
Aromatic TPH >C12-C16	mg/kg	8	< 1.0	64	-	-	10,000**	-	-	-
Aromatic TPH >C16-C21	mg/kg	8	< 1.0	150	-	-	7,600**	-	-	-
Aromatic TPH >C21-C35	mg/kg	8	< 1.0	500	-	-	7,800**	-	-	-
Aromatic TPH >C35-C44	mg/kg	8	< 1.0	160	-	-	7,800**	-	-	-
Total Aromatic Hydrocarbons	mg/kg	8	< 5.0	810	-	-	-	-	-	-
Benzene	µg/kg	8	2.8	6.1	-	-	90 mg/kg **	-	-	-
Toluene	µg/kg	8	1.3	120	-	-	87,000 mg/kg **	-	-	-
Ethylbenzene	µg/kg	8	1.7	220	-	-	17,000 mg/kg **	-	-	-
m & p-Xylene	µg/kg	8	3.1	4700	-	-	17,000 mg/kg **	-	-	-
o-Xylene	µg/kg	8	1.5	1200	-	-	17,000 mg/kg **	-	-	-
Polycyclic aromatic hydrocarbons (PAH)										
Naphthalene	mg/kg	8	< 0.10	1.8	-	-	1,200 **	-	-	-
Acenaphthylene	mg/kg	8	< 0.10	0.87	-	-	29,000**	-	-	-
Acenaphthene	mg/kg	8	< 0.10	8.7	-	-	29,000**	-	-	-
Fluorene	mg/kg	8	< 0.10	9.9	-	-	20,000**	-	-	-
Phenanthrene	mg/kg	8	< 0.10	53	-	-	6,200**	-	-	-
Anthracene	mg/kg	8	< 0.10	17	-	-	150,000**	-	-	-
Fluoranthene	mg/kg	8	< 0.10	42	-	-	6,300**	-	-	-
Pyrene	mg/kg	8	< 0.10	31	-	-	15,000**	-	-	-
Benzo[a]anthracene	mg/kg	8	< 0.10	19	-	-	49**	-	-	-
Chrysene	mg/kg	8	< 0.10	15	-	-	93**	-	-	-
Benzo[b]fluoranthene	mg/kg	8	< 0.10	19	13.06	2	13**	Yes	1	LG13, 6.0m
Dibenz(a,h)Anthracene	mg/kg	8	< 0.10	1.9	1.4	3	1.1**	Yes	1	LG13, 6.0m
Benzo[k]fluoranthene	mg/kg	8	< 0.10	8.9	-	-	370**	-	-	-
Benzo[a]pyrene	mg/kg	8	< 0.10	15	10.3	2	11**	No	1	LG11 6.0m
Indeno(1,2,3-c,d)Pyrene	mg/kg	8	< 0.10	7.6	-	-	150**	-	-	-
Benzo[g,h,i]perylene	mg/kg	8	<0.1	7	-	-	1,400**	-	-	-
VOCs and SVOCs (results above Laboratory Detection Limit), and Phenols										
Benzo[g,h,i]perylene	mg/kg	8	< 0.10	7.3	-	-	1,400**	-	-	-
Total Of 16 PAH's	mg/kg	8	< 2.0	170	-	-	-	-	-	-
cis 1,2-Dichloroethene	µg/kg	8	5.7	5.7	-	-	-	-	-	-
Chlorobenzene	µg/kg	8	22	180	-	-	-	-	-	-
Isopropylbenzene	µg/kg	8	1.5	68	-	-	-	-	-	-
N-Propylbenzene	µg/kg	8	3.2	64	-	-	-	-	-	-
1,3,5-Trimethylbenzene	µg/kg	8	1.6	130	-	-	-	-	-	-
1,2,4-Trimethylbenzene	µg/kg	8	2.2	500	-	-	-	-	-	-
1,3-Dichlorobenzene	µg/kg	8	28	28	-	-	-	-	-	-
4-Isopropyltoluene	µg/kg	8	12	92	-	-	-	-	-	-
1,4-Dichlorobenzene	µg/kg	8	150	150	-	-	-	-	-	-
1,2-Dichlorobenzene	µg/kg	8	230	230	-	-	-	-	-	-
2-Methylnaphthalene	mg/kg	8	< 0.10	2.3	-	-	-	-	-	-
Dibenzofuran	mg/kg	8	< 0.10	5.5	-	-	-	-	-	-
Carbazole	mg/kg	8	< 0.10	1.1	-	-	-	-	-	-
Total Phenols	mg/kg	8	<0.3	< 0.3	-	-	440**	-	-	-

Dataset includes LG13 (0.5mGBL) which may be assumed as capping layer, however the available logs indicate the presence of waste therefore this sample has been interpreted as part of the waste strata

* Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario
** Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario assuming 1% Soil Organic Matter (SOM) content
^ Category 4 Screening Level (C4SL) for Public Open Space (parks) scenario

Table 3: Summary of Soil Chemical Laboratory Analysis Results - Site 2, Capping Materials

Determinand	Units	No. of Samples	Result	Screening Value	No. of Exceedances above Screening Value	Location of Exceedances
Metals and Inorganics						
Asbestos Identification	-	4	No Asbestos Detected	n/a	-	-
pH	pH Units	1	8.4	-	-	-
Arsenic	mg/kg	1	25	170*	0	-
Cadmium	mg/kg	1	0.94	560*	0	-
Chromium	mg/kg	1	24	33,000*	0	-
Copper	mg/kg	1	31	44,000*	0	-
Mercury	mg/kg	1	0.15	240*	0	-
Nickel	mg/kg	1	35	3,400*	0	-
Lead	mg/kg	1	61	1,300^	0	-
Selenium	mg/kg	1	0.58	1,800*	0	-
Vanadium	mg/kg	1	30	5,000*	0	-
Zinc	mg/kg	1	92	170,000*	0	-
Total petroleum hydrocarbons (TPH) and BTEX						
Aliphatic TPH >C5-C6	mg/kg	1	< 1.0	95,000**	0	-
Aliphatic TPH >C6-C8	mg/kg	1	< 1.0	150,000**	0	-
Aliphatic TPH >C8-C10	mg/kg	1	< 1.0	14,000**	0	-
Aliphatic TPH >C10-C12	mg/kg	1	< 1.0	21,000**	0	-
Aliphatic TPH >C12-C16	mg/kg	1	< 1.0	25,000**	0	-
Aliphatic TPH >C16-C21	mg/kg	1	< 1.0	450,000**	0	-
Aliphatic TPH >C21-C35	mg/kg	1	< 1.0	450,000**	0	-
Aliphatic TPH >C35-C44	mg/kg	1	< 1.0	450,000**	0	-
Total Aliphatic Hydrocarbons	mg/kg	1	< 5.0	-	-	-
Aromatic TPH >C5-C7	mg/kg	1	< 1.0	76,000**	0	-
Aromatic TPH >C7-C8	mg/kg	1	< 1.0	87,000**	0	-
Aromatic TPH >C8-C10	mg/kg	1	< 1.0	7,200**	0	-
Aromatic TPH >C10-C12	mg/kg	1	< 1.0	9,200**	0	-
Aromatic TPH >C12-C16	mg/kg	1	< 1.0	10,000**	0	-
Aromatic TPH >C16-C21	mg/kg	1	7	7,600**	0	-
Aromatic TPH >C21-C35	mg/kg	1	10	7,800**	0	-
Aromatic TPH >C35-C44	mg/kg	1	< 1.0	7,800**	0	-
Total Aromatic Hydrocarbons	mg/kg	1	17	-	-	-
Polycyclic aromatic hydrocarbons (PAH)						
Naphthalene	mg/kg	1	0.36	1,200 **	0	-
Acenaphthylene	mg/kg	1	0.37	29,000**	0	-
Acenaphthene	mg/kg	1	0.14	29,000**	0	-
Fluorene	mg/kg	1	0.37	20,000**	0	-
Phenanthrene	mg/kg	1	3	6,200**	0	-
Anthracene	mg/kg	1	1.3	150,000**	0	-
Fluoranthene	mg/kg	1	5.5	6,300**	0	-
Pyrene	mg/kg	1	5	15,000**	0	-
Benzo[a]anthracene	mg/kg	1	3.8	49**	0	-
Chrysene	mg/kg	1	3.7	93**	0	-
Benzo[b]fluoranthene	mg/kg	1	4.7	13**	0	-
Benzo[k]fluoranthene	mg/kg	1	2.1	370**	0	-
Benzo[a]pyrene	mg/kg	1	4	11**	0	-
Indeno(1,2,3-c,d)Pyrene	mg/kg	1	3.5	150**	0	-
Dibenz(a,h)Anthracene	mg/kg	1	1.2	1.1**	1	LG10, 0.0m
Benzo[g,h,i]perylene	mg/kg	1	3.1	1,400**	0	-
VOCs, SVOCs and Phenols						
SVOCs	mg/kg	1	Below LoD	-	-	-
VOCs	µg/kg	1	Below LoD	-	-	-
Total Phenols	mg/kg	1	< 0.30	440	N	-

* Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario

** Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario assuming 1% Soil Organic Matter (SOM) content

^ Category 4 Screening Level (C4SL) for Public Open Space (parks) scenario

Table 4: Summary of Soil Chemical Laboratory Analysis Results - Site 2, Landfill Materials

Determinand	Units	No. of Samples	Minimum Concentration	Maximum Concentration	95% UCL (incl. outliers)	No. Outliers	Screening Value	Does 95% UCL Exceed Screening Value?	Number of Outliers Exceeding Screening Value	Location of Outliers Exceeding Screening Value
Metals and Inorganics										
Asbestos Identification	-	14	-	No Asbestos Detected	-	-	n/a	-	-	-
pH	pH Units	12	7.8	8.8	-	-	-	-	-	-
Arsenic	mg/kg	15	6.4	34	-	-	170*	-	-	-
Cadmium	mg/kg	15	0.7	41	-	-	560*	-	-	-
Chromium	mg/kg	15	8.5	199	-	-	33,000*	-	-	-
Copper	mg/kg	15	19	1202	-	-	44,000*	-	-	-
Mercury	mg/kg	15	0.11	0.37	-	-	240*	-	-	-
Nickel	mg/kg	15	12	559	-	-	3,400*	-	-	-
Lead	mg/kg	15	30	4955	1903.07	5	1,300^	Yes	1	TP6(M)
Selenium	mg/kg	15	0.35	2	-	-	1,800*	-	-	-
Vanadium	mg/kg	12	9.7	31	-	-	5,000*	-	-	-
Zinc	mg/kg	15	72	5242	-	-	170,000*	-	-	-
Total petroleum hydrocarbons (TPH) and BTEX										
Aliphatic TPH >C5-C6	mg/kg	12	0	0	-	-	95,000**	-	-	-
Aliphatic TPH >C6-C8	mg/kg	12	41	49	-	-	150,000**	-	-	-
Aliphatic TPH >C8-C10	mg/kg	12	4.1	69	-	-	14,000**	-	-	-
Aliphatic TPH >C10-C12	mg/kg	12	5.9	46	-	-	21,000**	-	-	-
Aliphatic TPH >C12-C16	mg/kg	12	4.3	57	-	-	25,000**	-	-	-
Aliphatic TPH >C16-C21	mg/kg	12	19	81	-	-	450,000**	-	-	-
Aliphatic TPH >C21-C35	mg/kg	12	170	670	-	-	450,000**	-	-	-
Aliphatic TPH >C35-C44	mg/kg	12	1.5	31	-	-	450,000**	-	-	-
Total Aliphatic Hydrocarbons	mg/kg	12	170	900	-	-	-	-	-	-
Aromatic TPH >C5-C7	mg/kg	12	27	27	-	-	76,000**	-	-	-
Aromatic TPH >C7-C8	mg/kg	12	1.3	1.3	-	-	87,000**	-	-	-
Aromatic TPH >C8-C10	mg/kg	12	9	49	-	-	7,200**	-	-	-
Aromatic TPH >C10-C12	mg/kg	12	1.9	94	-	-	9,200**	-	-	-
Aromatic TPH >C12-C16	mg/kg	12	2.2	160	-	-	10,000**	-	-	-
Aromatic TPH >C16-C21	mg/kg	12	4.7	310	-	-	7,600**	-	-	-
Aromatic TPH >C21-C35	mg/kg	12	30	350	-	-	7,800**	-	-	-
Aromatic TPH >C35-C44	mg/kg	12	7.1	48	-	-	7,800**	-	-	-
Total Aromatic Hydrocarbons	mg/kg	12	72	1000	-	-	-	-	-	-
Benzene	µg/kg	12	-	Below LoD	-	-	90 mg/kg **	-	-	-
Toluene	µg/kg	12	1.6	4.9	-	-	87,000 mg/kg **	-	-	-
Ethylbenzene	µg/kg	12	2.2	8.7	-	-	17,000 mg/kg **	-	-	-
m & p-Xylene	µg/kg	12	1.5	34	-	-	17,000 mg/kg **	-	-	-
o-Xylene	µg/kg	12	1.5	18	-	-	17,000 mg/kg **	-	-	-
Polycyclic aromatic hydrocarbons (PAH)										
Naphthalene	mg/kg	12	0.32	2.2	-	-	1,200 **	-	-	-
Acenaphthylene	mg/kg	12	0.19	1.2	-	-	29,000**	-	-	-
Acenaphthene	mg/kg	12	0.28	1.3	-	-	29,000**	-	-	-
Fluorene	mg/kg	12	0.4	2.7	-	-	20,000**	-	-	-
Phenanthrene	mg/kg	12	0.74	14	-	-	6,200**	-	-	-
Anthracene	mg/kg	12	0.14	3.8	-	-	150,000**	-	-	-
Fluoranthene	mg/kg	12	0.12	16	-	-	6,300**	-	-	-
Pyrene	mg/kg	12	0.1	15	-	-	15,000**	-	-	-
Benzo[a]anthracene	mg/kg	12	0.59	10	-	-	49**	-	-	-
Chrysene	mg/kg	12	0.75	11	-	-	93**	-	-	-
Benzo[b]fluoranthene	mg/kg	12	0.56	12	-	-	13**	-	-	-
Benzo[k]fluoranthene	mg/kg	12	0.21	5	-	-	370**	-	-	-
Benzo[a]pyrene	mg/kg	12	0.41	10	-	-	11**	-	-	-
Indeno(1,2,3-c,d)Pyrene	mg/kg	12	0.37	6.7	-	-	150**	-	-	-
Dibenz(a,h)Anthracene	mg/kg	12	0.11	2.9	1.39	3	1.1**	Yes	1	LG04, 6.5m
Benzo[g,h,i]perylene	mg/kg	12	0.35	7.5	-	-	1,400**	-	-	-
VOC and SVOC (results above Laboratory Detection Limit), and Phenols										
Chloromethane	µg/kg	12	2.6	2.6	-	-	-	-	-	-
Trichlorofluoromethane	µg/kg	12	23	23	-	-	-	-	-	-
Isopropylbenzene	µg/kg	12	1.7	4.9	-	-	12,000#	-	-	-
N-Propylbenzene	µg/kg	12	4.6	15	-	-	-	-	-	-
1,3,5-Trimethylbenzene	µg/kg	12	1.8	30	-	-	-	-	-	-
Tert-Butylbenzene	µg/kg	12	6.1	6.1	-	-	-	-	-	-
1,2,4-Trimethylbenzene	µg/kg	12	4.2	120	-	-	410#	-	-	-
Sec-Butylbenzene	µg/kg	12	4	9.1	-	-	-	-	-	-
4-Isopropyltoluene	µg/kg	12	2.3	39	-	-	-	-	-	-
Total Phenols	mg/kg	12	0.48	4.6	-	-	440**	-	-	-

Dataset includes LG7 (0.5mGBL), LG02 (0.0 mBGL) and LG04 (0.6 mBGL) which may be assumed as capping layer, however the available logs indicate the presence of waste therefore this sample has been interpreted as part of the waste strata.

* Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario
** Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario assuming 1% Soil Organic Matter (SOM) content
^ Category 4 Screening Level (C4SL) for Public Open Space (parks) scenario
# CL:AIRE Generic Assessment Criteria (GAC) for Residential without plant uptake scenario, assuming 1% SOM

Table 5: Summary of Soil Chemical Laboratory Analysis Results - Site 3A, Landfill Materials

Determinand	Units	No. of Samples	Min	Max	Screening Value	No. of Exceedances above Screening Value	Location of Exceedances
Metals and Inorganics							
Asbestos Identification	-	7	-	No Asbestos Detected	n/a	-	-
pH	pH Units	6	7.5	8.5	-	-	-
Arsenic	mg/kg	6	9.3	38	170*	0	-
Cadmium	mg/kg	6	0.88	4.7	560*	0	-
Chromium	mg/kg	6	12	51	33,000*	0	-
Copper	mg/kg	6	18	300	44,000*	0	-
Mercury	mg/kg	6	0.11	0.34	240*	0	-
Nickel	mg/kg	6	20	48	3,400*	0	-
Lead	mg/kg	6	27	540	1,300^	0	-
Selenium	mg/kg	6	0.38	1.3	1,800*	0	-
Vanadium	mg/kg	6	14	90	5,000*	0	-
Zinc	mg/kg	6	72	1100	170,000*	0	-
Total petroleum hydrocarbons (TPH) and BTEX							
Aliphatic TPH >C5-C6	mg/kg	6	-	Below LoD	95,000**	0	-
Aliphatic TPH >C6-C8	mg/kg	6	-	Below LoD	150,000**	0	-
Aliphatic TPH >C8-C10	mg/kg	6	8.7	17	14,000**	0	-
Aliphatic TPH >C10-C12	mg/kg	6	8	13	21,000**	0	-
Aliphatic TPH >C12-C16	mg/kg	6	12	23	25,000**	0	-
Aliphatic TPH >C16-C21	mg/kg	6	57	66	450,000**	0	-
Aliphatic TPH >C21-C35	mg/kg	6	390	830	450,000**	0	-
Aliphatic TPH >C35-C44	mg/kg	6	3	12	450,000**	0	-
Total Aliphatic Hydrocarbons	mg/kg	6	490	940	-	-	-
Aromatic TPH >C5-C7	mg/kg	6	-	Below LoD	76,000**	0	-
Aromatic TPH >C7-C8	mg/kg	6	2.2	2.2	87,000**	0	-
Aromatic TPH >C8-C10	mg/kg	6	6.3	30	7,200**	0	-
Aromatic TPH >C10-C12	mg/kg	6	29	44	9,200**	0	-
Aromatic TPH >C12-C16	mg/kg	6	7.7	9.1	10,000**	0	-
Aromatic TPH >C16-C21	mg/kg	6	4.5	22	7,600**	0	-
Aromatic TPH >C21-C35	mg/kg	6	180	280	7,800**	0	-
Aromatic TPH >C35-C44	mg/kg	6	80	80	7,800**	0	-
Total Aromatic Hydrocarbons	mg/kg	6	260	440	-	-	-
Benzene	µg/kg	6	4.30	6.8	90 mg/kg **	0	-
Toluene	µg/kg	6	9.90	28	87,000 mg/kg **	0	-
Ethylbenzene	µg/kg	6	5.80	43	17,000 mg/kg **	0	-
m & p-Xylene	µg/kg	6	9.00	140	17,000 mg/kg **	0	-
o-Xylene	µg/kg	6	4.20	65	17,000 mg/kg **	0	-
Polycyclic aromatic hydrocarbons (PAH)							
Naphthalene	mg/kg	6	0.36	1.8	1,200 **	0	-
Acenaphthylene	mg/kg	6	0.14	0.93	29,000**	0	-
Acenaphthene	mg/kg	6	0.33	1.4	29,000**	0	-
Fluorene	mg/kg	6	0.16	1.5	20,000**	0	-
Phenanthrene	mg/kg	6	0.29	3.7	6,200**	0	-
Anthracene	mg/kg	6	0.11	0.64	150,000**	0	-
Fluoranthene	mg/kg	6	0.31	3.2	6,300**	0	-
Pyrene	mg/kg	6	0.5	3.7	15,000**	0	-
Benzo[a]anthracene	mg/kg	6	0.23	3.6	49**	0	-
Chrysene	mg/kg	6	0.31	5.8	93**	0	-
Benzo[b]fluoranthene	mg/kg	6	-	Below LoD	13**	0	-
Benzo[k]fluoranthene	mg/kg	6	-	Below LoD	370**	0	-
Benzo[a]pyrene	mg/kg	6	-	Below LoD	11**	0	-
Indeno(1,2,3-c,d)Pyrene	mg/kg	6	-	Below LoD	150**	0	-
Dibenz(a,h)Anthracene	mg/kg	6	-	Below LoD	1.1**	0	-
Benzo[g,h,i]perylene	mg/kg	6	-	Below LoD	1,400**	0	-
VOC's and SVOC's (results above Laboratory Detection Limit), and Phenols							
cis 1,2-Dichloroethene	µg/kg	6	4.20	66	-	-	-
Tetrachloroethene	µg/kg	6	1.80	1.8	810,000#	0	-
Isopropylbenzene	µg/kg	6	2.00	3.5	12,000#	0	-
N-Propylbenzene	µg/kg	6	1.50	10	-	-	-
1,3,5-Trimethylbenzene	µg/kg	6	4.20	25	-	-	-
1,2,4-Trimethylbenzene	µg/kg	6	11.00	82	410#	0	-
4-Isopropyltoluene	µg/kg	6	2.10	870	-	-	-
Total Phenols	mg/kg	6	< 0.30	1.7	440**	0	-

Dataset includes LG15 (0.0mGBL) and LG19 (0.0 mBGL) which may be assumed as capping layer, however the available logs indicate the presence of waste therefore this sample has been interpreted as part of the waste strata.

* Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario
** Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario assuming 1% Soil Organic Matter (SOM) content
^ Category 4 Screening Level (C4SL) for Public Open Space (parks) scenario
# CL:AIRE Generic Assessment Criteria (GAC) for Residential without plant uptake scenario, assuming 1% SOM

Table 6: Summary of Soil Chemical Laboratory Analysis Results - Site 3B, Landfill Materials

Determinand	Units	No. of Samples	Min	Max	Screening Value	No. of Exceedances above Screening Value	Location of Exceedances
Metals and Inorganics							
Asbestos Identification	-	9	-	No Asbestos Detected	n/a	-	-
pH	pH Units	5	8.2	9.1	-	-	-
Arsenic	mg/kg	5	6.8	20	170*	0	-
Cadmium	mg/kg	5	0.78	1.8	560*	0	-
Chromium	mg/kg	5	17	140	33,000*	0	-
Copper	mg/kg	5	14	140	44,000*	0	-
Mercury	mg/kg	5	0.45	0.45	240*	0	-
Nickel	mg/kg	5	20	36	3,400*	0	-
Lead	mg/kg	5	24	180	1,300^	0	-
Selenium	mg/kg	5	0.44	1	1,800*	0	-
Vanadium	mg/kg	5	11	30	5,000*	0	-
Zinc	mg/kg	5	61	1,900	170,000*	0	-
Total petroleum hydrocarbons (TPH) and BTEX							
Aliphatic TPH >C5-C6	mg/kg	5	-	Below LoD	95,000**	0	-
Aliphatic TPH >C6-C8	mg/kg	5	-	Below LoD	150,000**	0	-
Aliphatic TPH >C8-C10	mg/kg	5	49	320	14,000**	0	-
Aliphatic TPH >C10-C12	mg/kg	5	39	240	21,000**	0	-
Aliphatic TPH >C12-C16	mg/kg	5	14	130	25,000**	0	-
Aliphatic TPH >C16-C21	mg/kg	5	44	540	450,000**	0	-
Aliphatic TPH >C21-C35	mg/kg	5	310	3,000	450,000**	0	-
Aliphatic TPH >C35-C44	mg/kg	5	470	470	450,000**	0	-
Total Aliphatic Hydrocarbons	mg/kg	5	920	4,300	-	-	-
Aromatic TPH >C5-C7	mg/kg	5	-	Below LoD	76,000**	0	-
Aromatic TPH >C7-C8	mg/kg	5	-	Below LoD	87,000**	0	-
Aromatic TPH >C8-C10	mg/kg	5	57	69	7,200**	0	-
Aromatic TPH >C10-C12	mg/kg	5	110	140	9,200**	0	-
Aromatic TPH >C12-C16	mg/kg	5	23	240	10,000**	0	-
Aromatic TPH >C16-C21	mg/kg	5	230	430	7,600**	0	-
Aromatic TPH >C21-C35	mg/kg	5	230	960	7,800**	0	-
Aromatic TPH >C35-C44	mg/kg	5	5.2	54	7,800**	0	-
Total Aromatic Hydrocarbons	mg/kg	5	700	1,800	-	-	-
Benzene	µg/kg	5	2.2	2.2	90 mg/kg **	0	-
Toluene	µg/kg	5	13	94	87,000 mg/kg **	0	-
Ethylbenzene	µg/kg	5	7.1	27	17,000 mg/kg **	0	-
m & p-Xylene	µg/kg	5	24	110	17,000 mg/kg **	0	-
o-Xylene	µg/kg	5	8.9	48	17,000 mg/kg **	0	-
Polycyclic aromatic hydrocarbons (PAH)							
Naphthalene	mg/kg	5	< 0.10	1.1	1,200 **	0	-
Acenaphthylene	mg/kg	5	<0.10	0.53	29,000**	0	-
Acenaphthene	mg/kg	5	< 0.10	0.39	29,000**	0	-
Fluorene	mg/kg	5	<0.10	0.63	20,000**	0	-
Phenanthrene	mg/kg	5	< 0.10	1.4	6,200**	0	-
Anthracene	mg/kg	5	<0.10	0.29	150,000**	0	-
Fluoranthene	mg/kg	5	1.2	3.2	6,300**	0	-
Pyrene	mg/kg	5	0.11	5.3	15,000**	0	-
Benzo[a]anthracene	mg/kg	5	< 0.10	1.7	49**	0	-
Chrysene	mg/kg	5	<0.10	0.88	93**	0	-
Benzo[b]fluoranthene	mg/kg	5	-	Below LoD	13**	0	-
Benzo[k]fluoranthene	mg/kg	5	-	Below LoD	370**	0	-
Benzo[a]pyrene	mg/kg	5	-	Below LoD	11**	0	-
Indeno(1,2,3-c,d)Pyrene	mg/kg	5	-	Below LoD	150**	0	-
Dibenz(a,h)Anthracene	mg/kg	5	-	Below LoD	1.1**	0	-
Benzo[g,h,i]perylene	mg/kg	5	-	Below LoD	1,400**	0	-
VOC's and SVOC's (results above Laboratory Detection Limit), and Phenols							
Trichlorofluoromethane	µg/kg	5	7.5	7.5	-	-	-
cis 1,2-Dichloroethene	µg/kg	5	38	38	-	-	-
Isopropylbenzene	µg/kg	5	5.8	8.8	12,000#	0	-
N-Propylbenzene	µg/kg	5	4.8	17	-	-	-
1,3,5-Trimethylbenzene	µg/kg	5	1.7	27	-	-	-
1,2,4-Trimethylbenzene	µg/kg	5	2.8	94	410#	0	-
Sec-Butylbenzene	µg/kg	5	5.6	5.6	-	-	-
4-Isopropyltoluene	µg/kg	5	160	300	-	-	-
Total Phenols	mg/kg	5	0.68	6.4	440**	0	-

Dataset includes LG17 (0.3mGBL) and LG21 (0.0 mBGL) which may be assumed as capping layer, however the available logs indicate the presence of waste therefore this sample has been interpreted as part of the waste strata.

* Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario

** Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario assuming 1% Soil Organic Matter (SOM) content

^ Category 4 Screening Level (C4SL) for Public Open Space (parks) scenario

CL:AIRE Generic Assessment Criteria (GAC) for Residential without plant uptake scenario, assuming 1% SOM

Table 7: Summary of Soil Chemical Laboratory Analysis Results - Site 3C, Landfill Materials

Determinand	Units	No. of Samples	Min	Max	Screening Value	No. of Exceedances above Screening Value	Location of Exceedances
Metals and Inorganics							
Asbestos Identification	-	5	-	No Asbestos Detected	n/a	-	-
pH	pH Units	3	3	8.9	-	-	-
Arsenic	mg/kg	2	34	38	170*	0	-
Cadmium	mg/kg	2	1.1	1.3	560*	0	-
Chromium	mg/kg	2	18	25	33,000*	0	-
Copper	mg/kg	2	34	88	44,000*	0	-
Mercury	mg/kg	2	< 0.10	0.19	240*	0	-
Nickel	mg/kg	2	28	36	3,400*	0	-
Lead	mg/kg	2	53	220	1,300^	0	-
Selenium	mg/kg	2	0.55	0.91	1,800*	0	-
Vanadium	mg/kg	2	85	89	5,000*	0	-
Zinc	mg/kg	2	160	280	170,000*	0	-
Total petroleum hydrocarbons (TPH) and BTEX							
Aliphatic TPH >C5-C6	mg/kg	2	-	Below LoD	95,000**	0	-
Aliphatic TPH >C6-C8	mg/kg	2	-	Below LoD	150,000**	0	-
Aliphatic TPH >C8-C10	mg/kg	2	3.8	21	14,000**	0	-
Aliphatic TPH >C10-C12	mg/kg	2	7.8	8.6	21,000**	0	-
Aliphatic TPH >C12-C16	mg/kg	2	1	29	25,000**	0	-
Aliphatic TPH >C16-C21	mg/kg	2	6.3	80	450,000**	0	-
Aliphatic TPH >C21-C35	mg/kg	2	160	240	450,000**	0	-
Aliphatic TPH >C35-C44	mg/kg	2	2.9	220	450,000**	0	-
Total Aliphatic Hydrocarbons	mg/kg	2	280	500	-	-	-
Aromatic TPH >C5-C7	mg/kg	2	-	Below LoD	76,000**	0	-
Aromatic TPH >C7-C8	mg/kg	2	-	Below LoD	87,000**	0	-
Aromatic TPH >C8-C10	mg/kg	2	3.4	3.9	7,200**	0	-
Aromatic TPH >C10-C12	mg/kg	2	15	15	9,200**	0	-
Aromatic TPH >C12-C16	mg/kg	2	< 1.0	11	10,000**	0	-
Aromatic TPH >C16-C21	mg/kg	2	< 1.0	30	7,600**	0	-
Aromatic TPH >C21-C35	mg/kg	2	50	210	7,800**	0	-
Aromatic TPH >C35-C44	mg/kg	2	< 1.0	4.4	7,800**	0	-
Total Aromatic Hydrocarbons	mg/kg	2	69	270	-	-	-
Benzene	µg/kg	2	-	Below LoD	90 mg/kg **	0	-
Toluene	µg/kg	2	5.9	12	87,000 mg/kg **	0	-
Ethylbenzene	µg/kg	2	17	62	17,000 mg/kg **	0	-
m & p-Xylene	µg/kg	2	58	64	17,000 mg/kg **	0	-
o-Xylene	µg/kg	2	31	32	17,000 mg/kg **	0	-
Polycyclic aromatic hydrocarbons (PAH)							
Naphthalene	mg/kg	2	0.13	0.33	1,200 **	0	-
Acenaphthylene	mg/kg	2	0.2	0.39	29,000**	0	-
Acenaphthene	mg/kg	2	0.11	0.64	29,000**	0	-
Fluorene	mg/kg	2	0.15	0.73	20,000**	0	-
Phenanthrene	mg/kg	2	0.46	3.1	6,200**	0	-
Anthracene	mg/kg	2	0.18	0.51	150,000**	0	-
Fluoranthene	mg/kg	2	0.13	2.5	6,300**	0	-
Pyrene	mg/kg	2	0.19	3.4	15,000**	0	-
Benzo[a]anthracene	mg/kg	2	-	Below LoD	49**	0	-
Chrysene	mg/kg	2	-	Below LoD	93**	0	-
Benzo[b]fluoranthene	mg/kg	2	-	Below LoD	13**	0	-
Benzo[k]fluoranthene	mg/kg	2	-	Below LoD	370**	0	-
Benzo[a]pyrene	mg/kg	2	-	Below LoD	11**	0	-
Indeno(1,2,3-c,d)Pyrene	mg/kg	2	-	Below LoD	150**	0	-
Dibenz(a,h)Anthracene	mg/kg	2	-	Below LoD	1.1**	0	-
Benzo[g,h,i]perylene	mg/kg	2	-	Below LoD	1,400**	0	-
VOC's and SVOC's (results above Laboratory Detection Limit), and Phenols							
Isopropylbenzene	µg/kg	2	1.7	4.1	12,000#	0	-
N-Propylbenzene	µg/kg	2	11	11	-	-	-
1,3,5-Trimethylbenzene	µg/kg	2	21	21	-	-	-
Tert-Butylbenzene	µg/kg	2	7.3	7.3	-	-	-
1,2,4-Trimethylbenzene	µg/kg	2	6.4	64	410#	0	-
4-Isopropyltoluene	µg/kg	2	180	410	-	-	-
Total Phenols	mg/kg	3	0.85	0.85	440**	0	-

Dataset includes LG14 (0.0mGBL) which may be assumed as capping layer, however the available logs indicate the presence of waste therefore this sample has been interpreted as part of the waste strata.

* Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario

** Suitable 4 Use Level (S4UL) for Public Open Space (parks) scenario assuming 1% Soil Organic Matter (SOM) content

^ Category 4 Screening Level (C4SL) for Public Open Space (parks) scenario

CL:AIRE Generic Assessment Criteria (GAC) for Residential without plant uptake scenario, assuming 1% SOM

APPENDIX L

Remedial Targets Worksheets

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu) | Variable | Value | Unit | Source

Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to pollutants in all phases (e.g. field derived value

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.05E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	
Plume thickness at source	Sy	1.24E+01	m	
Saturated aquifer thickness	da	2.20E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.00E-01	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	1.07E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	1.07E+01	m	*see options*
Transverse dispersivity	az	1.07E+00	m	*see options*
Vertical dispersivity	ay	1.07E-01	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	0.00E+00	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.07E+01	4.58E+00	m
Transverse dispersivity	**az**	0.00E+00	1.07E+00	4.58E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.07E-01	4.58E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

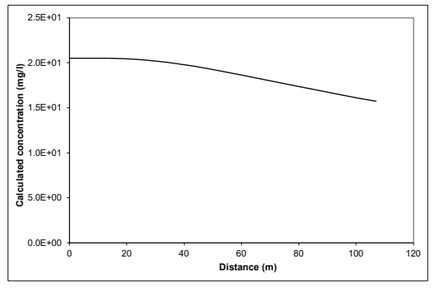
Calculated Parameters | Variable

Groundwater flow velocity	v	1.00E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	1.00E+01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.57E+01	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.30E+00**	

Remedial Targets

Remedial Target		**8.48E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**107**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.57E+01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	2.1E+01
5.4	2.05E+01
10.7	2.05E+01
16.1	2.05E+01
21.4	2.04E+01
26.8	2.03E+01
32.1	2.01E+01
37.5	1.99E+01
42.8	1.96E+01
48.2	1.93E+01
53.5	1.90E+01
58.9	1.87E+01
64.2	1.84E+01
69.6	1.80E+01
74.9	1.77E+01
80.3	1.73E+01
85.6	1.70E+01
91.0	1.67E+01
96.3	1.64E+01
101.7	1.60E+01
107.0	1.57E+01

Site being assessed:	Fassaroe - Site 1
Completed by:	Adrian Green
Date:	########
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1
Target concentration	**C_T**	**0.065**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	1.57E-03	m/d		
Area of contaminant source	A	7.20E+03	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	1.15E+02	m		
Saturated aquifer thickness	da	2.20E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	1.00E-01	fraction		
Width of contaminant source perpendicular to groundwater flow	w	6.00E+01	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.24E+01	m		

Calculated Parameters

Dilution Factor	**DF**	**6.94E+01**		
Level 2 Remedial Target		**4.51E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 1
Completed by:	Adrian Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.065	mg/l	from Level 1
Dilution Factor	DF	6.94E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		20.5	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	6.00E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	1.24E+01	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.01E-01	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	1.07E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.700	m	*see options*
Transverse dispersivity	az	1.070	m	*see options*
Vertical dispersivity	ay	0.107	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.01E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.01E-01	fraction
Rate of contaminant flow due to retardation	u	1.01E+01	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	9.43E-01	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**1.06E+00**	**fraction**
Soil leachate concentration	Co	2.05E+01	

Remedial Targets

Level 3 Remedial Target		**4.78E+00**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**107**	**m**	assumes Level 1 Remedial Target calculated from soil-water
				partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**9.43E-01**	**fraction**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

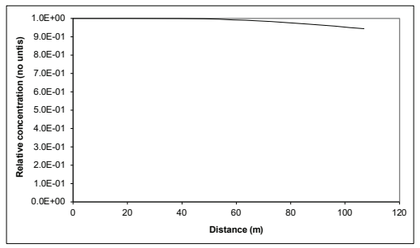
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.07E+01	4.58E+00	m
Transverse dispersivity	**az**	0.00E+00	1.07E+00	4.58E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.07E-01	4.58E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Fassaroe - Site 1
Completed by:	Adrian Green
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	**1.0E+00**	**2.95E-01**
5.4	**1.00E+00**	**2.95E-01**
10.7	**1.00E+00**	**2.95E-01**
16.1	**1.00E+00**	**2.95E-01**
21.4	**1.00E+00**	**2.95E-01**
26.8	**1.00E+00**	**2.95E-01**
32.1	**1.00E+00**	**2.95E-01**
37.5	**9.99E-01**	**2.95E-01**
42.8	**9.98E-01**	**2.95E-01**
48.2	**9.97E-01**	**2.94E-01**
53.5	**9.95E-01**	**2.94E-01**
58.9	**9.92E-01**	**2.93E-01**
64.2	**9.89E-01**	**2.92E-01**
69.6	**9.85E-01**	**2.91E-01**
74.9	**9.80E-01**	**2.90E-01**
80.3	**9.75E-01**	**2.88E-01**
85.6	**9.70E-01**	**2.86E-01**
91.0	**9.64E-01**	**2.85E-01**
96.3	**9.57E-01**	**2.83E-01**
101.7	**9.50E-01**	**2.81E-01**
107.0	**9.43E-01**	**2.79E-01**

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu) | Variable | Value | Unit | Source

Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to pollutants in all phases (e.g. field derived value

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.05E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	
Plume thickness at source	Sy	1.24E+01	m	
Saturated aquifer thickness	da	2.20E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.00E-01	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	1.07E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	1.07E+01	m	*see options*
Transverse dispersivity	az	1.07E+00	m	*see options*
Vertical dispersivity	ay	1.07E-01	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	0.00E+00	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.07E+01	4.58E+00	m
Transverse dispersivity	**az**	0.00E+00	1.07E+00	4.58E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.07E-01	4.58E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

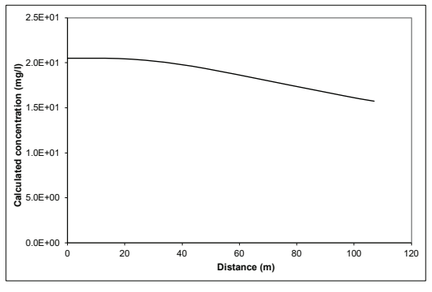
Calculated Parameters | Variable

Groundwater flow velocity	v	1.00E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	1.00E+01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.57E+01	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.30E+00**	

Remedial Targets

Remedial Target		**8.48E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**107**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.57E+01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	2.1E+01
5.4	2.05E+01
10.7	2.05E+01
16.1	2.05E+01
21.4	2.04E+01
26.8	2.03E+01
32.1	2.01E+01
37.5	1.99E+01
42.8	1.96E+01
48.2	1.93E+01
53.5	1.90E+01
58.9	1.87E+01
64.2	1.84E+01
69.6	1.80E+01
74.9	1.77E+01
80.3	1.73E+01
85.6	1.70E+01
91.0	1.67E+01
96.3	1.64E+01
101.7	1.60E+01
107.0	1.57E+01

Site being assessed:	Fassaroe - Site 1
Completed by:	Adrian Green
Date:	########
Version:	1

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu) | Variable | Value | Unit | Source

Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to pollutants in all phases (e.g. field derived value

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.05E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	
Plume thickness at source	Sy	1.24E+01	m	
Saturated aquifer thickness	da	2.20E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.00E-01	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	1.07E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	1.07E+01	m	*see options*
Transverse dispersivity	az	1.07E+00	m	*see options*
Vertical dispersivity	ay	1.07E-01	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	0.00E+00	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.07E+01	4.58E+00	m
Transverse dispersivity	**az**	0.00E+00	1.07E+00	4.58E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.07E-01	4.58E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

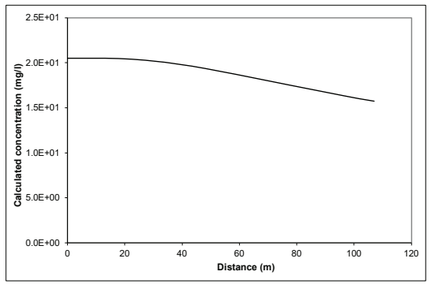
Calculated Parameters | Variable

Groundwater flow velocity	v	1.00E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	1.00E+01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.57E+01	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.30E+00**	

Remedial Targets

Remedial Target		**8.48E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**107**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.57E+01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	2.1E+01
5.4	2.05E+01
10.7	2.05E+01
16.1	2.05E+01
21.4	2.04E+01
26.8	2.03E+01
32.1	2.01E+01
37.5	1.99E+01
42.8	1.96E+01
48.2	1.93E+01
53.5	1.90E+01
58.9	1.87E+01
64.2	1.84E+01
69.6	1.80E+01
74.9	1.77E+01
80.3	1.73E+01
85.6	1.70E+01
91.0	1.67E+01
96.3	1.64E+01
101.7	1.60E+01
107.0	1.57E+01

Site being assessed:	Fassaroe - Site 1
Completed by:	Adrian Green
Date:	########
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Fassaroe - Site 2			
Site Address:	Fassaroe Co. Wicklow			
Completed by:	Adrian Green			
Date:	04-May-18		Version:	1
Contaminant	Ammonia			
Target Concentration (C_T)	0.065	mg/l	Origin of C_T:	Surface Water EQS & GW GTV

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1
Target concentration	**C_T**	**0.065**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	1.84E-04	m/d		
Area of contaminant source	A	4.21E+04	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	3.40E+02	m		
Saturated aquifer thickness	da	3.00E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	1.50E-01	fraction		
Width of contaminant source perpendicular to groundwater flow	w	1.35E+02	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	3.00E+01	m		

Calculated Parameters

Dilution Factor	**DF**	**7.22E+02**		
Level 2 Remedial Target		**4.69E+01**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 2
Completed by:	Adrian Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.065	mg/l	from Level 1
Dilution Factor	DF	7.22E+02		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		306	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.35E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	3.00E+01	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.50E-01	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	1.60E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	16.000	m	*see options*
Transverse dispersivity	az	1.600	m	*see options*
Vertical dispersivity	ay	0.160	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.50E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.50E-01	fraction
Rate of contaminant flow due to retardation	u	1.50E+01	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	9.97E-01	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**1.00E+00**	**fraction**
Soil leachate concentration	Co	3.06E+02	

Remedial Targets

Level 3 Remedial Target		**4.71E+01**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**160**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	**9.97E-01**	**fraction**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

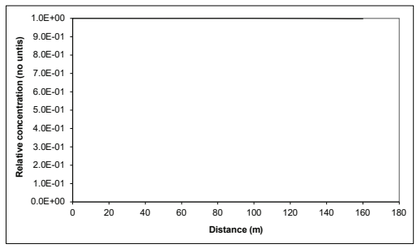
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.60E+01	5.59E+00	m
Transverse dispersivity	**az**	0.00E+00	1.60E+00	5.59E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.60E-01	5.59E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Fassaroe - Site 2
Completed by:	Adrian Green
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.24E-01
8.0	1.00E+00	4.24E-01
16.0	1.00E+00	4.24E-01
24.0	1.00E+00	4.24E-01
32.0	1.00E+00	4.24E-01
40.0	1.00E+00	4.24E-01
48.0	1.00E+00	4.24E-01
56.0	1.00E+00	4.24E-01
64.0	1.00E+00	4.24E-01
72.0	1.00E+00	4.24E-01
80.0	1.00E+00	4.24E-01
88.0	1.00E+00	4.24E-01
96.0	1.00E+00	4.24E-01
104.0	1.00E+00	4.24E-01
112.0	1.00E+00	4.24E-01
120.0	9.99E-01	4.24E-01
128.0	9.99E-01	4.23E-01
136.0	9.99E-01	4.23E-01
144.0	9.98E-01	4.23E-01
152.0	9.98E-01	4.23E-01
160.0	9.97E-01	4.23E-01

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu) | Variable | Value | Unit | Source

Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.24E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.35E+02	m	
Plume thickness at source	Sy	2.98E+01	m	
Saturated aquifer thickness	da	3.00E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.50E-01	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	1.60E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	1.60E+01	m	*see options*
Transverse dispersivity	az	1.60E+00	m	*see options*
Vertical dispersivity	ay	1.60E-01	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — 0.00E+00 — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer — foc — fraction

Organic carbon partition coefficient — Koc — l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species — $K_{oc,n}$ — l/kg

Sorption coefficient for ionised species — $K_{oc,i}$ — l/kg

pH value — pH

acid dissocation constant — pKa

Fraction of organic carbon in aquifer — foc — fraction

Soil water partition coefficient — Kd — 0.00E+00 — l/kg

Define dispersivity (click brown cell and use pull down list)

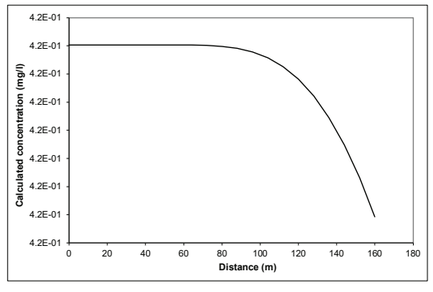
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.60E+01	5.59E+00	m
Transverse dispersivity	**az**	0.00E+00	1.60E+00	5.59E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.60E-01	5.59E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}X)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	4.2E-01
8.0	4.24E-01
16.0	4.24E-01
24.0	4.24E-01
32.0	4.24E-01
40.0	4.24E-01
48.0	4.24E-01
56.0	4.24E-01
64.0	4.24E-01
72.0	4.24E-01
80.0	4.24E-01
88.0	4.24E-01
96.0	4.24E-01
104.0	4.24E-01
112.0	4.24E-01
120.0	4.24E-01
128.0	4.23E-01
136.0	4.23E-01
144.0	4.23E-01
152.0	4.23E-01
160.0	4.23E-01

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated Parameters | Variable

Groundwater flow velocity	v	1.50E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	1.50E+01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.23E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.00E+00**	

Remedial Targets

Remedial Target		**6.52E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**160**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**4.23E-01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Site being assessed:	Fassaroe - Site 2
Completed by:	Adrian Green
Date:	########
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Fassaroe - Site 2			
Site Address:	Fassaroe Co. Wicklow			
Completed by:	Adrian Green			
Date:	04-May-18		Version:	1
Contaminant	Ammonia			
Target Concentration (C_T)	0.065	mg/l	Origin of C_T:	Surface Water EQS & GW GTV

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1
Target concentration	**C_T**	**0.065**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	1.57E-03	m/d		
Area of contaminant source	A	4.21E+04	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	3.40E+02	m		
Saturated aquifer thickness	da	3.00E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	1.50E-01	fraction		
Width of contaminant source perpendicular to groundwater flow	w	1.35E+02	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	3.00E+01	m		

Calculated Parameters

Dilution Factor	**DF**	**8.53E+01**		
Level 2 Remedial Target		**5.54E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 2
Completed by:	Adrian Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.065	mg/l	from Level 1
Dilution Factor	DF	8.53E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		306	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.35E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	3.00E+01	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.52E-01	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	1.60E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	16.000	m	*see options*
Transverse dispersivity	az	1.600	m	*see options*
Vertical dispersivity	ay	0.160	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.52E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.52E-01	fraction
Rate of contaminant flow due to retardation	u	1.52E+01	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	9.97E-01	fraction
Attenuation factor (C_0/C_{ED})	**AF**	**1.00E+00**	**fraction**
Soil leachate concentration	Co	3.06E+02	

Remedial Targets

Level 3 Remedial Target		**5.56E+00**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**160**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	**9.97E-01**	**fraction**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

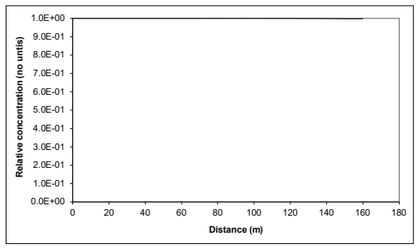
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.60E+01	5.59E+00	m
Transverse dispersivity	**az**	0.00E+00	1.60E+00	5.59E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.60E-01	5.59E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Fassaroe - Site 2
Completed by:	Adrian Green
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	3.59E+00
8.0	1.00E+00	3.59E+00
16.0	1.00E+00	3.59E+00
24.0	1.00E+00	3.59E+00
32.0	1.00E+00	3.59E+00
40.0	1.00E+00	3.59E+00
48.0	1.00E+00	3.59E+00
56.0	1.00E+00	3.59E+00
64.0	1.00E+00	3.59E+00
72.0	1.00E+00	3.59E+00
80.0	1.00E+00	3.59E+00
88.0	1.00E+00	3.59E+00
96.0	1.00E+00	3.59E+00
104.0	1.00E+00	3.59E+00
112.0	1.00E+00	3.59E+00
120.0	9.99E-01	3.59E+00
128.0	9.99E-01	3.58E+00
136.0	9.99E-01	3.58E+00
144.0	9.98E-01	3.58E+00
152.0	9.98E-01	3.58E+00
160.0	9.97E-01	3.58E+00

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu) | Variable | Value | Unit | Source

Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.06E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.35E+02	m	
Plume thickness at source	Sy	2.98E+01	m	
Saturated aquifer thickness	da	3.00E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.50E-01	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	1.60E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	1.60E+01	m	*see options*
Transverse dispersivity	az	1.60E+00	m	*see options*
Vertical dispersivity	ay	1.60E-01	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — 0.00E+00 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer — foc — fraction

Organic carbon partition coefficient — Koc — l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species — $K_{oc,n}$ — l/kg

Sorption coefficient for ionised species — $K_{oc,i}$ — l/kg

pH value — pH

acid dissocation constant — pKa

Fraction of organic carbon in aquifer — foc — fraction

Soil water partition coefficient — Kd — 0.00E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

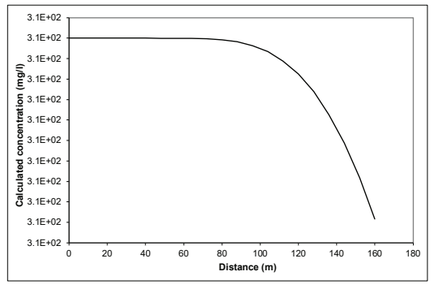
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.60E+01	5.59E+00	m
Transverse dispersivity	**az**	0.00E+00	1.60E+00	5.59E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.60E-01	5.59E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}X)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	3.1E+02
8.0	3.06E+02
16.0	3.06E+02
24.0	3.06E+02
32.0	3.06E+02
40.0	3.06E+02
48.0	3.06E+02
56.0	3.06E+02
64.0	3.06E+02
72.0	3.06E+02
80.0	3.06E+02
88.0	3.06E+02
96.0	3.06E+02
104.0	3.06E+02
112.0	3.06E+02
120.0	3.06E+02
128.0	3.06E+02
136.0	3.06E+02
144.0	3.05E+02
152.0	3.05E+02
160.0	3.05E+02

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated Parameters | Variable

Groundwater flow velocity	v	1.50E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	1.50E+01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.05E+02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.00E+00**	

Remedial Targets

Remedial Target		**6.52E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**160**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**3.05E+02**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Site being assessed:	Fassaroe - Site 2
Completed by:	Adrian Green
Date:	########
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Fassaroe - Site 3a			
Site Address:	Fassaroe Co. Wicklow			
Completed by:	Adrioan Green			
Date:	04-May-18		Version:	1
Contaminant	Ammonia			
Target Concentration (C_T)	0.175	mg/l	Origin of C_T:	Surface Water EQS & GW GTV

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1
Target concentration	C_T	**0.175**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	1.84E-04	m/d		
Area of contaminant source	A	2.65E+04	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.19E+02	m		
Saturated aquifer thickness	da	3.00E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	5.00E-02	fraction		
Width of contaminant source perpendicular to groundwater flow	w	1.06E+02	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	2.33E+01	m		

Calculated Parameters

Dilution Factor	**DF**	**2.90E+02**		
Level 2 Remedial Target		**5.08E+01**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 3a
Completed by:	Adrioan Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.175	mg/l	from Level 1
Dilution Factor	DF	2.90E+02		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to pollutants in all phases (e.g. field derived value, l

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		366	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.06E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	2.33E+01	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	5.02E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	9.60E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.600	m	*see options*
Transverse dispersivity	az	0.960	m	*see options*
Vertical dispersivity	ay	0.096	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	5.02E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	5.02E-02	fraction
Rate of contaminant flow due to retardation	u	5.02E+00	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	1.00E+00	fraction
Attenuation factor (C_0/C_{ED})	**AF**	**1.00E+00**	**fraction**
Soil leachate concentration	Co	3.66E+02	

Remedial Targets

Level 3 Remedial Target		**5.08E+01**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**96**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	**1.00E+00**	**fraction**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

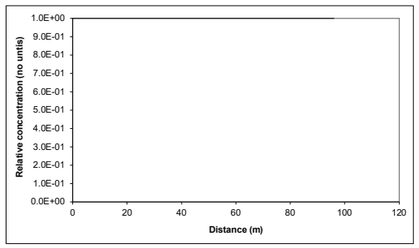
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	9.60E+00	4.33E+00	m
Transverse dispersivity	**az**	0.00E+00	9.60E-01	4.33E-01	m
Vertical dispersivity	**ay**	0.00E+00	9.60E-02	4.33E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Fassaroe - Site 3a
Completed by:	Adrioan Green
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	**1.0E+00**	**1.26E+00**
4.8	**1.00E+00**	**1.26E+00**
9.6	**1.00E+00**	**1.26E+00**
14.4	**1.00E+00**	**1.26E+00**
19.2	**1.00E+00**	**1.26E+00**
24.0	**1.00E+00**	**1.26E+00**
28.8	**1.00E+00**	**1.26E+00**
33.6	**1.00E+00**	**1.26E+00**
38.4	**1.00E+00**	**1.26E+00**
43.2	**1.00E+00**	**1.26E+00**
48.0	**1.00E+00**	**1.26E+00**
52.8	**1.00E+00**	**1.26E+00**
57.6	**1.00E+00**	**1.26E+00**
62.4	**1.00E+00**	**1.26E+00**
67.2	**1.00E+00**	**1.26E+00**
72.0	**1.00E+00**	**1.26E+00**
76.8	**1.00E+00**	**1.26E+00**
81.6	**1.00E+00**	**1.26E+00**
86.4	**1.00E+00**	**1.26E+00**
91.2	**1.00E+00**	**1.26E+00**
96.0	**1.00E+00**	**1.26E+00**

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu) | Variable | Value | Unit | Source

Contaminant		Ammonia		from Level 1
Target Concentration	C_T	1.75E-01	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.66E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.06E+02	m	
Plume thickness at source	Sy	2.39E+01	m	
Saturated aquifer thickness	da	3.00E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	5.00E-02	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	9.60E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.60E+00	m	*see options*
Transverse dispersivity	az	9.60E-01	m	*see options*
Vertical dispersivity	ay	9.60E-02	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	0.00E+00	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

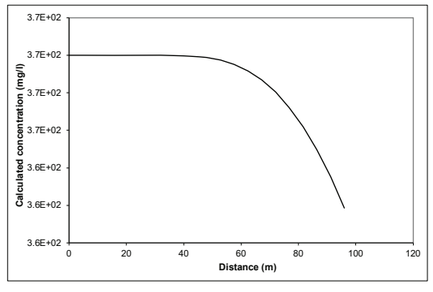
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	9.60E+00	4.33E+00	m
Transverse dispersivity	**az**	0.00E+00	9.60E-01	4.33E-01	m
Vertical dispersivity	**ay**	0.00E+00	9.60E-02	4.33E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}X)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	3.7E+02
4.8	3.66E+02
9.6	3.66E+02
14.4	3.66E+02
19.2	3.66E+02
24.0	3.66E+02
28.8	3.66E+02
33.6	3.66E+02
38.4	3.66E+02
43.2	3.66E+02
48.0	3.66E+02
52.8	3.66E+02
57.6	3.66E+02
62.4	3.66E+02
67.2	3.66E+02
72.0	3.66E+02
76.8	3.65E+02
81.6	3.65E+02
86.4	3.65E+02
91.2	3.64E+02
96.0	3.64E+02

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated Parameters | Variable

Groundwater flow velocity	v	5.00E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	5.00E+00	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.64E+02	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.01E+00**	

Remedial Targets

Remedial Target		**1.76E-01**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**96**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**3.64E+02**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Site being assessed:	Fassaroe - Site 3a
Completed by:	Adrioan Green
Date:	########
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Fassaroe - Site 3a			
Site Address:	Fassaroe Co. Wicklow			
Completed by:	Adrioan Green			
Date:	04-May-18		Version:	1
Contaminant	Ammonia			
Target Concentration (C_T)	0.065	mg/l	Origin of C_T:	Surface Water EQS & GW GTV

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	**C_T**	**0.065**	**mg/l**	from Level 1	

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	1.57E-03	m/d		
Area of contaminant source	A	2.65E+04	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.19E+02	m		
Saturated aquifer thickness	da	3.00E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	5.00E-02	fraction		
Width of contaminant source perpendicular to groundwater flow	w	1.06E+02	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	2.39E+01	m		

Calculated Parameters

Dilution Factor	**DF**	**3.57E+01**		
Level 2 Remedial Target		**2.32E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 3a
Completed by:	Adrioan Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.065	mg/l	from Level 1
Dilution Factor	DF	3.57E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to pollutants in all phases (e.g. field derived value, l

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		366	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.06E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	2.39E+01	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	5.14E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	9.60E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.600	m	*see options*
Transverse dispersivity	az	0.960	m	*see options*
Vertical dispersivity	ay	0.096	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	5.14E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	5.14E-02	fraction
Rate of contaminant flow due to retardation	u	5.14E+00	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	1.00E+00	fraction
Attenuation factor (C_0/C_{ED})	**AF**	**1.00E+00**	**fraction**
Soil leachate concentration	Co	3.66E+02	

Remedial Targets

Level 3 Remedial Target		**2.32E+00**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**96**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**1.00E+00**	**fraction**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

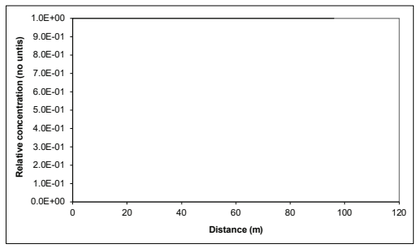
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	9.60E+00	4.33E+00	m
Transverse dispersivity	**az**	0.00E+00	9.60E-01	4.33E-01	m
Vertical dispersivity	**ay**	0.00E+00	9.60E-02	4.33E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Fassaroe - Site 3a
Completed by:	Adrioan Green
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	1.03E+01
4.8	1.00E+00	1.03E+01
9.6	1.00E+00	1.03E+01
14.4	1.00E+00	1.03E+01
19.2	1.00E+00	1.03E+01
24.0	1.00E+00	1.03E+01
28.8	1.00E+00	1.03E+01
33.6	1.00E+00	1.03E+01
38.4	1.00E+00	1.03E+01
43.2	1.00E+00	1.03E+01
48.0	1.00E+00	1.03E+01
52.8	1.00E+00	1.03E+01
57.6	1.00E+00	1.03E+01
62.4	1.00E+00	1.03E+01
67.2	1.00E+00	1.03E+01
72.0	1.00E+00	1.03E+01
76.8	1.00E+00	1.03E+01
81.6	1.00E+00	1.03E+01
86.4	1.00E+00	1.03E+01
91.2	1.00E+00	1.03E+01
96.0	1.00E+00	1.03E+01

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.03E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.06E+02	m	
Plume thickness at source	Sy	2.39E+01	m	
Saturated aquifer thickness	da	3.00E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	5.00E-02	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	9.60E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.60E+00	m	*see options*
Transverse dispersivity	az	9.60E-01	m	*see options*
Vertical dispersivity	ay	9.60E-02	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	0.00E+00	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

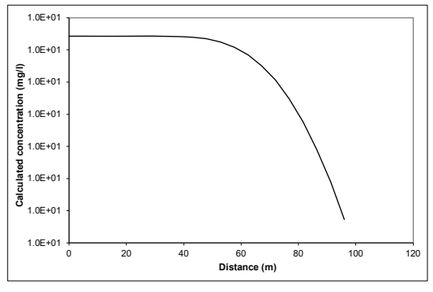
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	ax	0.00E+00	9.60E+00	4.33E+00	m
Transverse dispersivity	az	0.00E+00	9.60E-01	4.33E-01	m
Vertical dispersivity	ay	0.00E+00	9.60E-02	4.33E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}X)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+01
4.8	1.03E+01
9.6	1.03E+01
14.4	1.03E+01
19.2	1.03E+01
24.0	1.03E+01
28.8	1.03E+01
33.6	1.03E+01
38.4	1.03E+01
43.2	1.03E+01
48.0	1.03E+01
52.8	1.03E+01
57.6	1.03E+01
62.4	1.02E+01
67.2	1.02E+01
72.0	1.02E+01
76.8	1.02E+01
81.6	1.02E+01
86.4	1.02E+01
91.2	1.02E+01
96.0	1.02E+01

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated Parameters	Variable		
Groundwater flow velocity	v	5.00E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	5.00E+00	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.02E+01	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.01E+00**	

Remedial Targets

Remedial Target		**6.54E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**96**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.02E+01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Site being assessed:	Fassaroe - Site 3a
Completed by:	Adrioan Green
Date:	########
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Fassaroe - Site 3b			
Site Address:	Fassaroe Co. Wicklow			
Completed by:	Adrian Green			
Date:	04-May-18		Version:	1
Contaminant	Ammonia			
Target Concentration (C_T)	0.065	mg/l	Origin of C_T:	Surface Water EQS & GW GTV

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	**C_T**	**0.065**	**mg/l**	from Level 1	

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	1.84E-04	m/d		
Area of contaminant source	A	6.60E+03	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	8.50E+01	m		
Saturated aquifer thickness	da	3.50E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	2.00E-02	fraction		
Width of contaminant source perpendicular to groundwater flow	w	6.50E+01	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	9.07E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.17E+02**		
Level 2 Remedial Target		**7.62E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 3b
Completed by:	Adrian Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.065	mg/l	from Level 1
Dilution Factor	DF	1.17E+02		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		567	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	6.50E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	9.07E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	2.02E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	4.00E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	40.000	m	*see options*
Transverse dispersivity	az	4.000	m	*see options*
Vertical dispersivity	ay	0.400	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.02E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	2.02E-02	fraction
Rate of contaminant flow due to retardation	u	2.02E+00	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	1.69E-01	fraction
Attenuation factor (C_0/C_{ED})	**AF**	**5.93E+00**	**fraction**
Soil leachate concentration	Co	5.67E+02	

Remedial Targets

Level 3 Remedial Target		**4.52E+01**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**400**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**1.69E-01**	**fraction**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

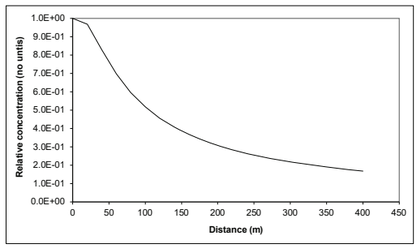
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	4.00E+01	8.35E+00	m
Transverse dispersivity	**az**	0.00E+00	4.00E+00	8.35E-01	m
Vertical dispersivity	**ay**	0.00E+00	4.00E-01	8.35E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Fassaroe - Site 3b
Completed by:	Adrian Green
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.83E+00
20.0	9.67E-01	4.67E+00
40.0	8.30E-01	4.01E+00
60.0	6.98E-01	3.37E+00
80.0	5.95E-01	2.88E+00
100.0	5.17E-01	2.50E+00
120.0	4.56E-01	2.20E+00
140.0	4.07E-01	1.97E+00
160.0	3.67E-01	1.78E+00
180.0	3.35E-01	1.62E+00
200.0	3.07E-01	1.49E+00
220.0	2.84E-01	1.37E+00
240.0	2.64E-01	1.28E+00
260.0	2.47E-01	1.19E+00
280.0	2.31E-01	1.12E+00
300.0	2.18E-01	1.05E+00
320.0	2.06E-01	9.95E-01
340.0	1.95E-01	9.43E-01
360.0	1.85E-01	8.96E-01
380.0	1.77E-01	8.53E-01
400.0	1.69E-01	8.15E-01

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu) | Variable | Value | Unit | Source

Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.67E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.50E+01	m	
Plume thickness at source	Sy	9.66E+00	m	
Saturated aquifer thickness	da	3.50E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	2.00E-02	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	4.00E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	4.00E+01	m	*see options*
Transverse dispersivity	az	4.00E+00	m	*see options*
Vertical dispersivity	ay	4.00E-01	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	0.00E+00	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

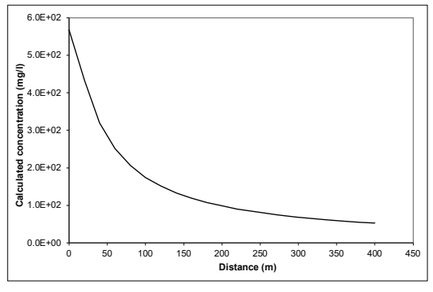
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	4.00E+01	8.35E+00	m
Transverse dispersivity	**az**	0.00E+00	4.00E+00	8.35E-01	m
Vertical dispersivity	**ay**	0.00E+00	4.00E-01	8.35E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}X)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	5.7E+02
20.0	4.34E+02
40.0	3.20E+02
60.0	2.51E+02
80.0	2.06E+02
100.0	1.75E+02
120.0	1.51E+02
140.0	1.33E+02
160.0	1.19E+02
180.0	1.08E+02
200.0	9.84E+01
220.0	9.04E+01
240.0	8.37E+01
260.0	7.79E+01
280.0	7.28E+01
300.0	6.84E+01
320.0	6.45E+01
340.0	6.10E+01
360.0	5.78E+01
380.0	5.50E+01
400.0	5.24E+01

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated Parameters | Variable

Groundwater flow velocity	v	2.00E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	2.00E+00	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.24E+01	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.08E+01**	

Remedial Targets

Remedial Target		**7.03E-01**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**400**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**5.24E+01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Site being assessed:	Fassaroe - Site 3b
Completed by:	Adrian Green
Date:	########
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Fassaroe - Site 3b			
Site Address:	Fassaroe Co. Wicklow			
Completed by:	Adrian Green			
Date:	04-May-18		Version:	1
Contaminant	Ammonia			
Target Concentration (C_T)	0.065	mg/l	Origin of C_T:	Surface Water EQS & GW GTV

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1
Target concentration	C_T	**0.065**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	1.57E-03	m/d		
Area of contaminant source	A	6.60E+03	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	8.50E+01	m		
Saturated aquifer thickness	da	3.50E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	2.00E-02	fraction		
Width of contaminant source perpendicular to groundwater flow	w	6.50E+01	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	9.66E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.55E+01**		
Level 2 Remedial Target		**1.01E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 3b
Completed by:	Adrian Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.065	mg/l	from Level 1
Dilution Factor	DF	1.55E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		567	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	6.50E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	9.66E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	2.14E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	4.00E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	40.000	m	*see options*
Transverse dispersivity	az	4.000	m	*see options*
Vertical dispersivity	ay	0.400	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.14E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	2.14E-02	fraction
Rate of contaminant flow due to retardation	u	2.14E+00	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	1.78E-01	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**5.61E+00**	**fraction**
Soil leachate concentration	Co	5.67E+02	

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

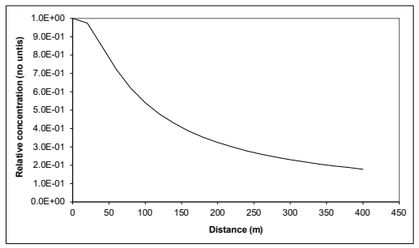
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	4.00E+01	8.35E+00	m
Transverse dispersivity	**az**	0.00E+00	4.00E+00	8.35E-01	m
Vertical dispersivity	**ay**	0.00E+00	4.00E-01	8.35E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	3.66E+01
20.0	9.74E-01	3.57E+01
40.0	8.49E-01	3.11E+01
60.0	7.21E-01	2.64E+01
80.0	6.19E-01	2.27E+01
100.0	5.39E-01	1.98E+01
120.0	4.77E-01	1.75E+01
140.0	4.27E-01	1.56E+01
160.0	3.86E-01	1.41E+01
180.0	3.52E-01	1.29E+01
200.0	3.24E-01	1.19E+01
220.0	2.99E-01	1.10E+01
240.0	2.79E-01	1.02E+01
260.0	2.60E-01	9.54E+00
280.0	2.44E-01	8.95E+00
300.0	2.30E-01	8.43E+00
320.0	2.18E-01	7.97E+00
340.0	2.06E-01	7.56E+00
360.0	1.96E-01	7.18E+00
380.0	1.87E-01	6.85E+00
400.0	1.78E-01	6.54E+00

Remedial Targets

Level 3 Remedial Target		**5.64E+00**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**400**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**1.78E-01**	**fraction**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Site being assessed:	Fassaroe - Site 3b
Completed by:	Adrian Green
Date:	########
Version:	1

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.66E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.50E+01	m	
Plume thickness at source	Sy	9.66E+00	m	
Saturated aquifer thickness	da	3.50E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	2.00E-02	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	4.00E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	4.00E+01	m	*see options*
Transverse dispersivity	az	4.00E+00	m	*see options*
Vertical dispersivity	ay	4.00E-01	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	0.00E+00	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

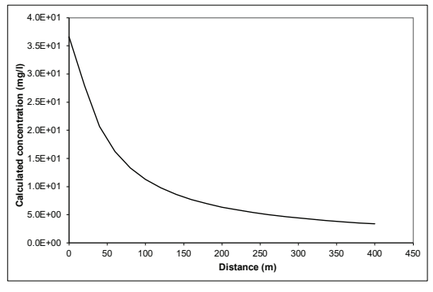
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	4.00E+01	8.35E+00	m
Transverse dispersivity	**az**	0.00E+00	4.00E+00	8.35E-01	m
Vertical dispersivity	**ay**	0.00E+00	4.00E-01	8.35E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}X)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	3.7E+01
20.0	2.80E+01
40.0	2.07E+01
60.0	1.62E+01
80.0	1.33E+01
100.0	1.13E+01
120.0	9.75E+00
140.0	8.60E+00
160.0	7.69E+00
180.0	6.95E+00
200.0	6.35E+00
220.0	5.84E+00
240.0	5.40E+00
260.0	5.03E+00
280.0	4.70E+00
300.0	4.41E+00
320.0	4.16E+00
340.0	3.93E+00
360.0	3.73E+00
380.0	3.55E+00
400.0	3.38E+00

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.00E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	2.00E+00	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.38E+00	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.08E+01**	

Remedial Targets

Remedial Target		**7.03E-01**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**400**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**3.38E+00**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Site being assessed:	Fassaroe - Site 3b
Completed by:	Adrian Green
Date:	########
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Fassaroe - Site 3c			
Site Address:	Fassaroe Co. Wicklow			
Completed by:	Adrian Green			
Date:	04-May-18		Version:	1
Contaminant	Ammonia			
Target Concentration (C_T)	0.065	mg/l	Origin of C_T:	Surface Water EQS & GW GTV

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1
Target concentration	**C_T**	**0.065**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	1.84E-04	m/d		
Area of contaminant source	A	8.70E+03	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	1.13E+02	m		
Saturated aquifer thickness	da	2.50E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	1.20E-01	fraction		
Width of contaminant source perpendicular to groundwater flow	w	6.00E+01	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.20E+01	m		

Calculated Parameters

Dilution Factor	**DF**	**6.94E+02**		
Level 2 Remedial Target		**4.51E+01**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 3c
Completed by:	Adrian Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.065	mg/l	from Level 1
Dilution Factor	DF	6.94E+02		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		203	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	6.00E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	1.20E+01	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.20E-01	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	9.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.000	m	*see options*
Transverse dispersivity	az	0.900	m	*see options*
Vertical dispersivity	ay	0.090	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.20E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.20E-01	fraction
Rate of contaminant flow due to retardation	u	1.20E+01	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	9.79E-01	fraction
Attenuation factor (C_0/C_{ED})	**AF**	**1.02E+00**	**fraction**
Soil leachate concentration	Co	2.03E+02	

Remedial Targets

Level 3 Remedial Target		**4.61E+01**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**90**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**9.79E-01**	**fraction**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

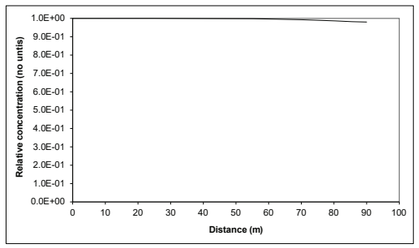
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	9.00E+00	4.18E+00	m
Transverse dispersivity	**az**	0.00E+00	9.00E-01	4.18E-01	m
Vertical dispersivity	**ay**	0.00E+00	9.00E-02	4.18E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Fassaroe - Site 3c
Completed by:	Adrian Green
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	2.93E-01
4.5	1.00E+00	2.93E-01
9.0	1.00E+00	2.93E-01
13.5	1.00E+00	2.93E-01
18.0	1.00E+00	2.93E-01
22.5	1.00E+00	2.93E-01
27.0	1.00E+00	2.93E-01
31.5	1.00E+00	2.93E-01
36.0	1.00E+00	2.93E-01
40.5	1.00E+00	2.92E-01
45.0	9.99E-01	2.92E-01
49.5	9.98E-01	2.92E-01
54.0	9.98E-01	2.92E-01
58.5	9.96E-01	2.91E-01
63.0	9.95E-01	2.91E-01
67.5	9.93E-01	2.91E-01
72.0	9.91E-01	2.90E-01
76.5	9.88E-01	2.89E-01
81.0	9.85E-01	2.88E-01
85.5	9.82E-01	2.87E-01
90.0	9.79E-01	2.86E-01

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.03E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	
Plume thickness at source	Sy	1.21E+01	m	
Saturated aquifer thickness	da	2.50E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.20E-01	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	9.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.00E+00	m	*see options*
Transverse dispersivity	az	9.00E-01	m	*see options*
Vertical dispersivity	ay	9.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.20E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	1.20E+01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.73E+02	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.17E+00**	

Remedial Targets

Remedial Target		**7.63E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**90**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.73E+02**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — 0.00E+00 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer — foc — fraction

Organic carbon partition coefficient — Koc — l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species — $K_{oc,n}$ — l/kg

Sorption coefficient for ionised species — $K_{oc,i}$ — l/kg

pH value — pH

acid dissocation constant — pKa

Fraction of organic carbon in aquifer — foc — fraction

Soil water partition coefficient — Kd — 0.00E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

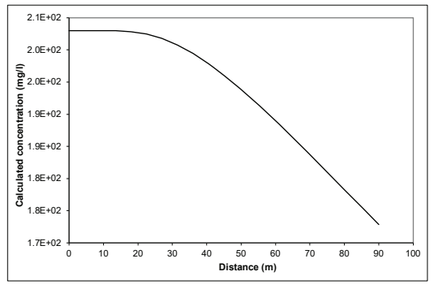
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	9.00E+00	4.18E+00	m
Transverse dispersivity	**az**	0.00E+00	9.00E-01	4.18E-01	m
Vertical dispersivity	**ay**	0.00E+00	9.00E-02	4.18E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}X)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	2.0E+02
4.5	2.03E+02
9.0	2.03E+02
13.5	2.03E+02
18.0	2.03E+02
22.5	2.02E+02
27.0	2.02E+02
31.5	2.01E+02
36.0	1.99E+02
40.5	1.98E+02
45.0	1.96E+02
49.5	1.94E+02
54.0	1.92E+02
58.5	1.90E+02
63.0	1.87E+02
67.5	1.85E+02
72.0	1.83E+02
76.5	1.80E+02
81.0	1.78E+02
85.5	1.75E+02
90.0	1.73E+02

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Fassaroe - Site 3c
Completed by:	Adrian Green
Date:	########
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Fassaroe - Site 3c			
Site Address:	Fassaroe Co. Wicklow			
Completed by:	Adrian Green			
Date:	04-May-18		Version:	1
Contaminant	Ammonia			
Target Concentration (C_T)	0.065	mg/l	Origin of C_T:	Surface Water EQS & GW GTV

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Ammonia**		from Level 1
Target concentration	C_T	**0.065**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	1.57E-03	m/d		
Area of contaminant source	A	8.70E+03	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	1.13E+02	m		
Saturated aquifer thickness	da	2.50E+01	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d		
Hydraulic gradient of water table	i	1.20E-01	fraction		
Width of contaminant source perpendicular to groundwater flow	w	6.00E+01	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.21E+01	m		

Calculated Parameters

Dilution Factor	**DF**	**8.29E+01**		
Level 2 Remedial Target		**5.39E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		0.00E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Fassaroe - Site 3c
Completed by:	Adrian Green
Date:	04-May-18
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	0.065	mg/l	from Level 1
Dilution Factor	DF	8.29E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Soil leachate concentration as mg/l		
Enter soil leachate concentration		203	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	6.00E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	1.21E+01	m	from Level 2
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.21E-01	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01	m/d	from Level 2
Distance to compliance point	x	9.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.000	m	*see options*
Transverse dispersivity	az	0.900	m	*see options*
Vertical dispersivity	ay	0.090	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.21E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.21E-01	fraction
Rate of contaminant flow due to retardation	u	1.21E+01	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	9.79E-01	fraction
Attenuation factor (C_0/C_{ED})	**AF**	**1.02E+00**	**fraction**
Soil leachate concentration	Co	2.03E+02	

Remedial Targets

Level 3 Remedial Target		**5.50E+00**	**mg/l**	For comparison with measured pore water concentration.
Domenico - Steady state		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		0.00E+00	**mg/kg**	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Distance to compliance point		**90**	**m**	Domenico - Steady state
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**9.79E-01**	**fraction**	

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

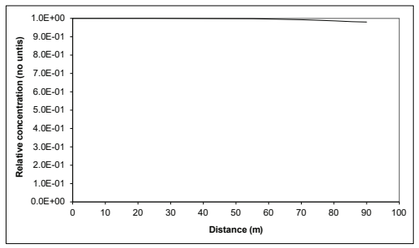
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	9.00E+00	4.18E+00	m
Transverse dispersivity	**az**	0.00E+00	9.00E-01	4.18E-01	m
Vertical dispersivity	**ay**	0.00E+00	9.00E-02	4.18E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Fassaroe - Site 3c
Completed by:	Adrian Green
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	**1.0E+00**	**2.45E+00**
4.5	**1.00E+00**	**2.45E+00**
9.0	**1.00E+00**	**2.45E+00**
13.5	**1.00E+00**	**2.45E+00**
18.0	**1.00E+00**	**2.45E+00**
22.5	**1.00E+00**	**2.45E+00**
27.0	**1.00E+00**	**2.45E+00**
31.5	**1.00E+00**	**2.45E+00**
36.0	**1.00E+00**	**2.45E+00**
40.5	**1.00E+00**	**2.45E+00**
45.0	**9.99E-01**	**2.45E+00**
49.5	**9.98E-01**	**2.45E+00**
54.0	**9.98E-01**	**2.44E+00**
58.5	**9.96E-01**	**2.44E+00**
63.0	**9.95E-01**	**2.44E+00**
67.5	**9.93E-01**	**2.43E+00**
72.0	**9.91E-01**	**2.43E+00**
76.5	**9.88E-01**	**2.42E+00**
81.0	**9.86E-01**	**2.41E+00**
85.5	**9.82E-01**	**2.41E+00**
90.0	**9.79E-01**	**2.40E+00**

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Ammonia		from Level 1
Target Concentration	C_T	6.50E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.04E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+99	days	
Calculated decay rate	λ	6.93E-100	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	
Plume thickness at source	Sy	1.21E+01	m	
Saturated aquifer thickness	da	2.50E+01	m	
Bulk density of aquifer materials	ρ	1.50E+00	g/cm^3	
Effective porosity of aquifer	n	1.00E-01	fraction	
Hydraulic gradient	i	1.20E-01	fraction	
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	
Distance to compliance point	x	9.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	7.30E+03	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.00E+00	m	*see options*
Transverse dispersivity	az	9.00E-01	m	*see options*
Vertical dispersivity	ay	9.00E-02	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	0.00E+00	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	9.00E+00	4.18E+00	m
Transverse dispersivity	**az**	0.00E+00	9.00E-01	4.18E-01	m
Vertical dispersivity	**ay**	0.00E+00	9.00E-02	4.18E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = $0.83(\log_{10}X)^{2.414}$; az = ax/10, ay = ax/100 are assumed

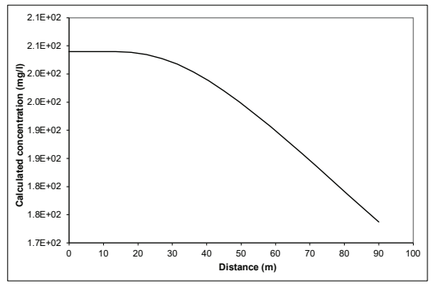
Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.20E+01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	6.93E-100	d^{-1}
Rate of contaminant flow due to retardation	u	1.20E+01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.74E+02	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.17E+00**	

Remedial Targets

Remedial Target		**7.63E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**90**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.74E+02**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	2.0E+02
4.5	2.04E+02
9.0	2.04E+02
13.5	2.04E+02
18.0	2.04E+02
22.5	2.03E+02
27.0	2.03E+02
31.5	2.02E+02
36.0	2.00E+02
40.5	1.99E+02
45.0	1.97E+02
49.5	1.95E+02
54.0	1.93E+02
58.5	1.91E+02
63.0	1.88E+02
67.5	1.86E+02
72.0	1.84E+02
76.5	1.81E+02
81.0	1.79E+02
85.5	1.76E+02
90.0	1.74E+02

Site being assessed:	Fassaroe - Site 3c
Completed by:	Adrian Green
Date:	########
Version:	1

APPENDIX M

Soil and Groundwater Monitoring Report Sept 2016

Fassaroe Historic Landfill
Surface & Groundwater Monitoring Report
September 2016

Client:	Cosgrave Development
Project Title:	Fassaroe Historic Landfill Monitoring
Document Title:	Surface & Groundwater Monitoring Report
Document No:	DD00203B/D1/004b

Text Pages:	14	Appendices:	2

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

In 2015, RPS was appointed by Cosgrave Developments to carry out an Environmental Risk Assessment (ERA) at the historic landfills at Fassaroe, Co. Wicklow. A detailed site investigation was conducted between November 2015 and March 2016 as part of the ERA and included an initial round of baseline sampling of waste leachate, groundwater and springs and surface waters at the site (RPS Report (2016); ref. no. MDR1206Rp0004 F01).

The current surface water and groundwater monitoring round, provides additional quality data for the Fassaroe Site to allow comparison to appropriate Environmental Quality Standards (EQS).

1.2 OBJECTIVES

The objectives of the current round of water quality monitoring at the Fassaroe Site are as follows:

- To obtain water quality from surface and groundwater bodies during low flow (dry) period.
- To assess the variability of water quality results.

1.3 SITE BACKGROUND

A detailed description of the Site Conceptual Model (CSM) is given in ERA Report (2016), and is summarised below:

The Fassaroe site consists of five historic landfills (Site 1, Site 2, Site 3A, Site 3B and Site 3C), most of which are in relatively close proximity to the County Brook River. All five waste bodies (sources) are surrounded by a thick sequence of unsaturated sand and gravels which represent glaciofluvial and glaciolacustrine sediments that make up the Enniskerry gravel aquifer body, classed as locally important gravel aquifer.

Groundwater boreholes were installed into the gravel aquifer, both up and down gradient, where possible, at all five waste sites. Groundwater flow in the gravel aquifer was shown to be to the north and northeast towards the river, based on water levels taken on the 29th of March 2016. Groundwater discharges emerge as springs and seepages along the northern boundary of the gravel aquifer in the river valley and feed a small strip of alkaline fen and tufa deposits within the Ballyman Glen Special Area of Conservation (SAC) [Site code: 000713].

The majority of the waste is underlain by unsaturated subsoil at Site 2 and Site 3a, however the most northerly parts of the waste body, closest to the river, appear to intercept the water table. In Site 3C the base of the waste appears to intercept the top of the water table across the majority of the site.

The underlying bedrock consists of Ordovician Metasediments of the Maulin Bedrock Formation characteristic of dark blue-grey slate, phyllite & schist, classified as a locally important, moderately productive bedrock aquifer in local zones (Ll). The depth to bedrock was not confirmed during the site investigation drilling programme of up to 35 metres.

1.4 SCOPE OF WORKS/METHODOLOGY

1.4.1 Surface Water & Spring Sampling

On the 24th of August (2016) surface water sampling was completed at 10 locations including five springs and five targeted locations along the County Brook River (Fassaroe Stream). The surface water monitoring locations are presented in Figure 1. The position of the springs relative to the waste bodies is identified in Table 1.1.

Table 1.1 – Spring Monitoring Locations

Sample ID	Location
SP1	60m down gradient of Site 2
SP2	85m down gradient of Site 1
SP3	140m down gradient of Site 3C
SP4	25m down gradient of Site 3A
SP5	60m down gradient of Site 3A

All surface water grab samples were obtained by placing the dedicated sampling bottles directly into the surface water body. Samples were obtained from areas where river level and flow was observed to ensure samples were representative. The sample inlet was placed below the surface flow while care was taken not to disturb the base/bed of the surface water body. Indicative field parameters of electrical conductivity, pH and temperature were taken for each sampling location.

1.4.2 Groundwater Sampling

Between the 30th of August and the 1st of September 2016, groundwater samples were taken from a total of seven groundwater monitoring boreholes (including one gas borehole G20), targeting both up-gradient and down-gradient locations of the landfills where possible. The position of groundwater monitoring boreholes relative to the waste bodies is identified in Table 1.2.

Table 1.2 - Groundwater Monitoring Boreholes Sampled

Site ID	BH ID	Relative Location	Other Groundwater boreholes (not sampled)
Site 1	BH05	Up gradient	none
Site 2	G20 (gas well)	Up gradient	*Up gradient:* BH03 (dry); BH04(dry); BH11(dry); BH13(dry);
	BH01	Down/Side gradient	
Site 3A	BH07, BH09, BH10 (d),	Up/Side Gradient	none
Site 3B	none		*Down gradient*: BH8 (dry)
Site 3C	BH06	Up-gradient	none

The boreholes which did not intercept groundwater include BH03, BH04, BH11 and BH13 (all of which are surrounding Site 2). BH8 at Site 3B did not intercept groundwater in the current round, albeit sufficient water for sampling was present in the previous monitoring round in March 2016.

Groundwater samples were obtained following purging a minimum of three well volumes prior to sample collection. To minimise cross contamination between sampling locations dedicated inertial tubing was used to collect each sample.

Indicative field parameters of electrical conductivity, pH and temperature were recorded at each sampling location.

1.4.3 Leachate Sampling

A total of 11 leachate samples were collected from the five sites between the 30th of August and the 1st of September 2016). The remaining leachate boreholes did not intercept any water or contained insufficient sample volumes. A summary of all leachate monitoring boreholes is presented in Table 1.3.

Table 1.3 - Leachate Monitoring Boreholes Sampled

Site ID	Sampled boreholes	Other boreholes (not sampled)
Site 1	LG11	LG12 (dry), LG13 (dry)
Site 2	LG03, LG07, LG09, LG10	LG01 (dry), LG02 (dry), LG04 (dry), LG05 (dry), LG06 (<40cm of leachate), LG08 (dry)
Site 3A	LG15, MW4, LG19	LG20 (dry), MW3
Site 3B	LG17	LG16 (<15cm of leachate), LG21 (<20cm of leachate)
Site 3C	LG14, MW2	LG18 (dry)

The leachate samples taken were collected by RPS staff in laboratory supplied sample containers and shipped to Chemtest Ltd. (UKAS Accredited), Depot Road, Newmarket, CB8 0AL, UK. To minimise cross contamination between sampling locations dedicated inertial tubing was used to collect each leachate sample.

Historic leachate monitoring wells are in existence at Sites 3A and Site 3C. For the current sampling round, leachate samples were collected from MW2 and MW4 for analysis. Other historic leachate monitoring boreholes are in existence across Sites 1 and 2, however borehole logs were not available therefore the integrity of existing monitoring infrastructure could not be established and were not utilised during the monitoring regime.

1.4.4 Laboratory Analysis

The surface water, spring water, leachate and groundwater samples were collected by RPS staff in laboratory supplied sample containers and shipped in cooler boxes including ice packs on the same day to Chemtest Ltd. (UKAS Accredited), Depot Road, Newmarket, CB8 0AL, UK. Confirmation of receipt was received the following day that all three batches of samples arrived in good condition.

All water and leachate samples were scheduled for testing of the following suite of parameters:

- Metals (including Al, As, Ba, B, Cd, Ca, Cr, Cu, Fe, Pb, Mn, Hg, Ni, K, Na, V, Zn)
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- pH
- Electrical Conductivity
- Alkalinity as CaCO3
- Ammoniacal Nitrogen as N
- Chloride as Cl
- Nitrite as N
- Nitrogen, Total Oxidised as N
- Phosphate, Ortho as P
- Sulphate as SO4
- Total Dissolved Solids
- Total Suspended Solids
- Total Organic Carbon
- Cyanide
- Fluoride
- Phenols
- Extractable Hydrocarbons
- Polycyclic aromatic Hydrocarbons
- Volatile Organic Compounds
- Semi-Volatile Organic Compound

The leachate and groundwater samples were also scheduled for dissolved gases including methane, oxygen and carbon dioxide.

2 RESULTS

2.1 SURFACE WATER & SPRINGS

2.1.1 Field Parameters

The field parameters for spring and surface waters are summarised in Table 2.1 below.

Table 2.1 – Surface water and Spring Field Parameters

Date	BH-ID	pH (-)	Temp (°C)	EC (µS/cm)	Visual
24/08/2016	SP1	7.67	14.8	1,379	Ochre, red discolouration & hydrocarbon sheen
24/08/2016	SP2	8.51	14.1	660	Calcite deposits present
24/08/2016	SP3	7.77	15.2	607	Calcite deposits present
24/08/2016	SP4	7.49	15.6	976	Ochre deposits present
24/08/2016	SP5	7.95	15.2	646	Calcite deposits present
24/08/2016	SW1	8.28	12.9	547	Clear
24/08/2016	SW2	8.52	12.5	539	Clear
24/08/2016	SW3	8.61	12.4	558	Clear
24/08/2016	SW4	8.47	12.1	550	Clear
24/08/2016	SW5	8.18	11.8	548	Clear

Spring locations SP2, SP3 and SP5 show accumulations of calcite (tufa) deposits. Spring locations SP1 and SP4, both show evidence of ochre staining, with lower pH readings than the calcite depositing springs. Spring location SP1 also showed evidence of hydrocarbon contamination and showed the highest electrical conductivity reading of all the spring locations.

Surface waters do not indicate any visual or olfactory evidence of contamination.

2.1.2 Laboratory Analysis

Surface water samples results were compared to Environmental Quality Standards (EQS) for freshwater bodies from the Surface Water Regulations (SI 327 of 2012 and SI 386 of 2015). These standards include a list of EQS for specific pollutants and for general physio-chemical conditions for good and high water body status. As such, these standards are considered to be the most appropriate generic assessment criteria for assessing the risk to surface water courses. The laboratory results for springs and surface waters are presented in Appendix A, and a summary of exceedances above EQS are summarised in Table 2.2.

Table 2.2 – Surface water & Spring EQS Exceedances

Type	Monitoring Location	Exceedances above EQS (specific pollutants)	Exceedance above general conditions for good status	Hydrocarbon & VOC detections
River	SW1		Ammoniacal Nitrogen	-
River	SW2		Ammoniacal Nitrogen	-
River	SW3		-	Chloromethane
River	SW4		Ammoniacal Nitrogen	Chloromethane
River	SW5	Mercury	Ammoniacal Nitrogen	Chloromethane
Spring	SP1		Ammoniacal Nitrogen	-
Spring	SP2		Ammoniacal Nitrogen	Chloromethane
Spring	SP3		Ammoniacal Nitrogen	Chloromethane
Spring	SP4	Nickel	Ammoniacal Nitrogen	Chloromethane
Spring	SP5	Zinc	Ammoniacal Nitrogen	Chloromethane

The results highlight exceedances at almost all locations of ammoniacal nitrogen, with exception of SW3, and chloromethane with the exception of SW1, SW2 and SP1. Isolated exceedances of nickel in SP4 and zinc in SP5 are also observed.

2.2 GROUNDWATER

2.2.1 Field Parameters

Field parameters for groundwater monitoring locations are summarised in Table 2.3. The purged and sampled groundwater at all monitoring locations contained significant amounts of fine sediment (silt) and as a result all samples were filtered on-site.

Table 2.3 – Groundwater Field Parameters

Date	BH-ID	Water level (mbgl)	pH (-)	Temp (^{o}C)	EC (µS/cm)	Visual
30/08/2016	BH9	7.78	7.06	13.8	740	Silty brown
30/08/2016	BH8	dry	-	-	-	-
30/08/2016	BH7	14.91	7.43	16.5	709	Brown, very silty
30/08/2016	BH10	9.33	7.35	13.6	727	Brown, very silty
31/08/2016	BH6	6.45	6.88	14.5	867	Silty brown
31/08/2016	BH5	20.23	7.12	13.3	972	Slight brown colour, very silty
31/08/2016	G20	15.20	7.76	14	523	Brown, very silty
01/09/2016	BH1	15.94	6.68	12.1	927	Brown, turbid, very silty

2.2.2 Laboratory Analysis

Groundwater concentrations have been compared to the Interim Guideline Values (IGV) for Groundwater as presented in EPA interim report "Towards Setting Guideline Values for the Protection of Groundwater in Ireland" (2003) and the Groundwater Regulations Threshold Values (GTV) (S.I. 9 of 2010). Groundwater quality results for all sites are presented in Appendix A, and exceedances above GTVs for all sites are summarised in Table 2.4.

Table 2.4 – Groundwater GTV and IGV Exceedances

Site	Monitoring location	Exceedances above GTV (*and IGV**)	Hydrocarbon and VOC Detections
Site 1	BH5	Ammoniacal Nitrogen, Chloride *(Boron, Iron)*	-
Site 2	G20	Ammoniacal Nitrogen , *(Boron, Iron, Chloride)*	-
Site 2	BH1	Ammoniacal Nitrogen, Boron *(Iron)*	-
Site 3A	BH7	Ammoniacal Nitrogen	-
Site 3A	BH9	Ammoniacal Nitrogen *(Iron)*	-
Site 3A	BH10	Ammoniacal Nitrogen *(Iron)*	-
Site 3C	BH6	Ammoniacal Nitrogen *(Iron)*	Chrysene

*Parameters listed in *italics* exceed only the IGV.

The results highlight that ammoniacal nitrogen exceeds the GTV at all groundwater monitoring locations. Exceedances above relevant GTV are also noted for Chloride in BH5 (up gradient of Site 1) and Boron in BH1 (down gradient of Site 2).

Exceedances above IGV's are observed for Iron at almost all groundwater monitoring locations, with the exception of BH7, for boron in BH5 (up gradient of Site 1) and G20 (up gradient of Site 2) and also for chloride in G20.

As summarised in Table 2.5 dissolved methane gas remained below detection limit of <0.050mg/l at all groundwater locations. Dissolved carbon dioxide gas ranged from 2.0 to 44mg/l across the sites.

Table 2.5 – Dissolved Gases in groundwater samples in mg/l

	Site 1	Site 2		Site 3A			Site 3C
Dissolved Gas	**BH5**	**G20**	**BH1**	**BH7**	**BH9**	**BH10**	**BH6**
Oxygen	11	9.5	14	8.7	8.4	9.9	9.3
CO2	44	9	30	2	3.3	1.7	25
Ethane	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Ethene	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Methane	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050

2.3 LEACHATE

2.3.1 Field Parameters

The field parameters for the leachate samples are summarised in Table 2.6.

The leachate ranged from dark grey/ black to brown in colour and measurements of electrical conductivity were above the maximum threshold (>3999µS/cm) of the field probe instrument for almost all sampling locations.

Table 2.6 – Leachate Field Parameters

Date	BH-ID	Water level (mbgl)	pH (-)	Temp (°C)	EC (µS/cm)	Visual
30/08/2016	LG17	3.67	7.23	16.2	>3,999	dark grey cloudy, strong foul odour
30/08/2016	LG15	6.94	6.82	19	3,467	black colour, strong foul odour
30/08/2016	LG19	~14.50	7.20	14	>3,999	slight black colour, strong foul odour
31/08/2016	LG14	~11.23	7.34	17	>3,999	dark grey, very turbid, strong foul odour
31/08/2016	LG11	12.12	7.01	15.7	2,473	dark grey/black, turbid, slight foul odour
01/09/2016	LG01	dry	-	-	-	-
01/09/2016	LG09	7.05	7.19	14.2	>3,999	dark brown, speckles of hydrocarbon sheen, strong foul odour
01/09/2016	LG10	~13	7.17	15	>3,999	dark brown, speckles of hydrocarbon sheen, strong foul odour
01/09/2016	LG07	11.63	7.18	15	>3,999	brown/grey, speckles of hydrocarbon sheen, strong foul odour
01/09/2016	LG04	dry	-	-	-	-
01/09/2016	LG05	dry	-	-	-	-
01/09/2016	LG03	17.57	6.99	15.3	>3,999	

2.3.2 Laboratory Analysis

Field measurements of electrical conductivity, temperature and pH for leachate samples taken at each of the sites are used as indicators of generic leachate properties.

Waste leachate concentrations obtained from chemical laboratory analysis have been compared to the Interim Guideline Values (IGV) for Groundwater as presented in EPA interim report "Towards Setting Guideline Values for the Protection of Groundwater in Ireland" 2002. The leachate results are also compared to the groundwater threshold values (GTV) in the Groundwater Regulations (SI 9 of 2010) and as such provide a conservative assessment of risk.

The tabulated results are presented in Appendix A and a summary of GTV exceedances for all sites is given in Table 2.7.

Table 2.7 – Leachate GTV Exceedances and IGV Exceedances

Site	Monitoring location	Exceedances above GTV (*and IGV)*	Hydrocarbon & VOC detections
Site 1	LG11	Boron, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, Sulphate, *(Barium, Boron, Calcium, Iron, Manganese, Potassium, Nitrite, Total Dissolved Solids, Total Phenols)*	-
Site 2	LG03	Arsenic, Boron, Mercury, Nickel, Sodium, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, *(Barium, Boron, Iron, Manganese, Potassium, Total Dissolved Solids, Total Petroleum Hydrocarbons)*	-
Site 2	LG07	Arsenic, Boron, Nickel, Sodium, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, *(Barium, Boron, Iron, Manganese, Potassium, Phosphate, Total Dissolved Solids)*	-
Site 2	LG09	Arsenic, Boron, Nickel, Sodium, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, *(Barium, Boron, Iron, Manganese, Potassium, Phosphate, Total Dissolved Solids)*	-
Site 2	LG10	Arsenic, Boron, Mercury, Nickel, Sodium, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, *(Barium, Boron, Iron, Manganese, Potassium, Phosphate, Total Dissolved Solids, Total Petroleum Hydrocarbons)*	-
Site 3A	LG15	Arsenic, Boron, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, Benzene, *(Barium, Boron, Calcium, Iron, Manganese, Potassium, Total Dissolved Solids, Total Phenols, Total Petroleum Hydrocarbons, Naphthalene, PAH, Toluene, m & p-Xylene, Methyl Tert-Butyl Ether)*	Vinyl Chloride, cis 1,2-Dichloroethene, Benzene, Toluene, Ethylbenzene, m & p-Xylene, o-Xylene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, 4-Isopropyltoluene
Site 3A	MW4	Arsenic, Boron, Nickel, Sodium, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, *(Barium, Boron, Iron, Manganese, Potassium, Phosphate, Total Dissolved Solids, Total Phenols, Total Petroleum Hydrocarbons, Naphthalene, PAH)*	Toluene, m & p-Xylene, o-Xylene
Site 3A	LG19	Arsenic, Boron, Nickel, Sodium, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, Benzene, *(Barium, Boron, Iron, Manganese, Potassium, Phosphate, Total Dissolved Solids, Total Phenols, Total Petroleum Hydrocarbons, Chlorobenzene, m & p-Xylene)*	Benzene, Toluene, Chlorobenzene, Ethylbenzene, m & p-Xylene, o-Xylene, Isopropylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, 4-Isopropyltoluene
Site 3B	LG17	Arsenic, Boron, Nickel, Sodium, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, Benzene, *(Barium, Boron, Iron, Manganese, Potassium, Phosphate, Total Dissolved Solids, Total Phenols, Total Petroleum Hydrocarbons, Toluene, m & p-Xylene)*	Vinyl Chloride, Benzene, Toluene, Ethylbenzene, m & p-Xylene, o-Xylene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, 4-Isopropyltoluene

Site	Monitoring location	Exceedances above GTV (*and IGV)*	Hydrocarbon & VOC detections
Site 3C	LG14	Arsenic, Boron, Nickel, Sodium, Electrical Conductivity, Ammoniacal Nitrogen, Chloride, *(Boron, Iron, Manganese, Potassium, Phosphate, Total Dissolved Solids, Total Phenols, Total Petroleum Hydrocarbons, Naphthalene)*	Nitrobenzene, 2-Nitrophenol, 2,4-Dimethylphenol, Naphthalene, 4-Chloro-3-Methylphenol, Diethyl Phthalate, Toluene, Ethylbenzene, m & p-Xylene, o-Xylene, 1,2,4-Trimethylbenzene, 4-Isopropyltoluene
Site 3C	MW2	Arsenic, Boron, Electrical Conductivity, *(Barium, Boron, Iron, Manganese, Potassium, Chloride, Naphthalene)*	1,4-Dichlorobenzene, Toluene, Naphthalene, 2-Methylnaphthalene

Table 2.8 summarises the dissolved gases in the leachate samples. Dissolved methane gas was detected in all leachate samples, ranging from 0.41 to 12mg/l, with the highest value observed in LG17 (Site 3B). Carbon dioxide gas ranges from 47 to 160mg/l across all sites, with the highest value observed in MW2 (Site 3C).

Table 2.8 – Dissolved Gases in Leachate samples in mg/l

	Site 1	Site 2				Site 3A			Site 3B	Site 3C	
Dissolved	**LG11**	**LG03**	**LG07**	**LG09**	**LG10**	**LG15**	**MW4**	**LG19**	**LG17**	**LG14**	**MW2**
Oxygen	3.1	9.9	7.8	8.5	9.9	4.1	1.6	3.0	2.7	0.8	4.6
CO2	100	85	88	110	78	73	80	76	47	71	160
Ethane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methane	0.94	2.9	1.5	5.9	0.41	5.2	1.8	6.9	12.0	8.5	1.8

4 DISCUSSION

4.1 SITE 1

The waste at Site 1 is largely comprised of construction and demolition waste, albeit the presence of domestic waste has also been documented from the site investigation. The waste leachate highlighted exceedances above groundwater threshold and guideline values of 15 water quality parameters, as summarised in Table 2.7.

Groundwater results for up-gradient BH05 show that there are a small number of exceedances above GTVs and/or IGVs for ammoniacal nitrogen, chloride, boron and iron concentrations. Due to slope instability towards the County Brook, there are no directly down gradient of the landfill at Site 1.

Dissolved methane gas concentrations were not detected in the groundwater sample at Site 1. Dissolved carbon dioxide concentrations were 100mg/l in the leachate sample and 44mg/l in the up-gradient groundwater monitoring borehole BH5.

Water quality results from spring SP2, which emerges approximately 85m downgradient of Site 1 in close proximity to the County Brook River, shows an exceedance above Surface Water EQS for ammoniacal nitrogen. There are no other exceedances above surface water EQS noted for tested water quality parameters at SP2.

4.2 SITE 2

Waste encountered at Site 2, the largest of the landfill sites, is comprised of mixed municipal waste. Leachate results from the four leachate monitoring boreholes (LG03, LG07, LG09 and LG10) highlighted exceedances above groundwater threshold and guideline values between 13 to 21 water quality parameters.

There are two groundwater monitoring boreholes at Site 2, an up-gradient borehole G20 and down-gradient borehole BH01. Up-gradient borehole G20 highlights one exceedance above GTV for ammoniacal nitrogen and above IGVs for boron, iron and chloride.

The downgradient borehole BH01 highlights an exceedance above GTV for ammoniacal nitrogen and above IGVs for iron, both parameters showing higher concentrations than in the up-gradient groundwater, indicating the waste body at Site 2 has impacted the groundwater quality downgradient.

Dissolved methane gas was not detected in up-gradient or downgradient groundwater, despite elevated concentrations in leachate samples ranging from 0.41 to 5.9mg/l at Site 2. Concentrations of dissolved carbon dioxide were higher in the downgradient borehole BH1 than in up-gradient monitoring borehole G20.

Spring location SP1 is located 60 metres down gradient of Site 2 in close proximity to the County Brook River. SP1 shows evidence of ochre staining and hydrocarbon sheen on the water surface and its quality results highlights an exceedance above surface water EQS for ammoniacal nitrogen

biochemical oxygen demand. The results indicate the waste body has impacted the spring water quality at Site 2.

4.3 SITE 3A

Waste encountered at Site 3A is comprised of mixed municipal waste and leachate results from three leachate monitoring boreholes (LG15, MW4 and LG19) highlight exceedances above groundwater threshold and guideline values for at least 13 water quality parameters including arsenic and hydrocarbons and total phenols.

There are three groundwater monitoring boreholes, including two locations up-gradient (BH7 and BH9) and one borehole located side/ downgradient (BH10) of the waste body. Water quality results from the up-gradient boreholes highlight exceedances above the GTV for ammoniacal nitrogen and BH9 also exceeds the IGV for iron. These exceedances may possibly relate to the waste body at Site 3B, which is located up-gradient of these groundwater monitoring boreholes.

The results for the side/ downgradient groundwater monitoring borehole BH10 shows the highest concentration of ammoniacal nitrogen at Site 3A, exceeding the GTV and also exceeds the IGVs for iron, manganese and potassium, signifying that the waste body has impacted the groundwater quality at Site 3A.

Dissolved methane gas was not detected in up-gradient or downgradient groundwater, despite elevated concentrations in leachate samples ranging from 1.8 to 6.9mg/l at Site 3A. Concentrations of dissolved carbon dioxide in groundwater range from 1.7 to 3.3mg/l were highest at BH9 and are likely related to the up-gradient waste body at Site 3B.

Results for the two sampled spring locations SP4 (25m downgradient of Site 3A) and SP5 (60m downgradient of Site 3A) show exceedances above surface water EQS for ammoniacal nitrogen. Additional exceedances above surface water EQS include nickel at SP4 and zinc at SP5. The ochre staining observed at SP4 also corresponds with the highest concentrations of iron (0.39mg/l) and manganese (7.4mg/l). There are currently no surface water EQS for iron and manganese. The results highlight that the downgradient spring water quality has been impacted by the waste body at Site 3A.

4.4 SITE 3B

Waste encountered at Site 3B is comprised of mixed municipal waste and leachate results from monitoring borehole LG17 indicates exceedances above groundwater threshold and guideline values for 17 water quality parameters including arsenic, chromium, iron and hydrocarbons and total phenols.

The groundwater monitoring borehole BH8 was dry on the day of sampling and therefore there are no groundwater quality results for Site 3B. Previous results have indicated the exceedance of a number of heavy metals in BH8, however the metal concentrations were based on total concentrations as opposed to dissolved concentrations.

There are no springs immediately down gradient of Site 3B.

4.5 SITE 3C

Waste encountered at Site 3C is comprised of mixed municipal waste and leachate results from LG14 and MW2 indicates exceedances above groundwater threshold and guideline values for nine water quality parameters including arsenic, and total phenols and total hydrocarbons in MW2.

Water quality results for groundwater monitoring borehole BH6 shows exceedances above groundwater threshold and guideline values for boron, iron, potassium and ammoniacal nitrogen. BH6 is located up-gradient but very close to the waste body. The elevated concentrations in the up-gradient groundwater may relate to a perched leachate head at the up-gradient perimeter of the waste body at the site, possibly causing localised mounding of the water table leading to the plume dispersing from the site. Alternatively, the groundwater quality may be influenced from up-gradient waste body at Site 3B.

Due to slope instability towards the County Brook River, there are no directly downgradient groundwater boreholes of the landfill at Site 3C.

Dissolved methane gas was not detected in up-gradient groundwater at BH6. Concentrations of carbon dioxide in groundwater at BH6 (25mg/l) were lower than concentrations in waste leachate (71 to 160mg/l) at Site 3C.

Quality results for spring SP3 located 140m downgradient of Site 3C, shows an exceedance above the surface water EQS for ammoniacal nitrogen, but is similar to up gradient groundwater concentrations. There are no other exceedances above surface water EQS noted for tested water quality parameters at SP3.

4.6 SURFACE WATERS

Surface water quality exceedances above relevant EQS correspond primarily to ammoniacal nitrogen for all sampling locations. The highest ammoniacal nitrogen concentration is observed at sampling location SW5, located upstream of all the sites.

Previous quality results from March (2016) also detected the presence of extractable hydrocarbons (EH C6-C40, C24-C40) at surface water monitoring locations SW3, SW4 and SW5. Hydrocarbons were not detected in the current round, however low concentrations of chloromethane were detected at these locations, which was not detected previously.

Concentrations of metals including zinc, manganese, boron and iron show generally increasing trend downstream, however there are currently no corresponding surface water EQS for these parameters.

The surface water quality results demonstrate the landfill sites are likely to be affecting water quality within the County Brook River, although the significance of this effect is mitigated by the dilution capacity within the main river itself.

5 CONCLUSIONS

Groundwater and surface water sampling was completed successfully at the Fassaroe Historical Landfill site and along the County Brook River in September 2016. Samples were collected from seven groundwater boreholes, 11 leachate boreholes, five springs and five surface water monitoring locations.

Leachate results from each site show exceedances above groundwater guidelines values for nine to 17 quality parameters, including heavy metals, ammonia and hydrocarbons.

Groundwater samples downgradient of the waste bodies confirm elevated levels of ammoniacal nitrogen and iron at all sites and manganese at Site 3C. In comparison to the up-gradient groundwater results, the downgradient groundwater results (at Sites 2 and Site 3A for which they are available) indicate that the waste body has impacted the groundwater quality.

Furthermore, quality results of SP1, SP4 and SP5 downgradient of Sites 2 and 3A also indicate that the waste bodies at these have impacted spring water quality at these sites.

The surface water quality results demonstrate the landfill sites are likely to be affecting water quality within the County Brook River, although the significance of this effect is mitigated by the dilution capacity within the main river itself.

Further bi-annually quality monitoring of leachate, spring and surface waters and groundwater is recommended using the current suite of parameters.

6 RECOMMENDATIONS

Further bi-annually quality monitoring of leachate, spring and surface waters and groundwater is recommended using the current suite of parameters.

SITE INVESTIGATION CO-ORDINATES		
ID	X Co-ordinate	Y Co-ordinate
Surface Water Monitoring Locations		
SW1	724137.00	718407.00
SW2	723733.00	718594.00
SW3	723598.00	718560.00
SW4	722837.00	718475.00
SW5	722609.00	718667.00

SITE INVESTIGATION CO-ORDINATES		
ID	X Co-ordinate	Y Co-ordinate
Spring Locations		
Spring 1	724052.00	718436.00
Spring 2	723554.00	718552.00
Spring 3	723365.00	718567.00
Spring 4	723200.00	718486.00
Spring 5	723100.00	718489.00
Spring 6	723038.00	718488.00
Spring 7	722982.00	718476.00
Spring 8	722842.00	718471.00
Spring 9	722780.00	718489.00
Spring 10	722783.12	718446.41

LEGEND

- ESB Overhead (38 kv)
- ESB Overhead (110kv)
- ESB Overhead (220kv)
- ESB Overhead (400kv)
- ESB Overhead (L□)
- ESB Overhead (M□)
- ESB Underground (38kv)
- ESB Underground (M□ □ L□)
- ESB Underground (Spare)
- Extent of Waste
- Special Areas of Conservation (SAC's)

Site Investigation

- MW1 — Existing Boreholes
- G01 — Gas Monitoring Borehole
- LG01 — Combined Gas/Leachate Monitoring Boreholes (Rotary)
- LG02 — Combined Gas/Leachate Monitoring Boreholes (Cable Percussive)
- Combined Gas/Leachate Monitoring Boreholes (Cable Percussive with Rotary follow on)
- BH01 — Combined Groundwater/Gas Monitoring Boreholes
- SW1 — Surface Water Monitoring Location
- Spring 1 — Spring Location
- SP1 — Spring Sampling Location

Proposed Road Alignment

Proposed Road Alignment

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Title: PLAN SHOWING MONITORING LOCATIONS

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APPENDIX A

Quality Results for Leachate, Groundwater and Surface Water

RPS

Appendix A
Leachate Results
Part 1

Fassaroe Leachate Monitoring 2016				Site 1	Site 2				Site 3A			Site 3B	Site 3C	
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**345695**	**346283**	**346280**	**346281**	**346282**	**345204**	**345205**	**345206**	**345202**	**345692**	**345693**
Customer Sample Ref.				**LG11**	**LG03**	**LG07**	**LG09**	**LG10**	**LG15**	**MW4**	**LG19**	**LG17**	**LG14**	**MW2**
Sample Date/Time				**31/08/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**	**31/08/2016**
Sample Matrix				**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
Aluminium (Dissolved)	ug/l	150	200	< 10	14	< 10	< 10	< 10	< 10	11	20	76	14	< 10
Arsenic (Dissolved)	ug/l	7.5	10	4.9	8.9	10	9.7	**14**	**11**	**19**	**73**	**45**	**33**	7.7
Barium (Dissolved)	ug/l	-	100	**240**	**500**	**300**	**330**	**350**	**250**	**130**	**270**	**300**	65	**240**
Boron (Dissolved)	ug/l	750	100	**1300**	**3400**	**3200**	**2600**	**4600**	**980**	**3600**	**9500**	**2300**	**2700**	**1100**
Cadmium (Dissolved)	ug/l	3.75	5	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Calcium	mg/l		200	**330**	130	95	78	69	**230**	95	68	150	79	200
Chromium (Dissolved)	ug/l	37.5	30	3.8	18	16	15	17	6.5	20	27	**34**	20	2.9
Copper (Dissolved)	ug/l	1500	30	< 1.0	3.1	2.9	3.1	3.4	< 1.0	6.9	8.7	5.6	3.8	< 1.0
Iron (Dissolved)	ug/l		200	**660**	**610**	**700**	**530**	**440**	**16000**	**1000**	**960**	**14000**	**900**	**1200**
Lead (Dissolved)	ug/l	18.75	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	7	2.9	1	2.2	< 1.0
Manganese (Dissolved)	ug/l		50	**960**	**290**	**190**	**110**	**390**	**1100**	**310**	**250**	**630**	**250**	**1500**
Mercury (Dissolved)	ug/l	0.75	1	< 0.50	0.79	< 0.50	0.71	0.86	< 0.50	0.59	0.68	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	ug/l	15	20	3.8	**38**	**59**	**50**	**36**	6.3	**94**	**200**	**95**	**82**	10
Potassium	mg/l		5	**32**	**270**	**340**	**310**	**350**	**140**	**550**	**500**	**750**	**550**	**43**
Sodium	mg/l	150	150	39	**570**	**670**	**640**	**670**	120	**820**	**1100**	**760**	**760**	59
Vanadium (Dissolved)	ug/l			< 1.0	2.8	4.1	3.6	3.5	< 1.0	6	12	12	12	< 1.0
Zinc (Dissolved)	ug/l		100	5.4	4.8	3.5	4.3	3.1	< 1.0	18	7.6	6.6	6.5	1.2
BODS	mg/l			< 4.0	11	26	21	20	120	< 4.0	63	420	23	19
COD	mg/l			78	430	780	620	790	290	680	730	< 10	800	79
pH	pH units		≥ 6.5 and ≤ 9.5	7.4	7.8	7.9	7.7	7.9	7.6	7.9	8.0	8.4	8.1	7.2
Conductivity Electrical	uS/cm	800-1875	1000	**2000**	**6600**	**8500**	**7900**	**8700**	**2900**	**10000**	**11000**	**12000**	**9800**	**1700**
Alkalinity as CaCO3	mg/l		NAC	1200	2700	3200	3000	2900	1500	3500	4200	6500	4400	1200
Ammoniacal Nitrogen as N	mg/l	0.175		29	270	310	280	330	100	590	540	780	0.93	69
Chloride as Cl	mg/l	187.5	30	**310**	**780**	**1100**	**1000**	**1300**	**190**	**1100**	**1700**	**1400**	**1100**	**58**
Nitrite as N	mg/l	0.375	0.1	**0.11**	0.02	0.025	0.02	0.012	0.061	0.052	0.067	0.011	< 0.010	< 0.010
Nitrogen, Total Oxidised as N	mg/l		NAC	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	0.23	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Phosphate as P	mg/l		0.03	< 0.020	< 0.020	**0.13**	**0.065**	**0.036**	< 0.020	**0.12**	**0.22**	**0.17**	**0.28**	< 0.020
Sulphate as SO4	mg/l	150	200	**170**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.2	< 1.0	14
Solids, Tot Dissolved	mg/l		1000	**1200**	**4000**	**5100**	**4700**	**5200**	**1700**	**6100**	**6400**	**7300**	**5900**	1000
Total Suspended Solids	mg/l			870	390	460	450	260	1700	500	770	780	3500	880
TOC as C	mg/l		NOC	24	71	86	90	120	110	130	220	240	180	90
Cyanide, Total as CN	mg/l	0.0375	10	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluoride as F	mg/l		1	0.12	0.3	0.38	0.38	0.33	0.16	0.47	0.6	**2**	0.78	0.23
Dissolved Oxygen	mg O2/l		NAC	3.1	9.9	7.8	8.5	9.9	4.1	1.6	3	2.7	0.76	4.6
Dissolved CO2	mg/l			100	85	88	110	78	73	80	76	47	71	160
Dissolved Ethane	mg/l			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Ethene	mg/l			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Methane	mg/l			0.94	2.9	1.5	5.9	0.41	5.2	1.8	6.9	12	8.5	1.8
Total Phenols	mg/l		0.0005	**0.077**	< 0.030	< 0.030	< 0.030	< 0.030	**0.058**	**0.074**	**0.053**	**11**	**0.15**	< 0.030
Total TPH >C6-C40	ug/l		10	< 10	**310**	< 10	< 10	**390**	**640**	**1600**	**750**	**2200**	**1100**	< 10
Acenaphthene	ug/l			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	ug/l			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	ug/l		10000	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) anthracene	ug/l			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (g,h,i) perylene	ug/l		0.05	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) pyrene	ug/l	0.0075	0.01	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (b) fluoranthene	ug/l		0.5	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (k) fluoranthene	ug/l		0.05	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	ug/l			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz (a,h) anthracene	ug/l			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	ug/l		1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	ug/l			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno (1,2,3) cd pyrene	ug/l		0.05	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene	ug/l		1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	**5.2**	**3.7**	< 0.10	< 0.10	< 0.10	< 0.10

Appendix A
Leachate Results
Part 1

Fassaroe Leachate Monitoring 2016	Units	GW Regs (2010) TV	EPA IGV value (GW)	Site 1	Site 2				Site 3A			Site 3B	Site 3C	
Laboratory Number				**345695**	**346283**	**346280**	**346281**	**346282**	**345204**	**345205**	**345206**	**345202**	**345692**	**345693**
Customer Sample Ref.				**LG11**	**LG03**	**LG07**	**LG09**	**LG10**	**LG15**	**MW4**	**LG19**	**LG17**	**LG14**	**MW2**
Sample Date/Time				**31/08/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**	**31/08/2016**
Sample Matrix				**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
Phenanthrene	ug/l			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	ug/l			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
PAH, Total	ug/l	75	0.1	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	**5.2**	**3.7**	< 2.0	< 2.0	< 2.0	< 2.0

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values	10	Exceedance above GW Regs TV	NAC	No Abnormal Change
EPA IGV - EPA Interim Guidelines Values for Groundwater (2003)	**10**	Exceedance above EPA IGV		

RPS

Appendix A
Leachate Results
Part 2

Fassaroe Leachate Monitoring 2016				Site 1	Site 2				Site 3A			Site 3B	Site 3C	
Laboratory Number	Units	GW Regs (2010) TV	EPA IGV value (GW)	345695	346283	346280	346281	346282	345204	345205	345206	345202	345692	345693
Customer Sample Ref.				LG11	LG03	LG07	LG09	LG10	LG15	MW4	LG19	LG17	LG14	MW2
Sample Date/Time				31/08/2016	01/09/2016	01/09/2016	01/09/2016	01/09/2016	30/08/2016	30/08/2016	30/08/2016	30/08/2016	31/08/2016	31/08/2016
Sample Matrix				Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
Phenol	ug/l		0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	4.4
1,2-Dichlorobenzene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	2.4	< 0.50
Isophorone	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	18	< 0.50
2,4-Dimethylphenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.56	< 0.50
Bis(2-Chloroethoxy)Methane	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	ug/l		1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	1.6	2.6
4-Chloroaniline	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	4	< 0.50
2-Methylnaphthalene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.68
Hexachlorocyclopentadiene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.82	< 0.50
4-Nitroaniline	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	ug/l		2	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	ug/l		10000	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	ug/l		1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

RPS

Appendix A
Leachate Results
Part 2

Fassaroe Leachate Monitoring 2016				Site 1	Site 2				Site 3A			Site 3B	Site 3C	
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**345695**	**346283**	**346280**	**346281**	**346282**	**345204**	**345205**	**345206**	**345202**	**345692**	**345693**
Customer Sample Ref.				**LG11**	**LG03**	**LG07**	**LG09**	**LG10**	**LG15**	**MW4**	**LG19**	**LG17**	**LG14**	**MW2**
Sample Date/Time				**31/08/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**	**31/08/2016**
Sample Matrix				**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
Bis(2-Ethylhexyl)Phthalate	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	ug/l		0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	ug/l		0.05	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	ug/l		0.01	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	ug/l		0.05	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	ug/l		0.05	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	ug/l			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values	10	Exceedance above GW Regs TV	10 Above Detection Limit
EPA IGV - EPA Interim Guidelines Values for Groundwater (2003)	**10**	Exceedance above EPA IGV	
SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average EQS	*10*	Exceedance above SW EQS	

RPS

Appendix A
Leachate Results
Part 3

Fassaroe Leachate Monitoring 2016				Site 1	Site 2				Site 3A			Site 3B	Site 3C	
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**345695**	**346283**	**346280**	**346281**	**346282**	**345204**	**345205**	**345206**	**345202**	**345692**	**345693**
Customer Sample Ref.				**LG11**	**LG03**	**LG07**	**LG09**	**LG10**	**LG15**	**MW4**	**LG19**	**LG17**	**LG14**	**MW2**
Sample Date/Time				**31/08/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**	**31/08/2016**
Sample Matrix				**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
Dichlorodifluoromethane	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	6.6	< 1.0	< 1.0	3	< 1.0	< 1.0
Bromomethane	ug/l			< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	ug/l	0.375		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l			< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	ug/l		12	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/l	0.75	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**2.9**	< 1.0	**1.8**	**1.1**	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	2.25	3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	ug/l	7.5	40	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	ug/l			< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	ug/l			< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	ug/l			< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Toluene	ug/l		10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**17**	2.8	5.4	**700**	8.2	< 1.0
Trans-1,3-Dichloropropene	ug/l			< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/l			< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene	ug/l	7.5	40	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	ug/l			< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	ug/l		0.04	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	ug/l		1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**3.9**	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	ug/l			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	ug/l		10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	6.7	< 1.0	8.4	6.4	2.6	< 1.0
m & p-Xylene	ug/l		10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**17**	4.2	**9.4**	**14**	6.8	< 1.0
o-Xylene	ug/l		10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	6.4	3.5	7.9	5.8	3.9	< 1.0
Styrene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.2	< 1.0	< 1.0	< 1.0
Bromobenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l			< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.3	< 1.0	2.8	1.7	< 1.0	< 1.0
4-Chlorotoluene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	5	< 1.0	4.1	3.5	4.8	< 1.0
Sec-Butylbenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

RPS

Appendix A
Leachate Results
Part 3

Fassaroe Leachate Monitoring 2016				Site 1	Site 2				Site 3A			Site 3B	Site 3C	
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**345695**	**346283**	**346280**	**346281**	**346282**	**345204**	**345205**	**345206**	**345202**	**345692**	**345693**
Customer Sample Ref.				**LG11**	**LG03**	**LG07**	**LG09**	**LG10**	**LG15**	**MW4**	**LG19**	**LG17**	**LG14**	**MW2**
Sample Date/Time				**31/08/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**	**31/08/2016**
Sample Matrix				**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
4-Isopropyltoluene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	11	< 1.0	6.5	70	19	< 1.0
1,4-Dichlorobenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	ug/l			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l		10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	ug/l			< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	ug/l		0.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l		0.1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether	ug/l		0.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**9.9**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	ug/l		30	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values

EPA IGV - EPA Interim Guidelines Values for Groundwater (2003)

10 Exceedance above GW Regs TV

10 Exceedance above EPA IGV

10 Above Detection Limit

RPS

Appendix A
Groundwater Results
Part 1

Fassaroe Groundwater Monitoring 2016					Site 1	Site 2		Site 3A			Site 3C
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**SW AA EQS**	**345694**	**345696**	**346279**	**345200**	**345201**	**345203**	**345691**
Customer Sample Ref.					**BH5**	**G20**	**BH1**	**BH7**	**BH9**	**BH10**	**BH6**
Sample Date/Time					**31/08/2016**	**31/08/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**
Sample Matrix					**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
Aluminium (Dissolved)	ug/l	150	200		< 10	< 10	< 10	< 10	< 10	< 10	< 10
Arsenic (Dissolved)	ug/l	7.5	10	25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.5	< 1.0
Barium (Dissolved)	ug/l	-	100		72	28	83	39	31	59	57
Boron (Dissolved)	ug/l	750	100		**450**	**530**	< 20	< 20	< 20	20	**1200**
Cadmium (Dissolved)	ug/l	3.75	5	0.08	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Calcium	mg/l		200		160	95	150	110	130	120	140
Chromium (Dissolved)	ug/l	37.5	30	3.4	4.2	< 1.0	< 1.0	2.5	3.0	1.0	1.2
Copper (Dissolved)	ug/l	1500	30	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Iron (Dissolved)	ug/l		200		**290**	**170**	**340**	180	**240**	**400**	**260**
Lead (Dissolved)	ug/l	18.75	10	1.2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Manganese (Dissolved)	ug/l		50		22	13	23	5.7	3.6	**210**	1.7
Mercury (Dissolved)	ug/l	0.75	1	0.05	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	ug/l	15	20	4	< 1.0	< 1.0	1.4	< 1.0	< 1.0	*4.3*	< 1.0
Potassium	mg/l		5		2.9	1.7	1.7	1.1	0.67	**30**	**31**
Sodium	mg/l	150	150		13	8.9	16	9.3	8.3	36	13
Vanadium (Dissolved)	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	ug/l		100	8	2.4	< 1.0	< 1.0	2.3	1.1	< 1.0	< 1.0
BODS	mg/l			1.5	4	< 4.0	< 4.0	5	6	< 4.0	5
COD	mg/l				16	< 10	72	12	< 10	880	12
pH	pH units		≥ 6.5 and ≤ 9.5	6.0 - 9.0	7.4	7.9	7.6	8.2	8.0	8.3	7.7
Conductivity Electrical	uS/cm	800-1875	1000		770	500	890	410	420	430	820
Alkalinity as CaCO3	mg/l		NAC		570	360	530	170	180	190	590
Ammoniacal Nitrogen as N	mg/l	0.175		0.065	0.34	0.93	2	0.86	3.5	14	0.59
Chloride as Cl	mg/l	187.5	30		**170**	**46**	21	28	23	31	22
Nitrite as N	mg/l	0.375	0.1		< 0.010	0.016	0.017	0.033	0.043	0.091	0.052
Nitrogen, Total Oxidised as N	mg/l		NAC		2.9	19	0.47	8.6	5.2	8.6	0.99
Phosphate as P	mg/l		0.03	0.035	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Sulphate as SO4	mg/l	150	200		69	31	25	27	18	24	22
Solids, Tot Dissolved	mg/l		1000		460	300	530	250	250	260	490
Total Suspended Solids	mg/l				840	240	390	4600	390	220	600
TOC as C	mg/l		NAC		18	17	9.3	6	4.7	98	8.8
Cyanide, Total as CN	mg/l	0.0375	10	0.01	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluoride as F	mg/l		1	0.5	0.097	0.092	0.14	0.12	0.097	0.11	0.11
Dissolved Oxygen	mg O2/l		NAC		11	9.5	14	8.7	8.4	9.9	9.3
Dissolved CO2	mg/l				44	9	30	2	3.3	1.7	25
Dissolved Ethane	mg/l				< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Ethene	mg/l				< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Methane	mg/l				< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Total Phenols	mg/l		0.0005	8	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030
Total TPH >C6-C40	ug/l		10		< 10	< 10	< 10	< 10	< 10	< 10	< 10
Acenaphthene	ug/l				< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	ug/l				< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Appendix A
Groundwater Results
Part 1

Fassaroe Groundwater Monitoring 2016					Site 1	Site 2		Site 3A			Site 3C
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**SW AA EQS**	**345694**	**345696**	**346279**	**345200**	**345201**	**345203**	**345691**
Customer Sample Ref.					**BH5**	**G20**	**BH1**	**BH7**	**BH9**	**BH10**	**BH6**
Sample Date/Time					**31/08/2016**	**31/08/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**
Sample Matrix					**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
Anthracene	ug/l		10000	0.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) anthracene	ug/l				< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (g,h,i) perylene	ug/l		0.05	0.002	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) pyrene	ug/l	0.0075	0.01	0.05	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (b) fluoranthene	ug/l		0.5	0.03	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (k) fluoranthene	ug/l		0.05		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	ug/l				< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz (a,h) anthracene	ug/l				< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	ug/l		1	0.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	ug/l				< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno (1,2,3) cd pyrene	ug/l		0.05	0.002	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene	ug/l		1	2	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	ug/l				< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	ug/l				< 0.10	< 0.10	1.9	< 0.10	< 0.10	< 0.10	< 0.10
PAH, Total	ug/l	75	0.1	n/a	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values	10	Exceedance above GW Regs TV	NAC No Abnormal Change
EPA IGV - EPA Interim Guidelines Values for Groundwater (2003)	**10**	Exceedance above EPA IGV	
SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average EQS	*10*	Exceedance above SW EQS	

RPS

Appendix A
Groundwater Results
Part 2

Fassaroe Groundwater Monitoring 2016					Site 1	Site 2		Site 3A			Site 3C
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**SW AA EQS**	**345694**	**345696**	**346279**	**345200**	**345201**	**345203**	**345691**
Customer Sample Ref.					**BH5**	**G20**	**BH1**	**BH7**	**BH9**	**BH10**	**BH6**
Sample Date/Time					**31/08/2016**	**31/08/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**
Sample Matrix					**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
Phenol	ug/l		0.5	8	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Isophorone	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	ug/l			0.4	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	ug/l		1	2.4	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloroaniline	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	ug/l			0.1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitroaniline	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	ug/l			0.01	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	ug/l		2	0.4	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	ug/l		10000		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	ug/l		1	0.1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.65
Bis(2-Ethylhexyl)Phthalate	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	ug/l		0.5	0.03	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	ug/l		0.05	0.03	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	ug/l		0.01	0.05	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	ug/l		0.05	0.002	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	ug/l		0.05		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Appendix A
Groundwater Results
Part 2

Fassaroe Groundwater Monitoring 2016	Units	GW Regs (2010) TV	EPA IGV value (GW)	SW AA EQS	Site 1	Site 2		Site 3A			Site 3C
Laboratory Number					**345694**	**345696**	**346279**	**345200**	**345201**	**345203**	**345691**
Customer Sample Ref.					**BH5**	**G20**	**BH1**	**BH7**	**BH9**	**BH10**	**BH6**
Sample Date/Time					**31/08/2016**	**31/08/2016**	**01/09/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**
Sample Matrix					**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
4-Nitrophenol	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values	10	Exceedance above GW Regs TV	10	Above Detection Limit
EPA IGV - EPA Interim Guidelines Values for Groundwater (2003)	**10**	Exceedance above EPA IGV		
SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average EQS	*10*	Exceedance above SW EQS		

RPS

Appendix A
Groundwater Results
Part 3

Fassaroe Groundwater Monitoring 2016					Site 1	Site 2		Site 3A			Site 3C
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**SW AA EQS**	**345694**	**346279**	**345696**	**345200**	**345201**	**345203**	**345691**
Customer Sample Ref.					**BH5**	**BH1**	**G20**	**BH7**	**BH9**	**BH10**	**BH6**
Sample Date/Time					**31/08/2016**	**01/09/2016**	**31/08/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**
Sample Matrix					**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
Dichlorodifluoromethane	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	ug/l				< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	ug/l	0.375			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l				< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	ug/l		12		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/l	0.75	1	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	2.25	3	10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	ug/l	7.5	40		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	ug/l				< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	ug/l				< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	ug/l				< 10	< 10	< 10	< 10	< 10	< 10	< 10
Toluene	ug/l		10	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	ug/l				< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/l				< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene	ug/l	7.5	40	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l				< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	ug/l				< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	ug/l		0.04		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	ug/l		1	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	ug/l				< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	ug/l		10		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	ug/l		10	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	ug/l		10	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Appendix A
Groundwater Results
Part 3

Fassaroe Groundwater Monitoring 2016					Site 1	Site 2		Site 3A			Site 3C
Laboratory Number	**Units**	**GW Regs (2010) TV**	**EPA IGV value (GW)**	**SW AA EQS**	**345694**	**346279**	**345696**	**345200**	**345201**	**345203**	**345691**
Customer Sample Ref.					**BH5**	**BH1**	**G20**	**BH7**	**BH9**	**BH10**	**BH6**
Sample Date/Time					**31/08/2016**	**01/09/2016**	**31/08/2016**	**30/08/2016**	**30/08/2016**	**30/08/2016**	**31/08/2016**
Sample Matrix					**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
Bromobenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l				< 50	< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Sec-Butylbenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	ug/l				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l		10		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	ug/l				< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	ug/l		0.4	0.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l		0.1	0.1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l		0.4	0.4	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether	ug/l		30	0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	ug/l				< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Legend

GW Regs TV - Groundwater Regulations (S.I. No. 9 of 2010) Groundwater Threshold Values	10	Exceedance above GW Regs TV	10 Above Detection Limit
EPA IGV - EPA Interim Guidelines Values for Groundwater (2003)	**10**	Exceedance above EPA IGV	
SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012) Annual Average EQS	*10*	Exceedance above SW EQS	

RPS

Appendix A
Surface Water Results
Part 1

Fassaroe Surface Water Monitoring 2016			River					Springs				
Laboratory Number	**Units**	**SW AA EQS**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**
Customer Sample Ref.			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SP1**	**SP2**	**SP3**	**SP4**	**SP5**
Sample Date/Time			**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**
Sample Matrix												
Aluminium (Dissolved)	ug/l		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Arsenic (Dissolved)	ug/l	25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Barium (Dissolved)	ug/l		27	33	25	22	21	150	25	23	320	81
Boron (Dissolved)	ug/l		47	25	< 20	< 20	< 20	1100	110	< 20	130	52
Cadmium (Dissolved)	ug/l	0.08	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Calcium	mg/l		110	110	110	120	120	160	110	120	190	120
Chromium (Dissolved)	ug/l	3.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper, (Dissolved)	ug/l	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Iron (Dissolved)	ug/l		200	250	170	180	160	250	200	180	390	170
Lead (Dissolved)	ug/l	1.2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Manganese (Dissolved)	ug/l		24	2.3	< 1.0	7.5	2.9	560	8.8	690	7400	160
Mercury (Dissolved)	ug/l	0.05	< 0.50	< 0.50	< 0.50	< 0.50	0.56	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	ug/l	4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.6	1.5	< 1.0	4.9	1.9
Potassium	mg/l		1.9	1.8	1.5	1.2	1.4	130	5.4	1.8	11	8
Sodium	mg/l		17	17	16	16	16	120	37	14	41	33
Vanadium (Dissolved)	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	ug/l	8	1.4	< 1.0	< 1.0	< 1.0	1.1	< 1.0	< 1.0	< 1.0	1.2	12
BODS	mg/l	1.5	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	7	< 4.0	< 4.0	< 4.0	< 4.0
COD	mg/l		14	14	13	13	< 10	55	24	26	21	26
pH	pH units	6.0 - 9.0	8.1	8.2	8.0	8.0	8.0	7.7	8.0	8.0	7.4	7.5
Conductivity- Electrical 20C	uS/cm	1875	560	460	570	600	610	1400	730	550	1100	730
Alkalinity as CaCO3	mg/l		250	240	240	260	270	660	290	290	490	310
Ammoniacal Nitrogen as N	mg/l	0.065	0.1	0.07	0.063	0.074	0.86	18	0.17	0.25	4.1	0.075
Chloride as Cl	mg/l		29	28	27	25	29	120	46	16	63	49
Nitrite as N	mg/l		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.011	< 0.010	< 0.010	0.033	0.016
Nitrogen, Total Oxidised as N	mg/l		4.1	3.6	3.6	3.8	3.6	< 0.20	0.34	< 0.20	0.68	0.97
Phosphate, Ortho as P	mg/l	0.035	0.021	0.021	< 0.020	0.02	0.022	< 0.020	< 0.020	0.021	< 0.020	< 0.020
Sulphate as SO4	mg/l		24	23	22	23	25	< 1.0	45	< 1.0	15	7.8
Solids, Tot Dissolved 180 DegC	mg/l		340	280	340	360	370	850	440	330	670	440
Total Suspended Solids	mg/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	30000	1500	11000	5100	8300
TOC as C	mg/l		11	6.3	5.8	5.7	5.5	10	11	30	13	8.8
Cyanide, Total as CN	ug/l	0.01	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluoride as F	mg/l	0.5	0.13	0.12	0.12	0.12	0.13	0.14	0.12	0.13	0.15	0.12
Total Phenols	mg/l	0.008	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030
Total TPH >C6-C40	ug/l		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	ug/l											
Acenaphthene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	ug/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (a) anthracene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (g,h,i) perylene	ug/l	0.002	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Appendix A
Surface Water Results
Part 1

Fassaroe Surface Water Monitoring 2016			River					Springs				
Laboratory Number	**Units**	**SW AA EQS**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**
Customer Sample Ref.			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SP1**	**SP2**	**SP3**	**SP4**	**SP5**
Sample Date/Time			**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**
Sample Matrix												
Benzo (a) pyrene	ug/l	0.05	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (b) fluoranthene	ug/l	0.03	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo (k) fluoranthene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz (a,h) anthracene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	ug/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno (1,2,3) cd pyrene	ug/l	0.002	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene	ug/l	2	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	ug/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
PAH, Total	ug/l	n/a	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Legend

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012 & SI 386 of 2015) Annual Average Environmental Quality Standards

10 Exceedance above SW EQS

RPS

Appendix A
Surface Water Results
Part 2

Fassaroe Surface Water Monitoring 2016			River					Springs				
Laboratory Number	**Units**	**SW AA EQS**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**
Customer Sample Ref.			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SP1**	**SP2**	**SP3**	**SP4**	**SP5**
Sample Date/Time			**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**
Sample Matrix			**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**
Phenol	ug/l	8	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Isophorone	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	ug/l	0.4	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	ug/l	2.4	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloroaniline	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	ug/l	0.1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitroaniline	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	ug/l	0.01	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	ug/l	0.4	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	ug/l	0.1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	ug/l	0.03	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Appendix A
Surface Water Results
Part 2

Fassaroe Surface Water Monitoring 2016			River					Springs				
Laboratory Number	**Units**	**SW AA EQS**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**
Customer Sample Ref.			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SP1**	**SP2**	**SP3**	**SP4**	**SP5**
Sample Date/Time			**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**
Sample Matrix			**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**	**Surface water**
Benzo[k]fluoranthene	ug/l	0.03	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	ug/l	0.05	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	ug/l	0.002	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Legend

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012 & SI 386 of 2015) Annual Average Environmental Quality Standards

10 Exceedance above SW EQS

10 Above Detection Limit

RPS

Appendix A
Surface Water Results
Part 3

Fassaroe Surface Water Monitoring 2016			River					Springs				
Laboratory Number	**Units**	**SW AA EQS**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**	**16-20343**
Customer Sample Ref.			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SP1**	**SP2**	**SP3**	**SP4**	**SP5**
Sample Date/Time			**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**	**24/08/2016**
Sample Matrix			**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**
Dichlorodifluoromethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l		<1.0	<1.0	27	29	36	< 1.0	34	9.9	23	29
Vinyl Chloride (chloroethene)	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	ug/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/l	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	ug/l		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	ug/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	ug/l		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Toluene	ug/l	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	ug/l		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/l		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene	ug/l	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	ug/l		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	ug/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	ug/l	1.5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	ug/l	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	ug/l	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l		< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Sec-Butylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

RPS

Appendix A
Surface Water Results
Part 3

4-Isopropyltoluene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	ug/l		< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	ug/l	0.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l	0.1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether (MBTE)	ug/l	0.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	ug/l		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Legend

SW AA EQS - Surface Water Regulation (S.I. No 327 of 2012 & SI 386 of 2015) Annual Average Environmental Quality Sta | *10* | Exceedance above SW EQS | 10 | Above Detection Limit

APPENDIX B

Chemtest Ltd. Laboratory Report

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

UKAS TESTING
2183

Final Report

Report No.:	16-20343-1		
Initial Date of Issue:	31-Aug-2016		
Client	RPS		
Client Address:	West Pier Business Campus Dun Laoghaire Co. Dublin Ireland		
Contact(s):	Janka Nitsche		
Project	MDR1206 - Fasseroe		
Quotation No.:	Q16-07130	**Date Received:**	25-Aug-2016
Order No.:		**Date Instructed:**	25-Aug-2016
No. of Samples:	10		
Turnaround (Wkdays):	3	**Results Due:**	30-Aug-2016
Date Approved:	30-Aug-2016		

Approved By:



Details: Glynn Harvey, Laboratory Manager

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		342238	342239	342240	342241	342242	342243	342244	342245	342246
			Client Sample ID.:		SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4
			Sample Type:		WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
			Date Sampled:		24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
pH	U	1010		N/A	8.1	8.2	8.0	8.0	8.0	7.7	8.0	8.0	7.4
Electrical Conductivity	U	1020	µS/cm	1.0	560	460	570	600	610	1400	730	550	1100
Suspended Solids At 105C	U	1030	mg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	30000	1500	11000	5100
Total Dissolved Solids	N	1040	mg/l	1.0	340	280	340	360	370	850	440	330	670
Chemical Oxygen Demand	U	1100	mg O2/l	10	14	14	13	13	< 10	55	24	26	21
Alkalinity (Total)	U	1220	mg CaCO3/l	10	250	240	240	260	270	660	290	290	490
Chloride	U	1220	mg/l	1.0	29	28	27	25	29	120	46	16	63
Fluoride	U	1220	mg/l	0.050	0.13	0.12	0.12	0.12	0.13	0.14	0.12	0.13	0.15
Ammoniacal Nitrogen	U	1220	mg/l	0.010	0.10	0.070	0.063	0.074	0.86	18	0.17	0.25	4.1
Nitrite as N	U	1220	mg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.011	< 0.010	< 0.010	0.033
Phosphate as P	U	1220	mg/l	0.020	0.021	0.021	< 0.020	0.020	0.022	< 0.020	< 0.020	0.021	< 0.020
Sulphate	U	1220	mg/l	1.0	24	23	22	23	25	< 1.0	45	< 1.0	15
Total Oxidised Nitrogen	U	1220	mg/l	0.20	4.1	3.6	3.6	3.8	3.6	< 0.20	0.34	< 0.20	0.68
Cyanide (Total)	U	1300	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Calcium	U	1415	mg/l	5.0	110	110	110	120	120	160	110	120	190
Potassium	U	1415	mg/l	0.50	1.9	1.8	1.5	1.2	1.4	130	5.4	1.8	11
Sodium	U	1415	mg/l	0.50	17	17	16	16	16	120	37	14	41
Aluminium (Dissolved)	N	1450	µg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Boron (Dissolved)	U	1450	µg/l	20	47	25	< 20	< 20	< 20	1100	110	< 20	130
Barium (Dissolved)	U	1450	µg/l	5.0	27	33	25	22	21	150	25	23	320
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Iron (Dissolved)	N	1480	µg/l	20	200	250	170	180	160	250	200	180	390
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.56	< 0.50	< 0.50	< 0.50	< 0.50
Manganese (Dissolved)	U	1450	µg/l	1.0	24	2.3	< 1.0	7.5	2.9	560	8.8	690	7400
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.6	1.5	< 1.0	4.9
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	1.4	< 1.0	< 1.0	< 1.0	1.1	< 1.0	< 1.0	< 1.0	1.2
Total Organic Carbon	U	1610	mg/l	2.0	11	6.3	5.8	5.7	5.5	10	11	30	13
Total TPH >C6-C40	U	1670	µg/l	10	[C] < 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Naphthalene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS					Chemtest Job No.:	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343
Quotation No.: Q16-07130					Chemtest Sample ID.:	342238	342239	342240	342241	342242	342243	342244	342245	342246
					Client Sample ID.:	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**										
Pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	1700	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dichlorodifluoromethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	27	29	36	< 1.0	34	9.9	23
Vinyl Chloride	N	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	U	1760	µg/l	5.0		[C] < 5.0	[C] < 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	U	1760	µg/l	2.0		[C] < 2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	U	1760	µg/l	5.0		[C] < 5.0	[C] < 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	U	1760	µg/l	2.0		[C] < 2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	N	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	U	1760	µg/l	10		[C] < 10	[C] < 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	U	1760	µg/l	5.0		[C] < 5.0	[C] < 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	N	1760	µg/l	10		[C] < 10	[C] < 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Toluene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	1760	µg/l	10		[C] < 10	[C] < 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	U	1760	µg/l	10		[C] < 10	[C] < 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	U	1760	µg/l	2.0		[C] < 2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	U	1760	µg/l	10		[C] < 10	[C] < 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	U	1760	µg/l	5.0		[C] < 5.0	[C] < 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	N	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	U	1760	µg/l	2.0		[C] < 2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS					Chemtest Job No.:	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343
Quotation No.: Q16-07130					Chemtest Sample ID.:	342238	342239	342240	342241	342242	342243	342244	342245	342246
					Client Sample ID.:	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**										
Ethylbenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	N	1760	µg/l	50		[C] < 50	[C] < 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Sec-Butylbenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	N	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	U	1760	µg/l	50		[C] < 50	[C] < 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	U	1760	µg/l	2.0		[C] < 2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Isophorone	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS					**Chemtest Job No.:**	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	342238	342239	342240	342241	342242	342243	342244	342245	342246
					Client Sample ID.:	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**										
Bis(2-Chloroethoxy)Methane	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloroaniline	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitroaniline	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS					**Chemtest Job No.:**	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343	16-20343
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	342238	342239	342240	342241	342242	342243	342244	342245	342246
					Client Sample ID.:	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**										
Benzo[k]fluoranthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Phenols	U	1920	mg/l	0.030		< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-20343
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		342247
			Client Sample ID.:		SP5
			Sample Type:		WATER
			Date Sampled:		24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
pH	U	1010		N/A	7.5
Electrical Conductivity	U	1020	µS/cm	1.0	730
Suspended Solids At 105C	U	1030	mg/l	5.0	8300
Total Dissolved Solids	N	1040	mg/l	1.0	440
Chemical Oxygen Demand	U	1100	mg O2/l	10	26
Alkalinity (Total)	U	1220	mg CaCO3/l	10	310
Chloride	U	1220	mg/l	1.0	49
Fluoride	U	1220	mg/l	0.050	0.12
Ammoniacal Nitrogen	U	1220	mg/l	0.010	0.075
Nitrite as N	U	1220	mg/l	0.010	0.016
Phosphate as P	U	1220	mg/l	0.020	< 0.020
Sulphate	U	1220	mg/l	1.0	7.8
Total Oxidised Nitrogen	U	1220	mg/l	0.20	0.97
Cyanide (Total)	U	1300	mg/l	0.050	< 0.050
Calcium	U	1415	mg/l	5.0	120
Potassium	U	1415	mg/l	0.50	8.0
Sodium	U	1415	mg/l	0.50	33
Aluminium (Dissolved)	N	1450	µg/l	10	< 10
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0
Boron (Dissolved)	U	1450	µg/l	20	52
Barium (Dissolved)	U	1450	µg/l	5.0	81
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0
Iron (Dissolved)	N	1480	µg/l	20	170
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50
Manganese (Dissolved)	U	1450	µg/l	1.0	160
Nickel (Dissolved)	U	1450	µg/l	1.0	1.9
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	12
Total Organic Carbon	U	1610	mg/l	2.0	8.8
Total TPH >C6-C40	U	1670	µg/l	10	< 10
Naphthalene	U	1700	µg/l	0.10	< 0.10
Acenaphthylene	U	1700	µg/l	0.10	< 0.10
Acenaphthene	U	1700	µg/l	0.10	< 0.10
Fluorene	U	1700	µg/l	0.10	< 0.10
Phenanthrene	U	1700	µg/l	0.10	< 0.10
Anthracene	U	1700	µg/l	0.10	< 0.10
Fluoranthene	U	1700	µg/l	0.10	< 0.10

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-20343
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		342247
			Client Sample ID.:		SP5
			Sample Type:		WATER
			Date Sampled:		24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Pyrene	U	1700	µg/l	0.10	< 0.10
Benzo[a]anthracene	U	1700	µg/l	0.10	< 0.10
Chrysene	U	1700	µg/l	0.10	< 0.10
Benzo[b]fluoranthene	U	1700	µg/l	0.10	< 0.10
Benzo[k]fluoranthene	U	1700	µg/l	0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700	µg/l	0.10	< 0.10
Dibenz(a,h)Anthracene	U	1700	µg/l	0.10	< 0.10
Benzo[g,h,i]perylene	U	1700	µg/l	0.10	< 0.10
Total Of 16 PAH's	U	1700	µg/l	2.0	< 2.0
Dichlorodifluoromethane	U	1760	µg/l	1.0	< 1.0
Chloromethane	U	1760	µg/l	1.0	29
Vinyl Chloride	N	1760	µg/l	1.0	< 1.0
Bromomethane	U	1760	µg/l	5.0	< 5.0
Chloroethane	U	1760	µg/l	2.0	< 2.0
Trichlorofluoromethane	U	1760	µg/l	1.0	< 1.0
1,1-Dichloroethene	U	1760	µg/l	1.0	< 1.0
Trans 1,2-Dichloroethene	U	1760	µg/l	1.0	< 1.0
1,1-Dichloroethane	U	1760	µg/l	1.0	< 1.0
cis 1,2-Dichloroethene	U	1760	µg/l	1.0	< 1.0
Bromochloromethane	U	1760	µg/l	5.0	< 5.0
Trichloromethane	U	1760	µg/l	1.0	< 1.0
1,1,1-Trichloroethane	U	1760	µg/l	1.0	< 1.0
Tetrachloromethane	U	1760	µg/l	1.0	< 1.0
1,1-Dichloropropene	U	1760	µg/l	1.0	< 1.0
Benzene	U	1760	µg/l	1.0	< 1.0
1,2-Dichloroethane	U	1760	µg/l	2.0	< 2.0
Trichloroethene	N	1760	µg/l	1.0	< 1.0
1,2-Dichloropropane	U	1760	µg/l	1.0	< 1.0
Dibromomethane	U	1760	µg/l	10	< 10
Bromodichloromethane	U	1760	µg/l	5.0	< 5.0
cis-1,3-Dichloropropene	N	1760	µg/l	10	< 10
Toluene	U	1760	µg/l	1.0	< 1.0
Trans-1,3-Dichloropropene	N	1760	µg/l	10	< 10
1,1,2-Trichloroethane	U	1760	µg/l	10	< 10
Tetrachloroethene	U	1760	µg/l	1.0	< 1.0
1,3-Dichloropropane	U	1760	µg/l	2.0	< 2.0
Dibromochloromethane	U	1760	µg/l	10	< 10
1,2-Dibromoethane	U	1760	µg/l	5.0	< 5.0
Chlorobenzene	N	1760	µg/l	1.0	< 1.0
1,1,1,2-Tetrachloroethane	U	1760	µg/l	2.0	< 2.0

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-20343
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		342247
			Client Sample ID.:		SP5
			Sample Type:		WATER
			Date Sampled:		24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Ethylbenzene	U	1760	µg/l	1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1.0	< 1.0
o-Xylene	U	1760	µg/l	1.0	< 1.0
Styrene	U	1760	µg/l	1.0	< 1.0
Tribromomethane	U	1760	µg/l	1.0	< 1.0
Isopropylbenzene	U	1760	µg/l	1.0	< 1.0
Bromobenzene	U	1760	µg/l	1.0	< 1.0
1,2,3-Trichloropropane	N	1760	µg/l	50	< 50
N-Propylbenzene	U	1760	µg/l	1.0	< 1.0
2-Chlorotoluene	U	1760	µg/l	1.0	< 1.0
1,3,5-Trimethylbenzene	U	1760	µg/l	1.0	< 1.0
4-Chlorotoluene	U	1760	µg/l	1.0	< 1.0
Tert-Butylbenzene	U	1760	µg/l	1.0	< 1.0
1,2,4-Trimethylbenzene	U	1760	µg/l	1.0	< 1.0
Sec-Butylbenzene	U	1760	µg/l	1.0	< 1.0
1,3-Dichlorobenzene	N	1760	µg/l	1.0	< 1.0
4-Isopropyltoluene	U	1760	µg/l	1.0	< 1.0
1,4-Dichlorobenzene	U	1760	µg/l	1.0	< 1.0
N-Butylbenzene	U	1760	µg/l	1.0	< 1.0
1,2-Dichlorobenzene	U	1760	µg/l	1.0	< 1.0
1,2-Dibromo-3-Chloropropane	U	1760	µg/l	50	< 50
1,2,4-Trichlorobenzene	U	1760	µg/l	1.0	< 1.0
Hexachlorobutadiene	U	1760	µg/l	1.0	< 1.0
1,2,3-Trichlorobenzene	U	1760	µg/l	2.0	< 2.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1.0	< 1.0
N-Nitrosodimethylamine	N	1790	µg/l	0.50	< 0.50
Phenol	N	1790	µg/l	0.50	< 0.50
2-Chlorophenol	N	1790	µg/l	0.50	< 0.50
Bis-(2-Chloroethyl)Ether	N	1790	µg/l	0.50	< 0.50
1,3-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50
1,4-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50
1,2-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50
2-Methylphenol (o-Cresol)	N	1790	µg/l	0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	N	1790	µg/l	0.50	< 0.50
Hexachloroethane	N	1790	µg/l	0.50	< 0.50
N-Nitrosodi-n-propylamine	N	1790	µg/l	0.50	< 0.50
4-Methylphenol	N	1790	µg/l	0.50	< 0.50
Nitrobenzene	N	1790	µg/l	0.50	< 0.50
Isophorone	N	1790	µg/l	0.50	< 0.50
2-Nitrophenol	N	1790	µg/l	0.50	< 0.50
2,4-Dimethylphenol	N	1790	µg/l	0.50	< 0.50

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-20343
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		342247
			Client Sample ID.:		SP5
			Sample Type:		WATER
			Date Sampled:		24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Bis(2-Chloroethoxy)Methane	N	1790	µg/l	0.50	< 0.50
2,4-Dichlorophenol	N	1790	µg/l	0.50	< 0.50
1,2,4-Trichlorobenzene	N	1790	µg/l	0.50	< 0.50
Naphthalene	N	1790	µg/l	0.50	< 0.50
4-Chloroaniline	N	1790	µg/l	0.50	< 0.50
Hexachlorobutadiene	N	1790	µg/l	0.50	< 0.50
4-Chloro-3-Methylphenol	N	1790	µg/l	0.50	< 0.50
2-Methylnaphthalene	N	1790	µg/l	0.50	< 0.50
Hexachlorocyclopentadiene	N	1790	µg/l	0.50	< 0.50
2,4,6-Trichlorophenol	N	1790	µg/l	0.50	< 0.50
2,4,5-Trichlorophenol	N	1790	µg/l	0.50	< 0.50
2-Chloronaphthalene	N	1790	µg/l	0.50	< 0.50
2-Nitroaniline	N	1790	µg/l	0.50	< 0.50
Acenaphthylene	N	1790	µg/l	0.50	< 0.50
Dimethylphthalate	N	1790	µg/l	0.50	< 0.50
2,6-Dinitrotoluene	N	1790	µg/l	0.50	< 0.50
Acenaphthene	N	1790	µg/l	0.50	< 0.50
3-Nitroaniline	N	1790	µg/l	0.50	< 0.50
Dibenzofuran	N	1790	µg/l	0.50	< 0.50
4-Chlorophenylphenylether	N	1790	µg/l	0.50	< 0.50
2,4-Dinitrotoluene	N	1790	µg/l	0.50	< 0.50
Fluorene	N	1790	µg/l	0.50	< 0.50
Diethyl Phthalate	N	1790	µg/l	0.50	< 0.50
4-Nitroaniline	N	1790	µg/l	0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	N	1790	µg/l	0.50	< 0.50
Azobenzene	N	1790	µg/l	0.50	< 0.50
4-Bromophenylphenyl Ether	N	1790	µg/l	0.50	< 0.50
Hexachlorobenzene	N	1790	µg/l	0.50	< 0.50
Pentachlorophenol	N	1790	µg/l	0.50	< 0.50
Phenanthrene	N	1790	µg/l	0.50	< 0.50
Anthracene	N	1790	µg/l	0.50	< 0.50
Carbazole	N	1790	µg/l	0.50	< 0.50
Di-N-Butyl Phthalate	N	1790	µg/l	0.50	< 0.50
Fluoranthene	N	1790	µg/l	0.50	< 0.50
Pyrene	N	1790	µg/l	0.50	< 0.50
Butylbenzyl Phthalate	N	1790	µg/l	0.50	< 0.50
Benzo[a]anthracene	N	1790	µg/l	0.50	< 0.50
Chrysene	N	1790	µg/l	0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	N	1790	µg/l	0.50	< 0.50
Di-N-Octyl Phthalate	N	1790	µg/l	0.50	< 0.50
Benzo[b]fluoranthene	N	1790	µg/l	0.50	< 0.50

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Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-20343
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		342247
			Client Sample ID.:		SP5
			Sample Type:		WATER
			Date Sampled:		24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Benzo[k]fluoranthene	N	1790	µg/l	0.50	< 0.50
Benzo[a]pyrene	N	1790	µg/l	0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	N	1790	µg/l	0.50	< 0.50
Dibenz(a,h)Anthracene	N	1790	µg/l	0.50	< 0.50
Benzo[g,h,i]perylene	N	1790	µg/l	0.50	< 0.50
4-Nitrophenol	N	1790	µg/l	0.50	< 0.50
Total Phenols	U	1920	mg/l	0.030	< 0.030

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample ID:	Sample Ref:	Sample ID:	Sampled Date:	Deviation Code(s):	Containers Received:
342238		SW1	24-Aug-2016	C	Plastic Bottle 1000ml
342239		SW2	24-Aug-2016	C	Coloured Winchester 1000ml
342239		SW2	24-Aug-2016	C	Plastic Bottle 1000ml

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Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

Chemtest
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Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

UKAS TESTING
2183

Final Report

Report No.:	16-20358-1		
Initial Date of Issue:	31-Aug-2016		
Client	RPS		
Client Address:	West Pier Business Campus Dun Laoghaire Co. Dublin Ireland		
Contact(s):	Janka Nitsche		
Project	MDR1206 - Fasseroe		
Quotation No.:	Q16-07130	**Date Received:**	25-Aug-2016
Order No.:		**Date Instructed:**	25-Aug-2016
No. of Samples:	10		
Turnaround (Wkdays):	6	**Results Due:**	02-Sep-2016
Date Approved:	31-Aug-2016		

Approved By:



Details: Glynn Harvey, Laboratory Manager

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS					**Chemtest Job No.:**	16-20358	16-20358	16-20358	16-20358	16-20358	16-20358	16-20358	16-20358
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	342327	342328	342329	342330	342331	342332	342333	342334	342335
					Client Sample ID.:	SW1	SW2	SW3	SW4	SW5	SP1	SP2	SP3	SP4
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016	24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**										
Biochemical Oxygen Demand	N	1090	mg O2/l	4.0		< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	7.0	< 4.0	< 4.0	< 4.0
Phosphate	U	1220	mg/l	0.050		< 0.050	0.052	< 0.050	0.058	0.062				

Results - Water

Project: MDR1206 - Fasseroe

Client: RPS					**Chemtest Job No.:** 16-20358
Quotation No.: Q16-07130					**Chemtest Sample ID.:** 342336
					Client Sample ID.: SP5
					Sample Type: WATER
					Date Sampled: 24-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Biochemical Oxygen Demand	N	1090	mg O2/l	4.0	< 4.0
Phosphate	U	1220	mg/l	0.050	

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Report Information

Key

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SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

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Chemtest Ltd.
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Newmarket
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Tel: 01638 606070
Email: info@chemtest.co.uk

UKAS TESTING
2183

Final Report

Report No.:	16-20856-1
Initial Date of Issue:	07-Sep-2016
Client	RPS
Client Address:	West Pier Business Campus Dun Laoghaire Co. Dublin Ireland
Contact(s):	Janka Nitsche
Project	MDR1206 Fassaroe
Quotation No.:	Q16-07130
Order No.:	
No. of Samples:	7
Turnaround (Wkdays):	6
Date Approved:	07-Sep-2016
Approved By:	

Date Received:	31-Aug-2016
Date Instructed:	31-Aug-2016
Results Due:	07-Sep-2016



Details: Martin Dyer, Laboratory Manager

Chemtest
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Results - Water

Project: MDR1206 Fassaroe

Client: RPS			**Chemtest Job No.:**	16-20856	16-20856	16-20856	16-20856	16-20856	16-20856	16-20856
Quotation No.: Q16-07130			**Chemtest Sample ID.:**	345200	345201	345202	345203	345204	345205	345206
			Client Sample ID.:	BH7	BH9	LG17	BH10	LG15	MW4	LG19
			Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER
			Date Sampled:	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
pH	U	1010		N/A	8.2	8.0	8.4	8.3	7.6	7.9	8.0
Electrical Conductivity	U	1020	µS/cm	1.0	410	420	12000	430	2900	10000	11000
Suspended Solids At 105C	U	1030	mg/l	5.0	4600	390	780	220	1700	500	770
Total Dissolved Solids	N	1040	mg/l	1.0	250	250	7300	260	1700	6100	6400
Biochemical Oxygen Demand	N	1090	mg O2/l	4.0	5.0	6.0	420	< 4.0	120	< 4.0	63
Chemical Oxygen Demand	U	1100	mg O2/l	10	12	< 10	< 10	880	290	680	730
Dissolved Oxygen	N	1150	mg O2/l	0.50	8.7	8.4	2.7	9.9	4.1	1.6	3.0
Dissolved CO2	N	1160	mg/l	0.60	2.0	3.3	47	1.7	73	80	76
Alkalinity (Total)	U	1220	mg CaCO3/l	10	170	180	6500	190	1500	3500	4200
Chloride	U	1220	mg/l	1.0	28	23	1400	31	190	1100	1700
Fluoride	U	1220	mg/l	0.050	0.12	0.097	2.0	0.11	0.16	0.47	0.60
Ammoniacal Nitrogen	U	1220	mg/l	0.010	0.86	3.5	780	14	100	590	540
Nitrite as N	U	1220	mg/l	0.010	0.033	0.043	0.011	0.091	0.061	0.052	0.067
Phosphate as P	U	1220	mg/l	0.020	< 0.020	< 0.020	0.17	< 0.020	< 0.020	0.12	0.22
Sulphate	U	1220	mg/l	1.0	27	18	3.2	24	< 1.0	< 1.0	< 1.0
Total Oxidised Nitrogen	U	1220	mg/l	0.20	8.6	5.2	< 0.20	8.6	0.23	< 0.20	< 0.20
Cyanide (Total)	U	1300	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Calcium	U	1415	mg/l	5.0	110	130	150	120	230	95	68
Potassium	U	1415	mg/l	0.50	1.1	0.67	750	30	140	550	500
Sodium	U	1415	mg/l	0.50	9.3	8.3	760	36	120	820	1100
Aluminium (Dissolved)	N	1450	µg/l	10	< 10	< 10	76	< 10	< 10	11	20
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	45	1.5	11	19	73
Boron (Dissolved)	U	1450	µg/l	20	< 20	< 20	2300	20	980	3600	9500
Barium (Dissolved)	U	1450	µg/l	5.0	39	31	300	59	250	130	270
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	2.5	3.0	34	1.0	6.5	20	27
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	5.6	< 1.0	< 1.0	6.9	8.7
Iron (Dissolved)	N	1480	µg/l	20	180	240	14000	400	16000	1000	960
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.59	0.68
Manganese (Dissolved)	U	1450	µg/l	1.0	5.7	3.6	630	210	1100	310	250
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	95	4.3	6.3	94	200
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	1.0	< 1.0	< 1.0	7.0	2.9
Vanadium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	12	< 1.0	< 1.0	6.0	12
Zinc (Dissolved)	U	1450	µg/l	1.0	2.3	1.1	6.6	< 1.0	< 1.0	18	7.6
Total Organic Carbon	U	1610	mg/l	2.0	6.0	4.7	240	98	110	130	220
Dissolved Ethane	N	1630	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Ethene	N	1630	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Methane	N	1630	mg/l	0.050	< 0.050	< 0.050	12	< 0.050	5.2	1.8	6.9
Total TPH >C6-C40	U	1670	µg/l	10	< 10	< 10	2200	< 10	640	1600	750
Naphthalene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	5.2	3.7	< 0.10

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 Fassaroe

Client: RPS					**Chemtest Job No.:**	16-20856	16-20856	16-20856	16-20856	16-20856	16-20856	16-20856
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	345200	345201	345202	345203	345204	345205	345206
					Client Sample ID.:	BH7	BH9	LG17	BH10	LG15	MW4	LG19
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Acenaphthylene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	1700	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	5.2	3.7	< 2.0
Dichlorodifluoromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	N	1760	µg/l	1.0		< 1.0	< 1.0	3.0	< 1.0	6.6	< 1.0	< 1.0
Bromomethane	U	1760	µg/l	5.0		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	U	1760	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	7.0	< 1.0	< 1.0
Bromochloromethane	U	1760	µg/l	5.0		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	U	1760	µg/l	1.0		< 1.0	< 1.0	1.1	< 1.0	2.9	< 1.0	1.8
1,2-Dichloroethane	U	1760	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	N	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	U	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	U	1760	µg/l	5.0		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	N	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10	< 10
Toluene	U	1760	µg/l	1.0		< 1.0	< 1.0	700	< 1.0	17	2.8	5.4
Trans-1,3-Dichloropropene	N	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	U	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10	< 10

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 Fassaroe

Client: RPS			**Chemtest Job No.:**		16-20856	16-20856	16-20856	16-20856	16-20856	16-20856	16-20856
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		345200	345201	345202	345203	345204	345205	345206
			Client Sample ID.:		BH7	BH9	LG17	BH10	LG15	MW4	LG19
			Sample Type:		WATER	WATER	WATER	WATER	WATER	WATER	WATER
			Date Sampled:		30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Tetrachloroethene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	U	1760	µg/l	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	U	1760	µg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	U	1760	µg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	N	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.9
1,1,1,2-Tetrachloroethane	U	1760	µg/l	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	6.4	< 1.0	6.7	< 1.0	8.4
m & p-Xylene	U	1760	µg/l	1.0	< 1.0	< 1.0	14	< 1.0	17	4.2	9.4
o-Xylene	U	1760	µg/l	1.0	< 1.0	< 1.0	5.8	< 1.0	6.4	3.5	7.9
Styrene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.2
Bromobenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	N	1760	µg/l	50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	1.7	< 1.0	2.3	< 1.0	2.8
4-Chlorotoluene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	3.5	< 1.0	5.0	< 1.0	4.1
Sec-Butylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	N	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	U	1760	µg/l	1.0	< 1.0	< 1.0	70	< 1.0	11	< 1.0	6.5
1,4-Dichlorobenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	U	1760	µg/l	50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	U	1760	µg/l	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	9.9	< 1.0	< 1.0
N-Nitrosodimethylamine	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Chemtest
The right chemistry to deliver results

Results - Water

Project: MDR1206 Fassaroe

Client: RPS		**Chemtest Job No.:**	16-20856	16-20856	16-20856	16-20856	16-20856	16-20856	16-20856
Quotation No.: Q16-07130		**Chemtest Sample ID.:**	345200	345201	345202	345203	345204	345205	345206
		Client Sample ID.:	BH7	BH9	LG17	BH10	LG15	MW4	LG19
		Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER
		Date Sampled:	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
N-Nitrosodi-n-propylamine	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Isophorone	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Chemtest
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Results - Water

Project: MDR1206 Fassaroe

Client: RPS					**Chemtest Job No.:**	16-20856	16-20856	16-20856	16-20856	16-20856	16-20856
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	345200	345201	345202	345203	345204	345205	345206
					Client Sample ID.:	BH7	BH9	LG17	BH10	LG15	MW4	LG19
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016	30-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Butylbenzyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Phenols	U	1920	mg/l	0.030		< 0.030	< 0.030	11	< 0.030	0.058	0.074	0.053

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

UKAS TESTING
2183

Final Report

Report No.:	16-21054-1
Initial Date of Issue:	09-Sep-2016
Client	RPS
Client Address:	West Pier Business Campus Dun Laoghaire Co. Dublin Ireland
Contact(s):	Janka Nitsche
Project	MDR1206 - Fasseroe
Quotation No.:	Q16-07130
Order No.:	
No. of Samples:	5
Turnaround (Wkdays):	5
Date Approved:	09-Sep-2016
Approved By:	

Date Received:	02-Sep-2016
Date Instructed:	02-Sep-2016
Results Due:	08-Sep-2016



Details: Robert Monk, Technical Development Chemist

Chemtest
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Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-21054	16-21054	16-21054	16-21054	16-21054
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		346279	346280	346281	346282	346283
Order No.:			Client Sample Ref.:		G.Water	Leachate	Leachate	Leachate	Leachate
			Client Sample ID.:		BH1	LG07	LG09	LG10	LG03
			Sample Type:		WATER	WATER	WATER	WATER	WATER
			Date Sampled:		01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
pH	U	1010		N/A	7.6	7.9	7.7	7.9	7.8
Electrical Conductivity	U	1020	µS/cm	1.0	890	8500	7900	8700	6600
Suspended Solids At 105C	U	1030	mg/l	5.0	390	460	450	260	390
Total Dissolved Solids	N	1040	mg/l	1.0	530	5100	4700	5200	4000
Biochemical Oxygen Demand	N	1090	mg O2/l	4.0	< 4.0	26	21	20	11
Chemical Oxygen Demand	U	1100	mg O2/l	10	72	780	620	790	430
Dissolved Oxygen	N	1150	mg O2/l	0.50	14	7.8	8.5	9.9	9.9
Dissolved CO2	N	1160	mg/l	0.60	30	88	110	78	85
Alkalinity (Total)	U	1220	mg CaCO3/l	10	530	3200	3000	2900	2700
Chloride	U	1220	mg/l	1.0	21	1100	1000	1300	780
Fluoride	U	1220	mg/l	0.050	0.14	0.38	0.38	0.33	0.30
Ammoniacal Nitrogen	U	1220	mg/l	0.010	2.0	310	280	330	270
Nitrite as N	U	1220	mg/l	0.010	0.017	0.025	0.020	0.012	0.020
Phosphate as P	U	1220	mg/l	0.020	< 0.020	0.13	0.065	0.036	< 0.020
Sulphate	U	1220	mg/l	1.0	25	< 1.0	< 1.0	< 1.0	< 1.0
Total Oxidised Nitrogen	U	1220	mg/l	0.20	0.47	< 0.20	< 0.20	< 0.20	< 0.20
Cyanide (Total)	U	1300	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Calcium	U	1415	mg/l	5.0	150	95	78	69	130
Potassium	U	1415	mg/l	0.50	1.7	340	310	350	270
Sodium	U	1415	mg/l	0.50	16	670	640	670	570
Aluminium (Dissolved)	N	1450	µg/l	10	< 10	< 10	< 10	< 10	14
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	10	9.7	14	8.9
Boron (Dissolved)	U	1450	µg/l	20	< 20	3200	2600	4600	3400
Barium (Dissolved)	U	1450	µg/l	5.0	83	300	330	350	500
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0	16	15	17	18
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	2.9	3.1	3.4	3.1
Iron (Dissolved)	N	1480	µg/l	20	340	700	530	440	610
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	0.71	0.86	0.79
Manganese (Dissolved)	U	1450	µg/l	1.0	23	190	110	390	290
Nickel (Dissolved)	U	1450	µg/l	1.0	1.4	59	50	36	38
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	< 1.0	4.1	3.6	3.5	2.8
Zinc (Dissolved)	U	1450	µg/l	1.0	< 1.0	3.5	4.3	3.1	4.8
Total Organic Carbon	U	1610	mg/l	2.0	9.3	86	90	120	71
Dissolved Ethane	N	1630	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Ethene	N	1630	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Methane	N	1630	mg/l	0.050	< 0.050	1.5	5.9	0.41	2.9
Total TPH >C6-C40	U	1670	µg/l	10	< 10	< 10	< 10	390	310

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Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-21054	16-21054	16-21054	16-21054	16-21054
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		346279	346280	346281	346282	346283
Order No.:			Client Sample Ref.:		G.Water	Leachate	Leachate	Leachate	Leachate
			Client Sample ID.:		BH1	LG07	LG09	LG10	LG03
			Sample Type:		WATER	WATER	WATER	WATER	WATER
			Date Sampled:		01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Naphthalene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	1700	µg/l	0.10	1.9	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	1700	µg/l	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dichlorodifluoromethane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	N	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	U	1760	µg/l	5.0	[C] < 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	U	1760	µg/l	2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	U	1760	µg/l	5.0	[C] < 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	U	1760	µg/l	2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	N	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	U	1760	µg/l	10	[C] < 10	< 10	< 10	< 10	< 10
Bromodichloromethane	U	1760	µg/l	5.0	[C] < 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	N	1760	µg/l	10	[C] < 10	< 10	< 10	< 10	< 10
Toluene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Chemtest
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Results - Water

Project: MDR1206 - Fasseroe

Client: RPS					**Chemtest Job No.:**	16-21054	16-21054	16-21054	16-21054
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	346279	346280	346281	346282	346283
Order No.:					Client Sample Ref.:	G.Water	Leachate	Leachate	Leachate	Leachate
					Client Sample ID.:	BH1	LG07	LG09	LG10	LG03
					Sample Type:	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Trans-1,3-Dichloropropene	N	1760	µg/l	10	[C] < 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	U	1760	µg/l	10	[C] < 10	< 10	< 10	< 10	< 10
Tetrachloroethene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	U	1760	µg/l	2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	U	1760	µg/l	10	[C] < 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	U	1760	µg/l	5.0	[C] < 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	N	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	U	1760	µg/l	2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	N	1760	µg/l	50	[C] < 50	< 50	< 50	< 50	< 50
N-Propylbenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Sec-Butylbenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	N	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	U	1760	µg/l	50	[C] < 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	U	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	U	1760	µg/l	2.0	[C] < 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1.0	[C] < 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

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Results - Water

Project: MDR1206 - Fasseroe

Client: RPS					**Chemtest Job No.:**	16-21054	16-21054	16-21054	16-21054
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	346279	346280	346281	346282	346283
Order No.:					Client Sample Ref.:	G.Water	Leachate	Leachate	Leachate	Leachate
					Client Sample ID.:	BH1	LG07	LG09	LG10	LG03
					Sample Type:	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
2-Methylphenol (o-Cresol)	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Isophorone	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloroaniline	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitroaniline	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

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Results - Water

Project: MDR1206 - Fasseroe

Client: RPS			**Chemtest Job No.:**		16-21054	16-21054	16-21054	16-21054	16-21054
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		346279	346280	346281	346282	346283
Order No.:			Client Sample Ref.:		G.Water	Leachate	Leachate	Leachate	Leachate
			Client Sample ID.:		BH1	LG07	LG09	LG10	LG03
			Sample Type:		WATER	WATER	WATER	WATER	WATER
			Date Sampled:		01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016	01-Sep-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Carbazole	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Phenols	U	1920	mg/l	0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample ID:	Sample Ref:	Sample ID:	Sampled Date:	Deviation Code(s):	Containers Received:
346279	G.Water	BH1	01-Sep-2016	C	Amber Glass 60ml
346279	G.Water	BH1	01-Sep-2016	C	Coloured Winchester 1000ml
346279	G.Water	BH1	01-Sep-2016	C	Plastic Bottle 1000ml

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Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

Chemtest
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Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

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Amended Report

Report No.:	16-20927-2		
Initial Date of Issue:	08-Sep-2016	**Date of Re-Issue:**	23-Sep-2016
Client	RPS		
Client Address:	Aquaterra Business Park Dun Laoghaire Co. Dublin Ireland		
Contact(s):	Janka Nitsche		
Project	MDR 1206 Fassaroe		
Quotation No.:	Q16-07130	**Date Received:**	01-Sep-2016
Order No.:		**Date Instructed:**	01-Sep-2016
No. of Samples:	6		
Turnaround (Wkdays):	5	**Results Due:**	07-Sep-2016
Date Approved:	23-Sep-2016		

Approved By:



Details: Glynn Harvey, Laboratory Manager

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Results - Water

Project: MDR 1206 Fassaroe

Client: RPS			**Chemtest Job No.:**		16-20927	16-20927	16-20927	16-20927	16-20927	16-20927
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		345691	345692	345693	345694	345695	345696
			Client Sample ID.:		BH6	LG14	MW2	BH5	LG11	G20
			Sample Type:		WATER	WATER	WATER	WATER	WATER	WATER
			Date Sampled:		31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
pH	U	1010		N/A	7.7	8.1	7.2	7.4	7.4	7.9
Electrical Conductivity	U	1020	µS/cm	1.0	820	9800	1700	770	2000	500
Suspended Solids At 105C	U	1030	mg/l	5.0	600	3500	880	840	870	240
Total Dissolved Solids	N	1040	mg/l	1.0	490	5900	1000	460	1200	300
Biochemical Oxygen Demand	N	1090	mg O2/l	4.0	5.0	23	19	4.0	< 4.0	< 4.0
Chemical Oxygen Demand	U	1100	mg O2/l	10	12	800	79	16	78	< 10
Dissolved Oxygen	N	1150	mg O2/l	0.50	9.3	0.76	4.6	11	3.1	9.5
Dissolved CO2	N	1160	mg/l	0.60	25	71	160	44	100	9.0
Alkalinity (Total)	U	1220	mg CaCO3/l	10	590	4400	1200	570	1200	360
Chloride	U	1220	mg/l	1.0	22	1100	58	170	310	46
Fluoride	U	1220	mg/l	0.050	0.11	0.78	0.23	0.097	0.12	0.092
Ammoniacal Nitrogen	U	1220	mg/l	0.010	0.59	0.93	69	0.34	29	0.93
Nitrite as N	U	1220	mg/l	0.010	0.052	< 0.010	< 0.010	< 0.010	0.11	0.016
Phosphate as P	U	1220	mg/l	0.020	< 0.020	0.28	< 0.020	< 0.020	< 0.020	< 0.020
Sulphate	U	1220	mg/l	1.0	22	< 1.0	14	69	170	31
Total Oxidised Nitrogen	U	1220	mg/l	0.20	0.99	< 0.20	< 0.20	2.9	< 0.20	19
Cyanide (Total)	U	1300	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Calcium	U	1415	mg/l	5.0	140	79	200	160	330	95
Potassium	U	1415	mg/l	0.50	31	550	43	2.9	32	1.7
Sodium	U	1415	mg/l	0.50	13	760	59	13	39	8.9
Aluminium (Dissolved)	N	1450	µg/l	10	< 10	14	< 10	< 10	< 10	< 10
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	33	7.7	< 1.0	4.9	< 1.0
Boron (Dissolved)	U	1450	µg/l	20	1200	2700	1100	450	1300	530
Barium (Dissolved)	U	1450	µg/l	5.0	57	65	240	72	240	28
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	1.2	20	2.9	4.2	3.8	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	3.8	< 1.0	< 1.0	< 1.0	< 1.0
Iron (Dissolved)	N	1480	µg/l	20	260	900	1200	290	660	170
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Manganese (Dissolved)	U	1450	µg/l	1.0	1.7	250	1500	22	960	13
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	82	10	< 1.0	3.8	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	2.2	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	< 1.0	12	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	< 1.0	6.5	1.2	2.4	5.4	< 1.0
Total Organic Carbon	U	1610	mg/l	2.0	8.8	180	90	18	24	17
Dissolved Ethane	N	1630	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Ethene	N	1630	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dissolved Methane	N	1630	mg/l	0.050	< 0.050	8.5	1.8	< 0.050	0.94	< 0.050
Total TPH >C6-C40	U	1670	µg/l	10	< 10	1100	< 10	< 10	< 10	< 10
Naphthalene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

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Results - Water

Project: MDR 1206 Fassaroe

Client: RPS					**Chemtest Job No.:**	16-20927	16-20927	16-20927	16-20927	16-20927
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	345691	345692	345693	345694	345695	345696
					Client Sample ID.:	BH6	LG14	MW2	BH5	LG11	G20
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Acenaphthylene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1700	µg/l	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	1700	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dichlorodifluoromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	N	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	U	1760	µg/l	5.0		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chloroethane	U	1760	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	U	1760	µg/l	5.0		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Trichloromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	U	1760	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichloroethene	N	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	U	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	U	1760	µg/l	5.0		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	N	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10
Toluene	U	1760	µg/l	1.0		< 1.0	8.2	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	U	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10

Chemtest
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Results - Water

Project: MDR 1206 Fassaroe

Client: RPS					Chemtest Job No.:	16-20927	16-20927	16-20927	16-20927	16-20927	16-20927
Quotation No.: Q16-07130					Chemtest Sample ID.:	345691	345692	345693	345694	345695	345696
					Client Sample ID.:	BH6	LG14	MW2	BH5	LG11	G20
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Tetrachloroethene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	U	1760	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromochloromethane	U	1760	µg/l	10		< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane	U	1760	µg/l	5.0		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chlorobenzene	N	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	U	1760	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylbenzene	U	1760	µg/l	1.0		< 1.0	2.6	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1.0		< 1.0	6.8	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	1760	µg/l	1.0		< 1.0	3.9	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	N	1760	µg/l	50		< 50	< 50	< 50	< 50	< 50	< 50
N-Propylbenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	U	1760	µg/l	1.0		< 1.0	4.8	< 1.0	< 1.0	< 1.0	< 1.0
Sec-Butylbenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	N	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	U	1760	µg/l	1.0		< 1.0	19	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Butylbenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	U	1760	µg/l	50		< 50	< 50	< 50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	U	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	U	1760	µg/l	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chlorophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	4.4	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachloroethane	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Chemtest
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Results - Water

Project: MDR 1206 Fassaroe

Client: RPS			**Chemtest Job No.:**		16-20927	16-20927	16-20927	16-20927	16-20927	16-20927
Quotation No.: Q16-07130			**Chemtest Sample ID.:**		345691	345692	345693	345694	345695	345696
			Client Sample ID.:		BH6	LG14	MW2	BH5	LG11	G20
			Sample Type:		WATER	WATER	WATER	WATER	WATER	WATER
			Date Sampled:		31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
N-Nitrosodi-n-propylamine	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Methylphenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nitrobenzene	N	1790	µg/l	0.50	< 0.50	2.4	< 0.50	< 0.50	< 0.50	< 0.50
Isophorone	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitrophenol	N	1790	µg/l	0.50	< 0.50	18	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	N	1790	µg/l	0.50	< 0.50	0.56	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	N	1790	µg/l	0.50	< 0.50	1.6	2.6	< 0.50	< 0.50	< 0.50
4-Chloroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	N	1790	µg/l	0.50	< 0.50	4.0	< 0.50	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	N	1790	µg/l	0.50	< 0.50	< 0.50	0.68	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthylene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dimethylphthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acenaphthene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenzofuran	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluorene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Azobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pentachlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phenanthrene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Anthracene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Carbazole	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Fluoranthene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Pyrene	N	1790	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Chemtest
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Results - Water

Project: MDR 1206 Fassaroe

Client: RPS					**Chemtest Job No.:**	16-20927	16-20927	16-20927	16-20927	16-20927
Quotation No.: Q16-07130					**Chemtest Sample ID.:**	345691	345692	345693	345694	345695	345696
					Client Sample ID.:	BH6	LG14	MW2	BH5	LG11	G20
					Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER
					Date Sampled:	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016	31-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Butylbenzyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chrysene	N	1790	µg/l	0.50		0.65	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-Nitrophenol	N	1790	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Phenols	U	1920	mg/l	0.030		< 0.030	0.15	< 0.030	< 0.030	0.077	< 0.030

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

PART 4

Addendum to Environmental Risk Assessment, RPS, 2022

ADDENDUM TO ENVIRONMENTAL RISK ASSESSMENT

Fassaroe Historical Landfills

JER8746
ADDENDUM TO ENVIRONMENTAL RISK ASSESSMENT:
2
2
30 March 2022

rpsgroup.com

Quality Management					
Version	**Revision**	**Authored by**	**Reviewed by**	**Approved by**	**Date**
1	1	Adam Parker	Phil Thomas	Phil Thomas	7 September 2020
2	1	Adam Parker	Phil Thomas	Phil Thomas	29 November 2021
2	2	Adam Parker	Phil Thomas	Phil Thomas	30 March 2022

Approval for issue			
Phil Thomas	Technical Director		31 March 2022

File Name
220329 R JER8476 AP Update to ERA 2022

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Prepared for:

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1 INTRODUCTION

1.1.1 RPS Consulting Services Limited (RPS) was appointed by Cosgrave Property Group to update an Environmental Risk Assessment (ERA) for the Fassaroe Site located in County Wicklow, Republic of Ireland. This report is an addendum to the ERA produced by RPS in 2018 (Ref. MDR1206Rp0007) which was prepared for the purposes of Certificate of Authorisation applications by Wicklow County Council to the EPA. This addendum reflects both further data collection undertaken following issue of the CoAs and also the detailed development proposals which are now the subject of the current Strategic Housing Development (SHD) application to An Bord Pleanála and which are presented within *Appendix A* and summarised in *Section 2*.

1.1.2 This addendum report presents details of the proposed SHD development and the further factual data and assesses if this further information generates the requirement for update and revision of the risk assessments presented within the previous ERA. Where update is considered to be necessary this addendum report presents a refined conceptual site model (CSM) and an updated Generic Quantitative Risk Assessment.

1.2 Background

1.2.1 The previous Environmental Risk Assessment has been accepted by the EPA on with reference to the of the Certificates of Authorisation it issued to Wicklow County Council in 2019 which authorise the remediation of the closed landfill sites 2, 3a, 3b and 3c at the Fassaroe site. With this authorisation in place Cosgrave Property Group wishes to pursue the planning application for the proposed residential development. To support the proposed SHD planning application, this update to the previous Environmental Risk Assessment, produced by RPS in June 2018 (Ref. DR1206Rp0007) has been prepared to incorporate and assess the additional information acquired, as set out in paragraph 1.2.2 below. The updates to this document will in turn require consideration within the Gas Management Strategy for the Proposed Development.

1.2.2 Since the production of the aforementioned report further information has become available which allows update of the report. This information includes:

- The results of a further rounds of gas and groundwater level data;
- The results of a landfill gas pumping trial, and;
- A development layout has been developed.

1.2.3 This data satisfies some but not all of the further data collection recommendation set out within Section 4 of the RPS Gas Management Strategy (Ref. MDR1206Rp0005). The further data collection recommendations outlined in Section 4 of the RPS Gas Management Strategy will need to be implemented in support of detailed design of the gas protections measures.

1.3 Report Structure

1.3.1 The report is split into the following sections:

Section 2. Proposed Development. This details the current development proposals and refers to the proposed masterplan drawings for the CPG owned lands at Fassaroe provided in October 2021.

Section 3. Tier 2 Site Investigation Testing. This provides details of the new factual data that has been provided for the site which includes further monitoring and gas pumping trials. To aid interpretation of the results, the results from the previous monitoring rounds are represented. Interpretation is also provided.

Section 4. Requirement to Update Previous Risk Assessments. This section considers if the further data collection and / or specific development details generate the requirement for update of the landfill gas, human health and / or water environment risk assessments.

Section 5. Refinement of Conceptual Site Model (CSM) and Quantitative Risk Assessment. This provides an update of Section 5 of the 2018 ERA. It details any changes to the CSM including source pathway and receptor linkages and the quantitative risk assessment for those risk assessments requiring update.

Section 6. Tier 3 Quantitative Risk Assessment. This provides an update of Section 6 of the 2018 ERA for those risk assessments requiring update.

Section 7. Remedial Options Appraisal. Any changes with regard to this section of the ERA 2018 are detailed in this section.

2 PROPOSED DEVELOPMENT

2.1 General Scheme

2.1.1 The proposed redevelopment comprises a mixed use development over a series of phases. A detailed layout has been developed for Phase 1 of the development with general land uses being defined for subsequent phases. The Phase 1 development comprises:

- 650 no. residential units, comprising 241 no. houses and 409 no. apartments;
- Stage 1 of Neighbourhood Centre to be provided comprising of 1,395 sq.m. of retail / retail services / commercial / café space, with residential development overhead. A community concierge area (480 sq.m.) will also be provided at the neighbourhood centre which will serve the entire Fassaroe future development. Note: Stage 2 of the Neighbourhood Centre will be provided within a later phase of the overall development at Fassaroe as the on-site population expands;
- 733 sq.m approx. crèche with capacity for approx. 138 no. childcare spaces;
- Retail / café kiosk (108 sq.m.) in district park;
- East-west Road link (2.4km) connecting N11 to Ballyman Road;
- Pedestrian / cycle route along east-west road link, across the N11 to Dargle Road via a new bridge and connecting to the Dargle Road Upper and to proposed Dargle River Greenway (to be delivered by WCC by early 2023);
- 15.3ha of District Park / Active Open Space;
- Demolition of an existing dwelling at Berryfield Lane;
- Rerouting and undergrounding of overhead ESB lines (110kV and 38kV lines);
- Site development / ground works on future development areas; and
- Water supply, foul and surface water drainage proposals.

2.1.2 It should be noted that the further building proposed for the further development phases are not accounted for in the unit numbers and square meterage's set out above.

2.1.3 The current development proposals are detailed in McCrossan O' Rourke Manning Architects Drawings presented within **Appendix A**.

2.2 Proximity to Landfill Sites

2.2.1 A key consideration when assessing the risk associated with landfill gas and the risk to human health and / or water environment as a result of the development is the impact that the specific development proposals may have on the contaminant pathways and proximity of receptors to the known contamination sources (the landfills). The remainder of this section summaries the development proposals with respects to their proximity to the landfills.

Landfill Site 1

2.2.2 The proposed Phase 1 scheme proposes the following features within the footprint of landfill site 1:

- Public Open Space comprising open land, vegetated and hardstanding areas, and trees; and
- Trees along northern boundary.

2.2.3 The proposed Phase 1 scheme also includes residential development to the immediate southwest, south and southeast of landfill site 1.

Landfill Site 2

2.2.4 The proposed Phase 1 scheme includes the following features within the footprint of the landfill site 2:

- Public Open Space comprising picnic area, ponds with sandy beach areas and associated amphitheatre seating walls, wildflower meadow, with pedestrian / cycle route, open land and wooded areas;
- Playground located to immediate west of the landfill site;
- Trees in northeastern area; and
- Access road in southwestern area.

2.2.5 Landfill site 2 is located to the immediate northwest of a proposed area of development comprising residential housing with gardens and apartment blocks to the south and southeast, with a creche located at the southwest corner. At its nearest point, the landfill site boundary is within c. 10 m from the area of development, but is more typically c. 10 – 20 m. The creche at the southwestern corner is located c. 25 m to the southeast of landfill site 2. A proposed access road crosses the southwestern corner of landfill site 2, with a kiosk located c. 5 m to the west of the landfill site's southwestern boundary.

2.2.6 Outside of the phase 1 development area an additional area of housing (subject to future planning) is also indicated to be present to the immediate east of the far eastern area of the landfill site. There is no defined layout for this housing at present.

Landfill Sites 3A, 3B and 3C

2.2.7 A section of the proposed access road will bisect Landfill site 3B. No buildings are proposed to be located within the landfill sites. These areas are considered likely to be developed for future use as public open space.

2.2.8 Landfill sites 3A, 3B and 3C are located to the west of the main phase 1 development areas. As part of the further proposed phases of development the areas to the south, east and west of landfill 3C are designated for housing. Likewise, Site 3A is located to the west of an area proposed for development as part of the further proposed phases of development, with site 3B located to the southwest of an existing sports ground. There is no defined layout for this housing at present.

2.2.9 Site 3C is located to the north of an existing residence on Berryfield Lane.

2.2.10 The existing 33" watermain runs through the site in a south to north direction. Landfill gas has been detected in close proximity to the watermain which may indicate some lateral landfill gas migration toward and within the vicinity of the watermain.

3 REQUIREMENT TO UPDATE PREVIOUS RISK ASSESSMENTS

3.1 Introduction

3.1.1 This section considers if the further data collection and / or specific development details generate the requirement for update of the landfill gas, human health and / or water environment risk assessments presented with the previous ERA. The need to update each of the risk assessments is considered in turn within the remainder of this section.

3.2 Landfill Gas Risk Assessment

3.2.1 The further data collection undertaken post issue of the previous ERA has provided significant additional information with respect to gas flow rates and concentrations over an extended period of time through both static monitoring and pumping trials. It is considered that this further data necessitates the update of the risk assessment. Additionally, the detailed development proposals provide an improved understanding of gas migration pathways and receptors.

3.3 Human Health Risk Assessment

3.3.1 Conceptual site models for each of the sites are detailed in Section 5 of the ERA report (Ref. DR1206Rp0007) with risk assessments being presented within Section 6. These are summarised below. As these conceptual models remains valid it is considered that the risk assessment does not require update.

Summary of Previous Assessment

3.3.2 A Human Health Risk Assessment was undertaken which assessed the risk to human health as a result of soil contamination identified at the site. Data confirming the contamination status of soils at the site was derived from multiple stages of investigation, the most recent and comprehensive data being provided by the ground investigation undertaken by RPS in 2015.

3.3.3 A Tier 1 qualitative risk assessment qualitatively identified each of the Source-Pathway-Receptor components that are present on site, which forms the basis of the risk assessment approach.

3.3.4 A Tier 2 risk assessment was undertaken which aimed to identify contaminants of concern and their spatial distribution and requires benchmarks against which to compare the concentrations of soil contaminants. The following standards were applied for the stated contaminants:

- Suitable 4 Use Levels (S4ULs), for all contaminants for which there are published values;
- Category 4 Screening Levels (C4SLs), for lead; and
- Generic Assessment Criteria (GAC) developed by Contaminated Land: Application in Real Environments (CL:AIRE), 2010. Soil Generic Assessment Criteria for Human Health Risk Assessment (CL:AIRE) for where there are no S4ULs or C4SLs available.

3.3.5 To summarise the Tier 2 human health risk assessment has identified that contaminant concentrations are generally below the selected screening criteria for a public open space (parks) use.

3.3.6 The risk assessment identified elevated concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) within the landfill materials in Site 1, elevated concentrations of lead and PAHs within the landfill materials in Site 2 and elevated concentrations of PAH within the capping materials in Site 2. In addition, asbestos containing materials was encountered at one location within the landfill materials in Site 1.

3.3.7 Despite the presence of elevated concentrations of contaminants and the presence of asbestos within the landfilled materials, it was considered that future site users are unlikely to be exposed to the contamination due to the depth at which the contamination is present (>1.0 m).

3.3.8 With regard to the PAH contamination within the capping materials within Site 2, additional sampling was considered as an option to further determine levels of contamination within these materials.

3.3.9 A suitable capping layer was recommended for construction in any faces where landfill materials in Sites 2 and 3B are exposed as a result of any future development, to mitigate potential risks to site end users in these areas.

3.3.10 Where site levels are altered, the report indicated that the risk assessment will require review.

Impact of Further Data Collection and Development Layout

3.3.11 The further data collection has provided no information of relevance to the Human Health Risk Assessment, focusing on ground gas. The further data collection does not change the conceptual model considered within the previous assessment.

3.3.12 The proposed Strategic Housing Development proposals do not alter the pathways or receptors considered within the previous assessment but do result in some alterations to ground elevations at the site, potentially exposing deeper contamination. Whilst the previous assessment suggests that an updated assessment would be required in such a scenario, the subsequent Remediation Strategy Report (Ref. MDR1206RP0008) approved under the certificate of authorisation confirmed that all of the landfills would be capped effectively breaking all pathways other than inhalation of volatiles. In the absence of any enclosed structures within the landfills it is considered that the proposed capping will essentially mitigate the risk to end users from any unforeseen contamination and therefore the risk assessment is not considered to require update.

3.4 Water Environment Risk Assessment

3.4.1 Conceptual site models for each of the sites are detailed in Section 5 of the ERA report (Ref. DR1206Rp0007) with risk assessments being presented within Section 6. These are summarised below. As these conceptual models remain valid it is considered that the risk assessment does not require update.

Summary of Previous Assessment

3.4.2 All five waste bodies are situated within a thick sequence of sand and gravel deposits that form the principal aquifer unit in the local area. Each waste body is overlain by a clay cap which is approximately 1 to 2 m thick although its integrity is questioned following observations with respect to landfill gas emissions. The underlying bedrock consists of Ordovician Metasediments of the Maulin Bedrock Formation of which are classified by the Geological Survey Ireland (GSI) as a locally important, moderately productive bedrock aquifer in local zones.

3.4.3 A Detailed Quantitative Risk Assessment (DQRA) was undertaken to quantify the potential significance of the soil and groundwater contamination upon the quality of the water environment and to allow the likely effect of any proposed remediation options to be evaluated.

3.4.4 The DQRA was carried out individually for each of the landfill sites using the EA Remedial Targets Methodology RTM and Worksheet (Release 3.2, issued January 2013).

3.4.5 This was undertaken for ammoniacal nitrogen, one of the principal contaminants of concern associated with leachate on the sites. The DQRA confirmed that that all five landfill sites at Fassaroe have the potential to impact the underlying sand and gravel aquifer and potentially the County Brook River (Fassaroe Stream) although impact to that water course is likely to be

reduced through mixing at the water table. The monitoring works undertaken on the site demonstrate that the actual impact on down-gradient groundwater quality reduces significantly over relatively short distances of 20 to 50 m, as indicated by down-gradient borehole and spring water quality. This reduction in concentrations was considered to confirm the dilution and natural attenuation capacity along the groundwater pathway. The significant flow in the County Brook River (Fassaroe Stream) also provides dilution to the potential impact on surface water quality, and for the case of ammonia concentrations, reduces the concentrations in the river below laboratory detection limit.

3.4.6 The evidence collected to date also demonstrated that the five landfill sites have the potential to affect conditions with the alkaline fen of the Ballyman Glen SAC and its associated watercourse.

Impact of Further Data Collection and Development Layout

3.4.7 The further data collection has provided limited additional information of relevance to the Water Environment Risk Assessment. Whilst further data with respect to groundwater levels has been obtained from a number of the monitoring wells this information does not change the conceptual model considered within the previous risk assessment. Similarly the Strategic Housing Development proposals do not introduce further pathways or alter the previous considered pathways.

3.4.8 In the above context it is considered that the Water Environment Risk Assessment presented in the previous ERA remains valid and does not require update.

4 TIER 2 SITE INVESTIGATION TESTING

4.1 Introduction

4.1.1 This section presents the further factual data and provides an up-to-date interpretation of the results. As previously set out, to aid the subsequent interpretation, the results from the previous gas monitoring rounds have been presented.

4.2 Landfill Gas

4.2.1 This section re-presents the previous borehole landfill gas monitoring records (obtained between March 2016 and February 2017) together with results of the further pumping trial information including quarterly monitoring rounds between the first quarter of 2020 and second quarter of 2021 (of which one was undertaken immediately prior to the pumping trials in June and July 2020). This section is an update of Section 4.6.6 of the 2018 ERA. The results are detailed below.

4.2.2 RPS Drawing MDR1206-RPS-00-XX-DR-C-DG1002 entitled 'Plan showing Waste Extents and Borehole Locations' details the location of each borehole with respect to the landfill sites.

Routine Gas Monitoring

4.2.3 Historical guidance generally suggest that a minimum of 6 to 10 readings are required to make decisions regarding a gas regime (Harries et al 1995 and Environment Agency et al 2000) however of utmost importance is that the monitoring period covers the 'worst case' scenario which occurs during falling atmospheric pressure and particular weather events including rainfall, frost and dry weather. Gas sampling has been undertaken in accordance with published guidance *Evaluation Of Development Proposals On Sites Where Methane And Carbon Dioxide Are Present* (Rpt. Ed. No. 4), which recommends that gas monitoring covers varying climatic conditions (including falling atmospheric pressure and after heavy rainfall) in accordance with CIRIA Guidance (R150).

4.2.4 A total of 24 No. gas monitoring rounds have been undertaken on the Fassaroe site and includes the following:

- 8 No. weekly gas monitoring rounds between 7th March and 27th April 2016; and
- 10 No. monthly gas monitoring rounds (May 2016 to February 2017).
- 1 No. gas monitoring round in June and July 2020 prior to pumping trials for the landfill sites.
- 6 No. quarterly gas monitoring rounds in 2020 and 2021 (including above monitoring round).

4.2.5 The monitoring undertaken generally conforms to the recommendations of Wilson et al (2005) and CIRIA Guidance C665 present typical/idealised periods and frequencies of monitoring, which suggest a 12-24 period of monitoring on a fortnightly or monthly frequency for sites with a high sensitivity of development (i.e. houses with gardens) and a high to very high source potential (i.e. landfill gas).

4.2.6 The gas monitoring network is summarised in **Table 4.1**. The majority of these boreholes were monitored in each of the 24 No. monitoring rounds. The results of the static monitoring round in June / July 2020 are presented with the pumping trial results in **Appendix B**. The results of the 6 No. quarterly monitoring rounds in 2020 and 2021 are also presented in **Appendix B.**

Table 4-1 - Gas Monitoring Boreholes

Site ID		BH ID
Site 1	Onsite	LG11,LG12,LG13

Site ID		BH ID
	Offsite	BH05,G06,G07,G08,G10,G18,G19
Site 2	Onsite	LG01,LG02,LG03,LG04,LG05,LG06, LG07,LG08,LG09,LG10
	Offsite	BH01,BH03,BH04,BH11,BH13,G01,G02,G03,G04,G05,G13,G20,G21,G22,G23,G24,G25
Site 3A	Onsite	LG15,LG19,LG20,MW3,MW4
	Offsite	BH07,BH09,BH10,G12,G14
Site 3B	Onsite	LG16,LG17,LG21
	Offsite	BH08,G15,G16,G17
Site 3C	Onsite	LG14,LG18,MW2
	Offsite	BH06,G09,G11

Pumping Gas Trials

4.2.7 In addition to the routine gas monitoring undertaken, pumping gas trials have been undertaken for each site to assess the potential for sustainable active extraction of landfill gas at the landfill sites, and provide an indication of gas migration pathways with respect to connectivity between boreholes. These comprised a combination of static and dynamic gas abstraction tests.

4.2.8 The trials were undertaken by Automatic Flare Systems Limited (AFS) with the methodology, results and conclusions detailed in the following report:

- *AFS, Report on the Gas Abstraction Pumping, Fassaroe Closed Landfill Sites, for Wicklow County Council, 28 July 2020).*

4.2.9 A temporary gas extraction system was setup up which involved connection of designated extraction wells to a temporary flare (200 m^3/hr Lo-Cal specification) powered by a generator with a separate fuel bowser. The extraction was undertaken for approximately a week at each landfill site.

4.2.10 Monitoring of landfill gases was typically undertaken three times a day from the extraction wells and surrounding monitoring wells throughout the pumping trial. The wells subject to extraction during the pumping trials are detailed below:

- Sites 1 and 2: Pumping test conducted between 21st and 28th June (8 days) using the same flare extraction system from extraction wells LG05, LG07, LG09, LG10 (site 2), LG12 and LG13 (site 1);
- Site 3B: Pumping test conducted between 4th and 10th July (7 days) using the same flare extraction system from extraction wells LG16, LG17 and LG21; and
- Site 3A and 3C: Pumping test conducted between 14th and 20th July (7 days) using the same extraction system from extraction wells LG15, LG19, LG20 (site 3A), LG14 and LG18 (site 3C).

4.2.11 The wells that were monitored as part of the pumping trials are detailed in **Table 4.2**.

Table 4-2– Boreholes Monitoring During Pumping Trials

Landfill Site	Monitored Extraction Boreholes	Monitored Non Extraction Boreholes
1	LG12, LG13	LG11, G07, G08, G18, G19
2	LG05, LG07, LG09, LG10	LG01, LG02, LG03, LG04, LG08, BH01, BH13, G04, G05, G25
3A	LG15, LG19, LG20	MW3, MW4
3B	LG16, LG17, LG21	BH07, BH08, BH09, G16, G17
3C	LG14, LG18	MW2, G09

4.2.12 The AFS report is provided in **Appendix C**.

4.3 Groundwater Observations

4.3.1 Groundwater was identified in 17 boreholes (both groundwater and gas monitoring boreholes) completed in the sands and gravel deposits, both onsite and offsite of the former landfills in the monitoring rounds. 19 boreholes, most of which were gas monitoring boreholes, were dry. Groundwater Monitoring was undertaken on 18 no. occasions in 2016 and 2017 at the same intervals as the ground gas monitoring.

4.3.2 In the 2018 ERA, the available groundwater level dataset (suggested that the flow direction in all sites does follow topography being orientated towards the river to the north and northeast. The hydraulic gradient steepens towards the valleys and is flatter on the plateau. As a result there was a steeper hydraulic gradient underlying Sites 1 and 2 than Sites 3A, B and C.

4.3.3 The available groundwater level dataset suggested that the flow direction in all sites does generally follow topography being orientated towards the river to the north and northeast. This indicates in particular that there are steep gradients to the north and northeast in the area of site 1 and 3A, with groundwater flow generally with a component towards the north and northeast across the whole area. However it has been observed that in the central area to the south of the site 1, other monitoring rounds have suggested a flow component towards the south, for example location G19 has a groundwater elevation of 89.98 mAOD compared to 84.34 mAOD at location G10, located circa 180 m to the southwest in the August 2016 monitoring round. This suggests that localised variability in the direction of groundwater flow may be present. The area to the southeast of site 2 contains a large number of dry boreholes to maximum depths of 33 mbgl (at borehole BH11) and therefore there is an absence of local groundwater data in some areas of the proposed development.

4.3.4 Seasonal variation was also very obvious at some locations with the majority of locations where groundwater levels were between 0.5 m and 2 m lower in August 2016 compared to March 2016.

4.3.5 A summary of all of the monitoring results from 2016 and 2017 is provided in **Table 4.3.** This is an update of Table 4.16 and Section 4.5.5 of the 2018 ERA.

Table 4-3 - Groundwater Monitoring Results, 2016-2017

BH ID	Type	Site	Installation depth (mbgl)	Standpipe Level (mAOD)	15/03/2016		22/03/2016		29/03/2016		05/04/2016		12/04/2016		20/04/2016		26/04/2016		31/05/2016		30/06/2016	
					mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD
G19	Gas	1	14.0	98.39	7.94	90.45	7.97	90.42	dry	<84.39	8.03	90.36	7.93	90.46	7.9	90.49	7.92	90.47	8.13	90.26	8.25	90.14
G08	Gas	1	14.0	94.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6
G07	Gas	1	14.0	93.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236
BH05	GW	1	29.0	96.32	20.43	75.89	20.07	76.25	20.1	76.22	20.06	<67.32	dry	<67.32	19.95	76.37	20	76.32	20.055	76.265	20.5	75.82
G18	Gas	1	14.0	93.83	dry	<79.83	dry	<79.8	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83
G06	Gas	1	11.0	91.303	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	6.3	85	dry	<80.3
BH04	GW	2	25.5	84.53	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0
G04	Gas	2	20.0	85.97	8.76	77.21	9.05	76.92	9.48	76.49	7.75	78.22	2.19	83.78	6.46	79.51	8.23	77.74	10.5	75.47	11.01	74.96
G05	Gas	2	20.0	86.86	16.06	70.8	16.16	70.7	16.23	70.63	16.36	70.5	16.45	70.41	16.46	70.4	16.46	70.4	dry	<66.86	16.73	70.13
G25	Gas	2	20.0	86.027	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03
BH13	GW	2	19.5	87.99	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49
BH01	GW	2	21.0	79.46	14.38	65.08	14.14	65.32	14.49	64.97	14.65	64.81	14.71	64.75	14.86	64.6	14.82	64.64	15.13	64.33	15.39	64.07
G03	Gas	2	19.5	69.63	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13
G02	Gas	2	19.5	72.64	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14
G13	Gas	2	20.0	99.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87
G22	Gas	2	20.0	63.85	-	-	-	-	-	-	-	-	9.27	54.58	9.38	54.47	9.42	54.43	9.86	53.99	10.23	53.62
G23	Gas	2	20.0	78.94	-	-	-	-	dry	<58.94	17	61.94	17.05	61.89	dry	61.89	17.24	61.7	dry	<58.94	dry	<58.94
G24	Gas	2	20.0	86.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84
BH03	GW	2	19.5	78.8	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3
G20	Gas	2	20.0	85.826	14.43	71.396	14.41	71.416	14.45	71.376	14.49	71.336	14.53	71.336	16.57	69.256	14.57	71.256	14.75	71.08	14.9	70.93
G21	Gas	2	17.0	87	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0
G01	Gas	2	17.5	85.4	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9
BH11	GW	2	33.0	82.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83
G10	Gas	2	18.0	98.95	9.22	89.73	9.24	89.71	9.27	89.68	9.32	89.63	9.23	89.72	9.24	89.71	9.26	89.69	9.565	89.385	11.5	87.45
G12	Gas	3A	14.0	99.02	10.13	88.89	10.29	88.73	10.44	88.58	10.55	88.47	10.64	88.38	10.73	88.29	10.75	88.27	11.24	87.78	11.28	87.74
BH10	GW	3A	14.0	99.51	8.43	91.08	8.5	91.01	8.61	90.9	8.63	90.88	8.71	90.8	8.7	90.81	8.73	90.78	9.06	90.45	9.09	90.42
G14	Gas	3A	14.0	98.83	7.53	91.3	7.63	91.2	7.75	91.08	7.81	91.02	7.87	90.96	7.91	90.92	7.94	90.89	8.15	90.68	8.37	90.46
BH09	GW	3B	12.0	98.14	6.43	91.71	6.57	91.57	6.75	91.39	6.85	91.29	6.88	91.26	6.94	91.2	6.96	91.18	7.27	90.87	7.53	90.61
G17	Gas	3B	6.0	98.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76
BH08	GW	3B	13.5	98.95	6.61	92.34	6.92	92.03	7.09	91.86	7.26	91.69	7.35	91.6	7.47	91.48	7.62	91.33	8.03	90.92	dry	<85.45
G15	Gas	3B	6.0	99.51	5.41	94.1	dry	<93.5	dry	<93.5	dry	<93.5	dry	<93.5	dry	<93.5	dry	<93.5	dry	<93.5	dry	<93.5
G16	Gas	3B	6.0	100.76	4.08	96.68	4.11	96.65	4.18	96.58	4.27	96.49	4.27	96.49	4.31	96.45	4.35	96.41	4.7	96.06	5.07	95.69
BH07	GW	3B	21.0	106.37	13.71	92.66	13.76	92.61	13.81	92.56	13.88	92.49	13.97	92.4	14.09	92.28	14.13	92.24	14.32	92.05	14.64	91.73
G11	Gas	3C	15.0	97.4	9.83	87.57	9.87	87.53	10	87.4	10.05	87.35	10.13	87.27	10.17	87.23	10.18	87.22	10.56	86.84	10.87	86.53
BH06	GW	3C	14.0	95.4	5.53	89.87	5.57	89.83	5.65	89.75	5.74	89.66	5.7	89.7	5.75	89.65	5.78	89.62	6.08	89.32	6.28	89.12
G09	Gas	3C	14.0	98.14	12.3	85.84	12.38	85.76	12.47	85.67	12.6	85.54	12.65	85.49	12.74	85.4	12.78	85.36	13.15	84.99	dry	<84.14

Table 4-4 - Groundwater Monitoring Results, 2016-2017 (Continued)

BH ID	Type	Site	Installation depth (mbgl)	Standpipe Level (mAOD)	28/07/2016		24/08/2016		29/09/2016		24/10/2016		26/11/2016		16/12/2016		27/01/2017		21/02/2017	
					mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD	mbtoc	mAOD
G19	Gas	1	14.0	98.39	8.37	90.02	8.51	89.88	dry	<84.39	dry	<84.39	dry	<84.39	dry	<84.39	dry	<84.39	dry	<84.39
G08	Gas	1	14.0	94.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6	dry	<80.6
G07	Gas	1	14.0	93.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236	dry	<79.236
BH05	GW	1	29.0	96.32	-	-	20.04	76.28	20.02	76.30	20.43	75.89	20.54	75.78	20.27	76.05	dry	<67.32	20.68	75.64
G18	Gas	1	14.0	93.83	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83	dry	<79.83
G06	Gas	1	11.0	91.303	-	-	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3	dry	<80.3
BH04	GW	2	25.5	84.53	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0	dry	<59.0
G04	Gas	2	20.0	85.97	11.65	74.32	11.85	74.12	12.32	73.65	12.67	73.3	12.15	73.82	13.09	72.88	13.15	72.82	dry	<65.97
G05	Gas	2	20.0	86.86	16.83	70.03	16.84	70.02	16.97	69.89	17.3	69.56	17.39	69.47	dry	66.86	17.56	69.3	17.67	69.19
G25	Gas	2	20.0	86.027	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03	dry	<66.03
BH13	GW	2	19.5	87.99	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49	dry	<68.49
BH01	GW	2	21.0	79.46	15.71	63.75	dry	58.46	16.26	63.2	16.53	62.93	dry	58.46	16.89	62.57	17.39	62.07	17.53	61.93
G03	Gas	2	19.5	69.63	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13	dry	<50.13
G02	Gas	2	19.5	72.64	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14	dry	<53.14
G13	Gas	2	20.0	99.87	15.05	84.82	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87	dry	<79.87
G22	Gas	2	20.0	63.85	10.51	53.34	10.76	53.09	11.08	52.77	11.47	52.38	dry	<43.85	dry	<43.85	dry	<43.85	dry	<43.85
G23	Gas	2	20.0	78.94	dry	<58.94	dry	<58.94	dry	<58.94	dry	<58.94	dry	<58.94	dry	<58.94	dry	<58.94	dry	<58.94
G24	Gas	2	20.0	86.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84	dry	<66.84
BH03	GW	2	19.5	78.8	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3	dry	<59.3
G20	Gas	2	20.0	85.826	dry	<65.83	15.18	70.65	15.3	70.52	15.73	70.10	dry	<65.83	dry	<65.83	dry	<65.83	dry	<65.83
G21	Gas	2	17.0	87	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0	dry	<70.0
G01	Gas	2	17.5	85.4	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9	dry	<67.9
BH11	GW	2	33.0	82.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83	dry	<49.83
G10	Gas	2	18.0	98.95	14.05	84.9	14.56	84.39	14.68	84.27	15.00	83.95	dry	<80.95	dry	<80.95	12.3	86.65	9.78	89.17
G12	Gas	3A	14.0	99.02	11.62	87.4	11.9	87.12	12.13	86.89	12.5	86.52	12.58	86.44	12.43	86.59	dry	<85.02	dry	<85.02
BH10	GW	3A	14.0	99.51	9.2	90.31	9.29	90.22	9.42	90.09	9.63	89.88	9.77	89.74	9.57	89.94	dry	<85.51	9.81	89.7
G14	Gas	3A	14.0	98.83	8.47	90.36	8.59	90.24	8.7	90.13	8.9	89.93	9.15	89.68	8.89	89.94	9.13	89.7	9.12	89.71
BH09	GW	3B	12.0	98.14	7.71	90.43	7.85	90.29	7.99	90.15	8.27	89.87	8.36	89.78	7.25	90.89	8.49	89.65	8.48	89.66
G17	Gas	3B	6.0	98.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76	dry	<92.76
BH08	GW	3B	13.5	98.95	dry	<85.45	dry	<85.45	dry	<85.45	dry	<85.45	dry	<85.45	dry	<85.45	dry	<85.45	dry	<85.45
G15	Gas	3B	6.0	99.51	dry	<93.51	dry	<93.51	dry	<93.51	dry	<93.51	dry	<93.51	dry	<93.51	dry	<93.51	dry	<93.51
G16	Gas	3B	6.0	100.76	5.37	95.39	dry	<94.76	dry	<94.76	dry	<94.76	dry	<94.76	dry	<94.76	dry	<94.76	dry	<94.76
BH07	GW	3B	21.0	106.37	14.79	91.58	14.84	91.53	15.07	91.3	15.39	90.98	15.4	90.81	15.48	90.89	15.81	90.56	15.9	90.47
G11	Gas	3C	15.0	97.4	11.9	85.5	11.58	85.82	11.98	85.42	12.49	84.91	dry	<82.4	12.73	84.67	dry	<82.4	13.12	84.28
BH06	GW	3C	14.0	95.4	6.39	89.01	6.42	88.98	6.48	88.92	6.81	88.59	6.94	88.46	6.62	88.78	6.84	88.36	6.62	88.78
G09	Gas	3C	14.0	98.14	dry	<84.14	dry	<84.14	dry	<84.14	dry	<84.14	dry	<84.14	dry	<84.14	dry	<84.14	dry	<84.14

4.4 Landfill Gas Monitoring Results

4.4.1 Gas monitoring was carried out on eighteen occasions between 7th March 2016 and 21st February 2017 with six rounds of static monitoring undertaken between the first quarter of 2020 and second quarter of 2021. One of these rounds undertaken in June / July 2020 in the majority of boreholes immediately prior to pumping trials. The gas monitoring dataset is summarised on a site by site basis in the following tables and time series charts. The data from the standard monitoring and pumping trial data are presented in separate sections. The pumping trial data section includes the data from the 2020 monitoring round undertaken immediately prior to the trial.. Atmospheric pressure during the monitoring events ranged from 983 to 1020 mbar. Gas monitoring data is presented in **Appendix B**.

4.4.2 Although the static monitoring results for 2020 and 2021 have been including in the landfill gas summary tables, these have not been included in the charts based on the significant time interval between the monitoring results from the recent and earlier rounds.

Site 1: Standard Monitoring

4.4.3 In total ten boreholes were monitored for gas at Site 1, three onsite combined gas/leachate boreholes and seven offsite boreholes including six gas boreholes and one groundwater borehole. This includes the 2016,2017, 2020 and 2021 monitoring rounds. .

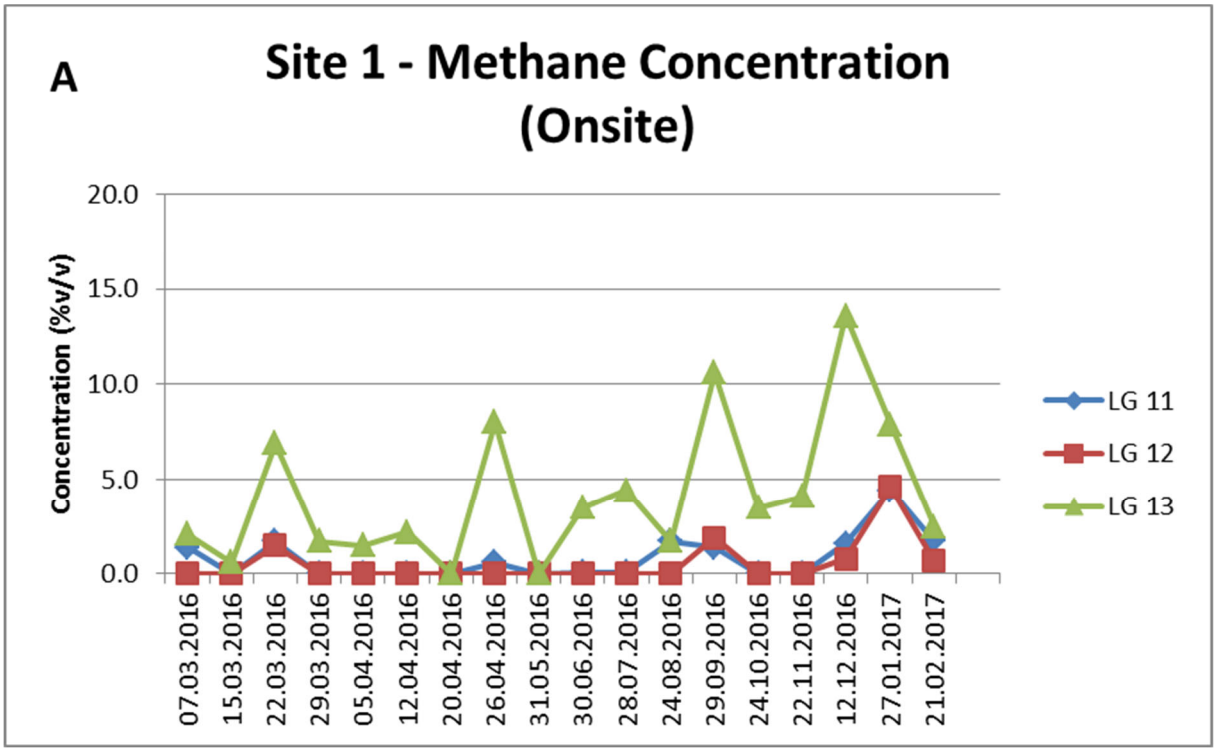
4.4.4 A summary of gas monitoring data for Site 1 is presented in **Table 4.5** below.

Table 4-5– Site 1: Summary of Landfill Gas Monitoring Data, Onsite and Offsite, 2016 - 2021

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow (l/hr)	Water level (mbgl)	Range of atmospheric pressure (mbar)
Site 1							
Onsite							
LG11	In waste	19	0-4.8	0.1-11.7	0 – 0.4	dry -12.2	983-1020
LG12	In waste	23	0-37.1	0.1 - 22.2	0 – 2.8	dry	983-1020
LG13	In waste	23	0-36.4	2.0 – 21.9	0 - 4.0	8.7 - 9.5	983-1020
Offsite^							
G06	No	22	0 – 23.9	0 - 8.1	0 - 3.5	dry	983-1020
G07	No	24	0	0 - 3.3	-3.2 - 6.9	dry	983-1020
G08	No		0	0 - 2.8	-3.7 – 6.3	dry	983-1020
G10	No	18	0	0.3 - 1.9	-1.5 – 3.1	dry – 15	983-1020
G18	No	23	0 – 9.2	0 – 4.7	-3.2 - 0.3	dry – 8	983-1020
G19	No	19	0	0.2 - 2.0	-0.1 – 0.6	dry – 8.5	983-1020
BH05	No	23	0 – 0.5	0 - 5.9	0 - 9.0	dry - 20.7	983-1020
^ Water level measurements provided measured from top of borehole casing (2016, 2017 monitoring rounds).							

4.4.5 The gas monitoring data is presented graphically in Chart 4-1 and Chart 4-2.

Chart 4-1 – Site 1 Methane Concentrations



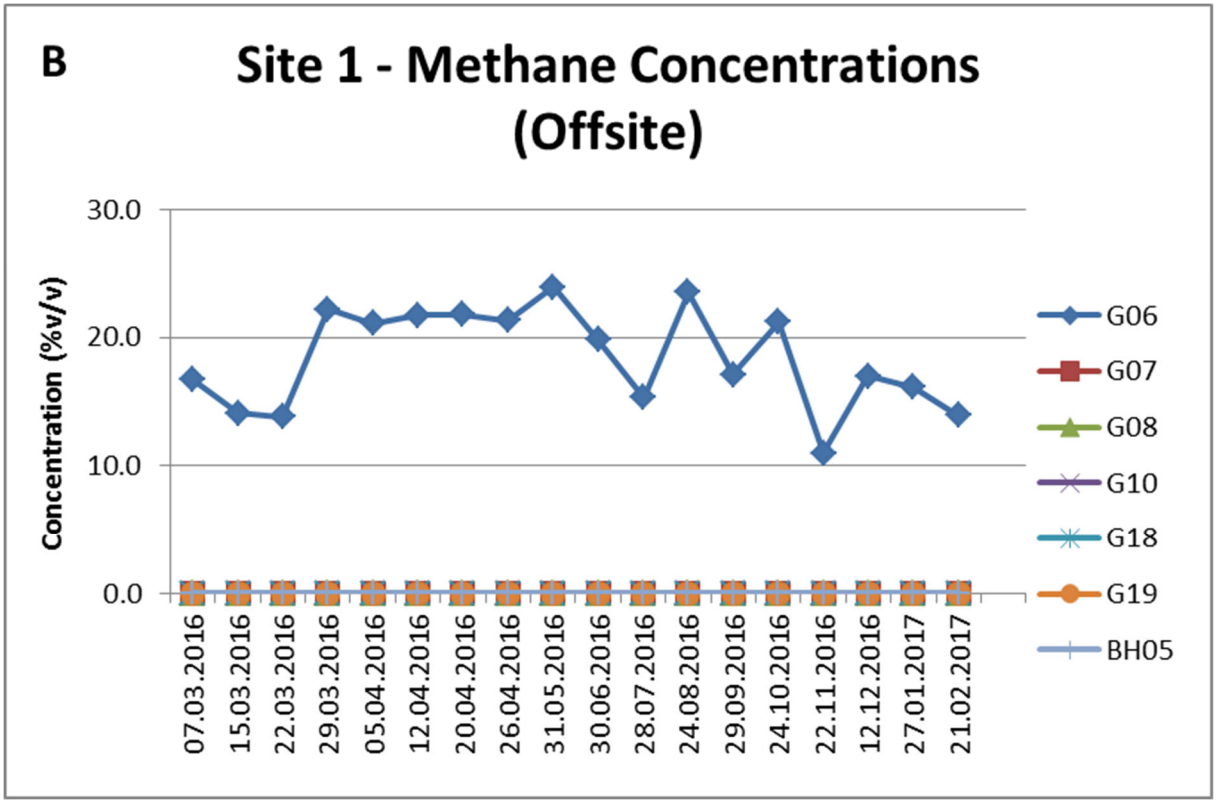
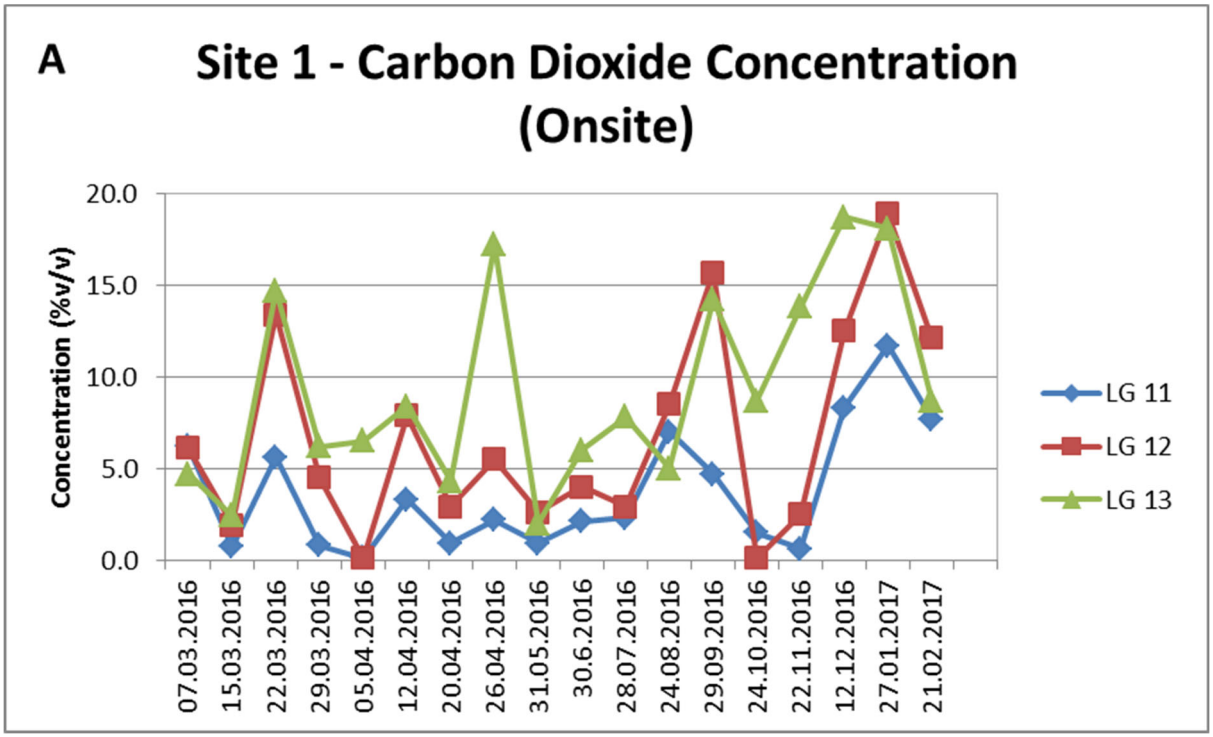


Chart 4-2 – Site 1 Carbon Dioxide Concentrations



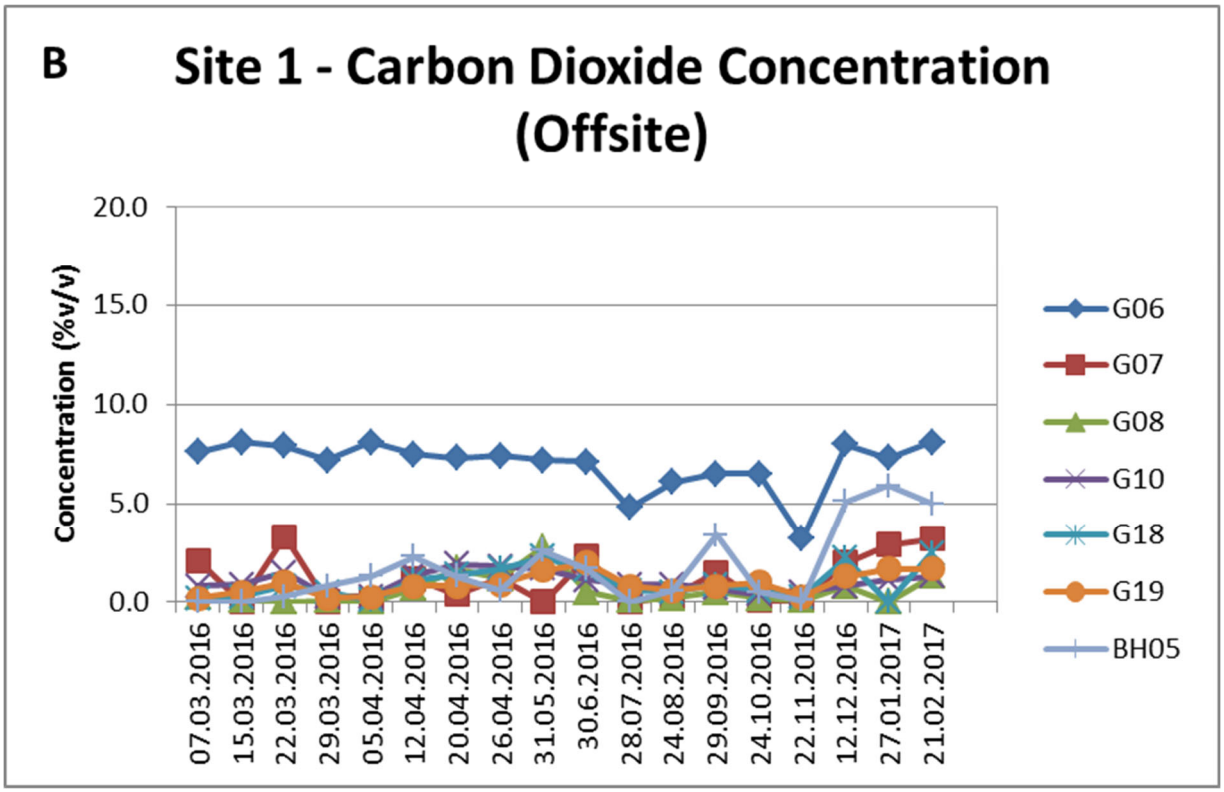
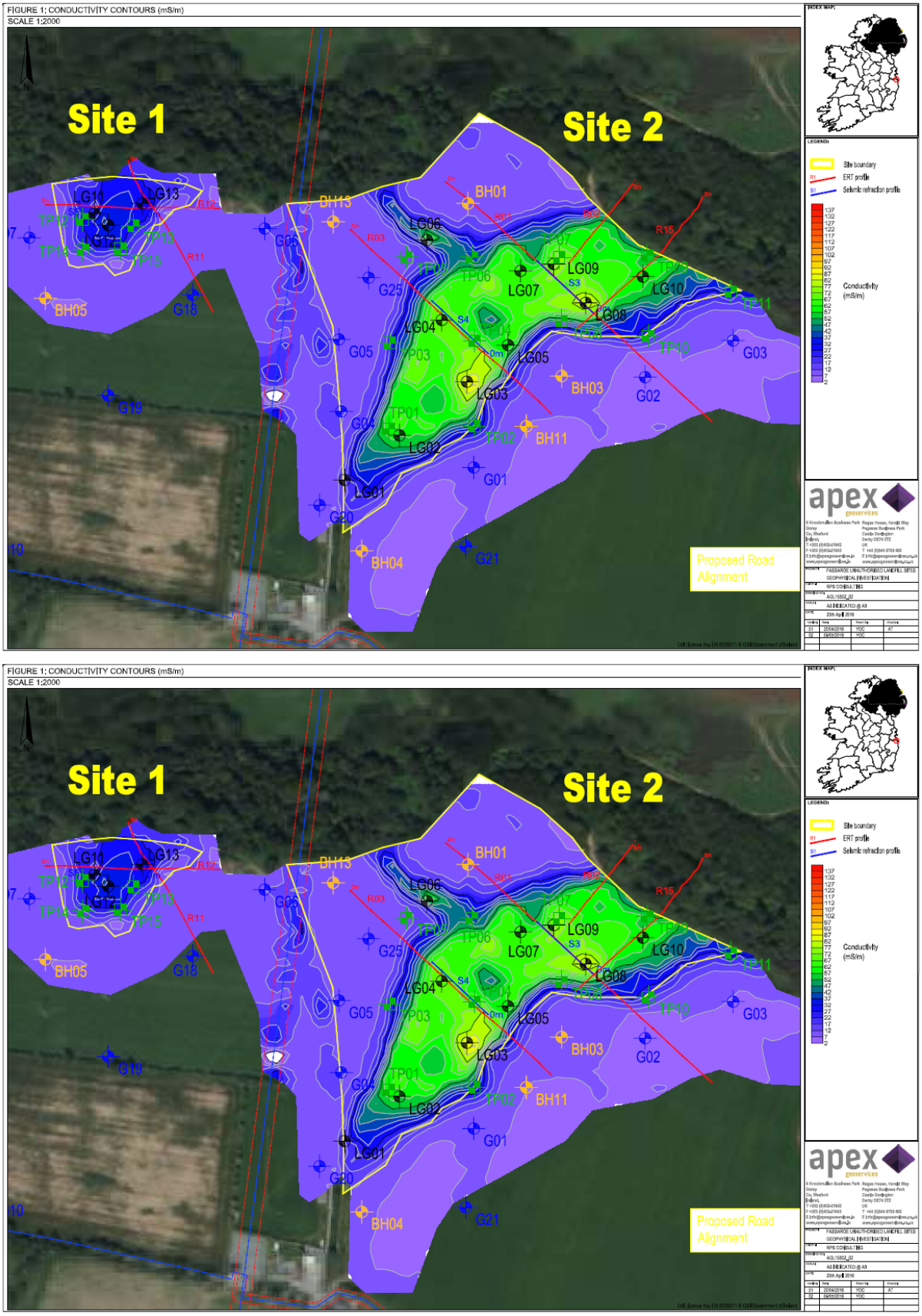


Figure 4-1 - Site 1 and 2 Conductivity Contours (extract from Apex Geophysical Survey)



Site 1: Pumping Test Results

On-site

4.4.6 Gas extraction was undertaken from in waste wells LG12 and LG13 during the pumping trial.

4.4.7 Flows from the flare peaked at 1300 m^3/hr on 22nd June 2020 with flows of between 70 m^3/hr to 85 m^3/hr between 25th and 28th June 2020. Methane concentration at the flare rose from 19.5% v/v to 34.7% v/v on 26th June 2020 before reducing to 29.9% v/v at the end of the trial. Carbon dioxide and oxygen remained stable at c. 17.5-19.5% v/v and c. 4-6% v/v respectively.

4.4.8 The carbon dioxide concentrations decreased from 19% v/v in LG12 at start of trial to 3.5 % v/v on 25th June before increasing then stabilising at about 8.3 % v/v. A similar trend was observed in LG13 with concentration starting at 21.8% v/v in LG13 before reducing to 10.3 % v/v on 25th June before generally increasing to 14% v/v.

4.4.9 With regard to methane concentrations, with the exception of very high starting point concentrations (36.4-37.1% v/v) these quickly dropped off from 11.9% v/v to c. 2-3% v/v over the monitoring period in LG13, and from 4% v/v to 1-1.5% in LG12.

4.4.10 Observed flows peaked at c. 10 m^3/hr and reduced to zero flow from 25th June onwards.

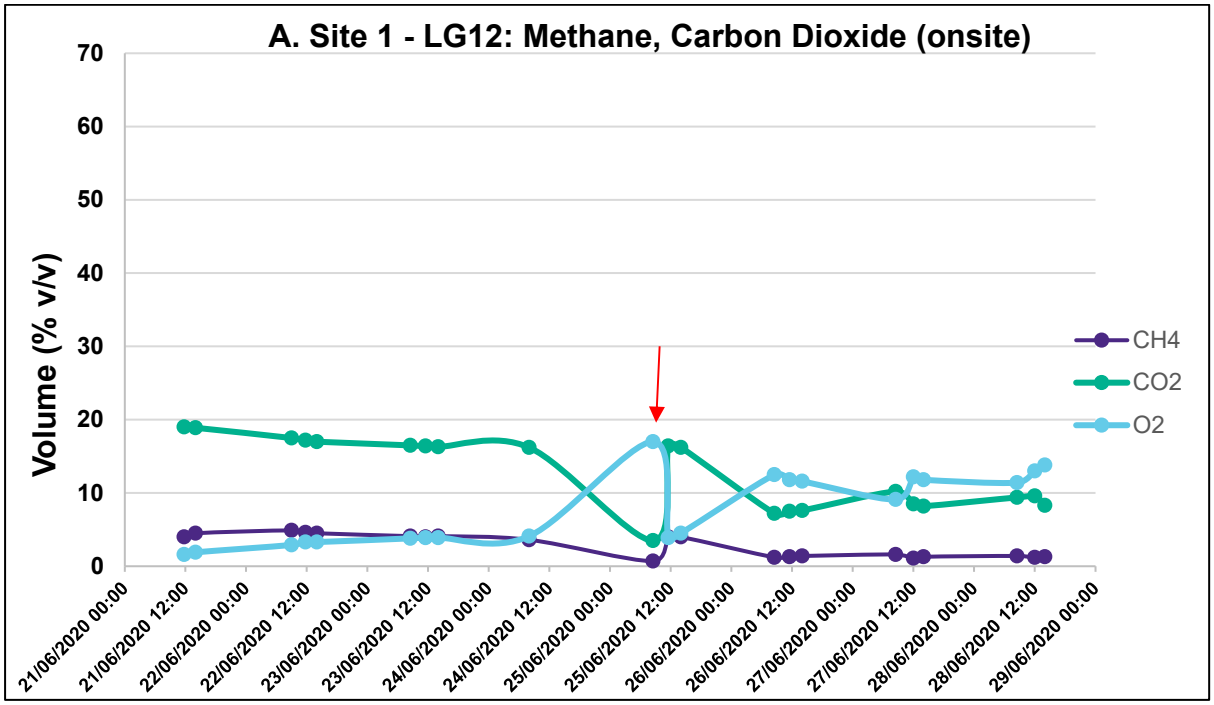
Off-site

4.4.11 A number of the surrounding boreholes, as detailed in **Table 4.1,** were monitored during the trial. No flows were observed and generally very low ground gas concentrations. The exception to this was within borehole G18 where elevated results were identified. The static readings gave methane and carbon dioxide concentrations of 9.2% v/v and 4.7% v/v respectively at this location. The concentrations exceeded those encountered during the 2016 and 2017 monitoring rounds, where methane was absent and carbon dioxide peaked at 2.5 % v/v. These concentrations also exceeded the concentrations identified during the further monitoring rounds in 2020 and 2021. The pumping trial reading for carbon dioxide exceeded the pre-test static result (5.5% v/v) however the methane concentration never exceeded the static pre-test result. Location G19 also gave a peak concentration of 3.5% v/v carbon dioxide during the pumping trial which exceeded other monitoring results (including the pre-test static reading).

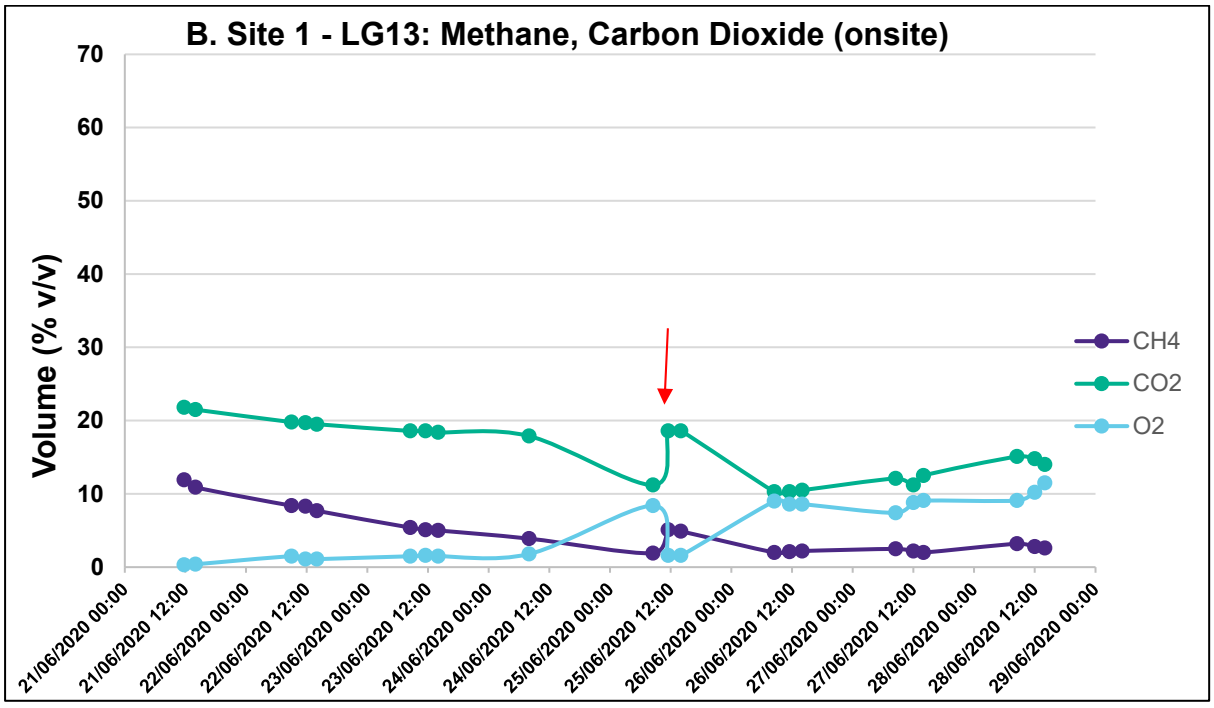
4.4.12 Locations G06 and BH05 were not monitored during the pumping trial.

4.4.13 The gas monitoring data is presented graphically in Chart 4.3.

Chart 4-3 – Site 1 Pumping Trial: Methane and Carbon Dioxide



Red arrow indicates approximate date/time at which extraction at well was terminated due to sudden increase in oxygen and low levels of methane encountered.



Red arrow indicates approximate date/time at which extraction at well was terminated due to sudden increase in oxygen and low levels of methane encountered.

Summary of Site 1 Gas Conditions Onsite

4.4.14 For the 2016 and 2017 monitoring rounds, the gas monitoring data collected from onsite monitoring boreholes at Site 1 recorded methane concentrations up to 13.6% v/v and carbon dioxide concentrations up to 18.9% v/v. The observed conditions encountered

during site investigation indicate Site 1 predominantly comprises construction and demolition (C&D) waste with some municipal waste.

4.4.15 There is some suggestion of possible increasing methane and carbon dioxide concentrations within the waste mass on Site 1. Flows are typically very low and do not exceed 4.0 l/hr in any borehole.

4.4.16 Immediately before the pumping trial in 2020, methane and carbon dioxide concentrations were higher than the 2016 and 2017 monitoring results (maximum of 37.1% v/v and 22.2% v/v respectively) and were higher than the concentrations identified during the 2020 and 2021 monitoring rounds and as the pumping trial progressed over the first two to three days, methane and carbon dioxide concentrations were on average higher than the static monitoring results. As time progressed the concentrations generally further reduced to low levels as flow rates dropped to zero. The concentrations and patterns within both boreholes during the pumping trials suggest a relatively consistent gas regime over the area represented by these boreholes. Oxygen levels spiked within boreholes LG12 and LG13 during the 25th June 2020 monitoring round (between days 3 and 4 of the trial), indicating that oxygen may have been drawn into the landfill mass at this point. After this was recorded, wells LG12 and LG13 were turned off for the remainder of the trial. The results show a sudden drop then steady rise in oxygen after this event as these wells were monitored without extraction. This may indicate a high level of connectivity between the landfill site and the surrounding area.

4.4.17 The consistent moderately elevated gas concentrations during static monitoring suggests that the gas source within the landfill is significant with regard to stored volumes or ongoing production. However, during the pumping trial, the influx of oxygen paired with low levels of methane as pumping progressed suggests that there may be connectivity with the surrounding area.

Summary of Site 1 Gas Conditions Offsite

4.4.18 In 2016 and 2017, with the exception of G06, methane concentrations in off-site boreholes were zero and carbon dioxide concentrations low, typically below 3.0 % v.v. In contrast G06 had elevated methane concentrations of 11 to 23.9% v/v and carbon dioxide concentration of 3.2 to 8.1 % v.v. Monitoring point G06 is located immediately to the west of the existing 33” water main which runs in a north south direction.

4.4.19 On review of the 2016 and 2017 site investigation data it was noted that elevated Electrical Conductivity (EC) has been recorded within the vicinity of G06. This appears to correspond to the backfilling activities associated with the water main routing in this area, as shown in **Figure 1** taken from the geophysical survey.

4.4.20 The methane concentrations recorded at G06 were significantly higher than those recorded at the initially perceived source (worst case) location i.e. within Site 1, and may therefore be reflective of a separate gassing regime associated with the made ground/backfill surrounding the water main.

4.4.21 The static measurements in June 2020 prior to the pumping tests indicated relatively high concentrations in G18 (methane - 9.2% v/v; carbon dioxide - 4.7% v/v) which exceeded that encountered in the 2016 and 2017 monitoring and the concentrations identified during the further monitoring rounds undertaken in 2020 and 2021. Location G19 also gave a peak concentration of 3.5% v/v carbon dioxide during the pumping trial which exceeded previous monitoring results. This suggests a possible increase in gas migration from Site 1.

4.4.22 These results suggest that in particular an increase in concentration of methane has been observed in G18 in 2020, but this does not appear to be directly related to the pumping test as the figures were not significant different during this trial. However the results reduced to lower concentrations in the following static monitoring rounds in 2021.

4.4.23 Boreholes G06 and BH05 were not monitoring during the trial so a direct comparison of these results could not be made.

Pumping Trial Recommendations

4.4.24 The AFS report (AFS, July 2020) detailing the results of the pumping trial suggested that a flow rate of a suitable quantity and quantity of gas of 120 m^3/hr could be generated for sites 1 and 2. Recommendations for site 1 comprise a future gas control system at the site comprised a network of vent pipes and rotating cowls to produce a negative suction in the waste mass, with vent trenches around the perimeter of the site.

4.4.25 The methane concentrations in-waste boreholes in site 1 fall below this threshold with the exception of LG13 at the beginning of the trial. The trial was also terminated in the two extraction boreholes (LG12 and LG13) after a sudden rise in oxygen and drop The encountered flow rates are also generally low in the in-waste and surrounding boreholes.

Site 2: Standard Monitoring

4.4.26 A total of twenty seven (27) boreholes were monitored for gas at Site 2 which included ten (10) onsite combined gas/leachate boreholes, seventeen (17) offsite boreholes comprising twelve (12) gas boreholes and five (5) groundwater monitoring boreholes.

4.4.27 A summary of gas monitoring data collected during the monitoring period is presented in **Table 4.6** below.

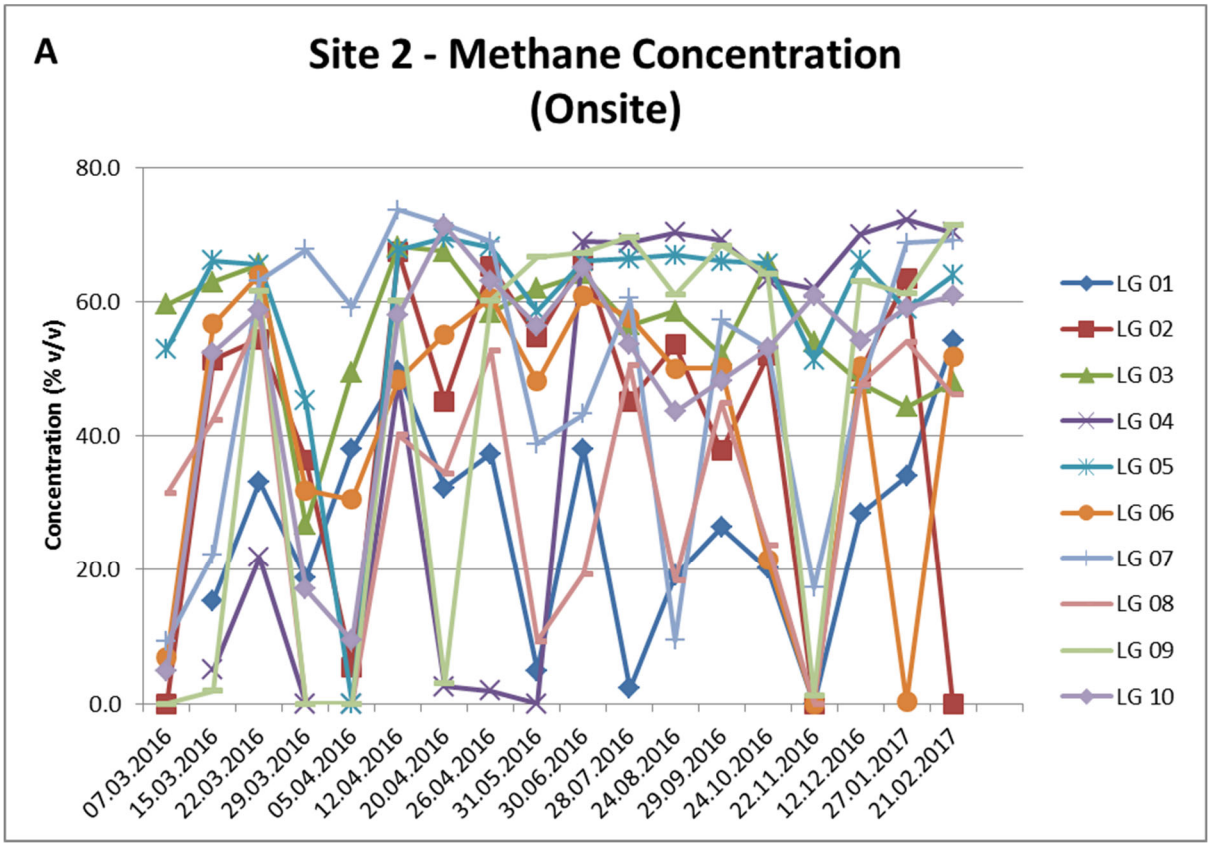
Table 4-6 – Site 2: Summary of Landfill Gas Monitoring Data, Onsite and Offsite, 2016 - 2021

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow (l/hr)	Water level(mbgl)	Range of atmospheric pressure (mbar)
Site 2							
Onsite							
LG01	In waste	23	0- 54.1	0-22.0	-0.6 to 2.5	3.7-3.95	983-1020
LG02	In waste	24	0-76.5	0-29.8	-2.5 to 7.0	7.95-8.33	983-1020
LG03	In waste	24	26.6-73.3	10-29.7	-1 to 4.3	12.65-15.67	983-1020
LG04	In waste	24	0-72.2	0-27.7	-5.2 to 7.6	11.76-12.29	983-1020
LG05	In waste	24	0-69.5	0-36.1	-6.2 to 7	12.56-13.85	983-1020
LG06	In waste	23	0-64	0.3-30.3	0-3.3	6.11-6.18	983-1020
LG07	In waste	24	0-73.7	0.1-26.6	-0.3 to 3.9	1.95-11.20	983-1020
LG08	In waste	24	0-57.9	0-36.6	-3.1 to 4.6	dry-7.65	983-1020
LG09	In waste	24	0-71.5	0-24.4	-6.6 to 6.0	9.26-11.36	983-1020
LG10	In waste	24	0-71.3	0.1-30	-1.2-4.8	11.95-17.25	983-1020
Offsite^							
G01	No	22	0-8.0	0-25.5	-15.9 to 3.8	dry	983-1020
G02	No	18	0-0.1	0-9.5	-3.3 to 5.0	dry	983-1020
G03	No	18	0-4.9	0-17.2	-5.3 to 4.7	dry	983-1020
G04	No	24	0	0-2.8	-0.3 to 0.1	6.46 – 13.15	983-1020
G05	No	22	0-55.7	0-8.1	-4.2-6.3	16.06 – 17.67	983-1020
G13	No	18	0	0-1.4	-8.2 to 6.4	dry	983-1020
G20	No	18	0-0.1	0-1.1	-10.9 to 13.6	dry – 16.57	983-1020
G21	No	18	0	0.1-2.2	-7.6 to 5.8	dry	983-1020
G22	No	18	0	0-2.5	-2.7 to 19.8	dry – 11.47	983-1020
G23	No	18	0	0-1.5	-10.3 to 3.4	dry to 17.24	983-1020
G24	No	18	0	0-1.6	-15.9 to 10.5	dry	983-1020
G25	No	23	0-55.3	0-11.6	-0.3 to 9.0	dry	983-1020
BH01	No	24	0 – 0.6	0-4.8	-0.4 to 3.4	14.14 – 17.53	983-1020
BH03	No	20	0-8.6	0-15.4	-9.3 to 10.2	dry	983-1020
BH04	No	22	0	0-2.2	-18.6 to 10.8	dry	983-1020
BH11	No	19	0-16.3	0 - 16.9	-14.1 to 7.2	dry	983-1020
BH13	No	24	0-21.7	0 - 9.5	-0.2 to 4.7	dry	983-1020

^ Water level measurements provided measured from top of borehole casing (2016, 2017 monitoring rounds).

4.4.28 The gas monitoring data is presented graphically in **Chart 4.4** and **Chart 4.5.**

Chart 4-4 – Site 2 Methane Concentrations



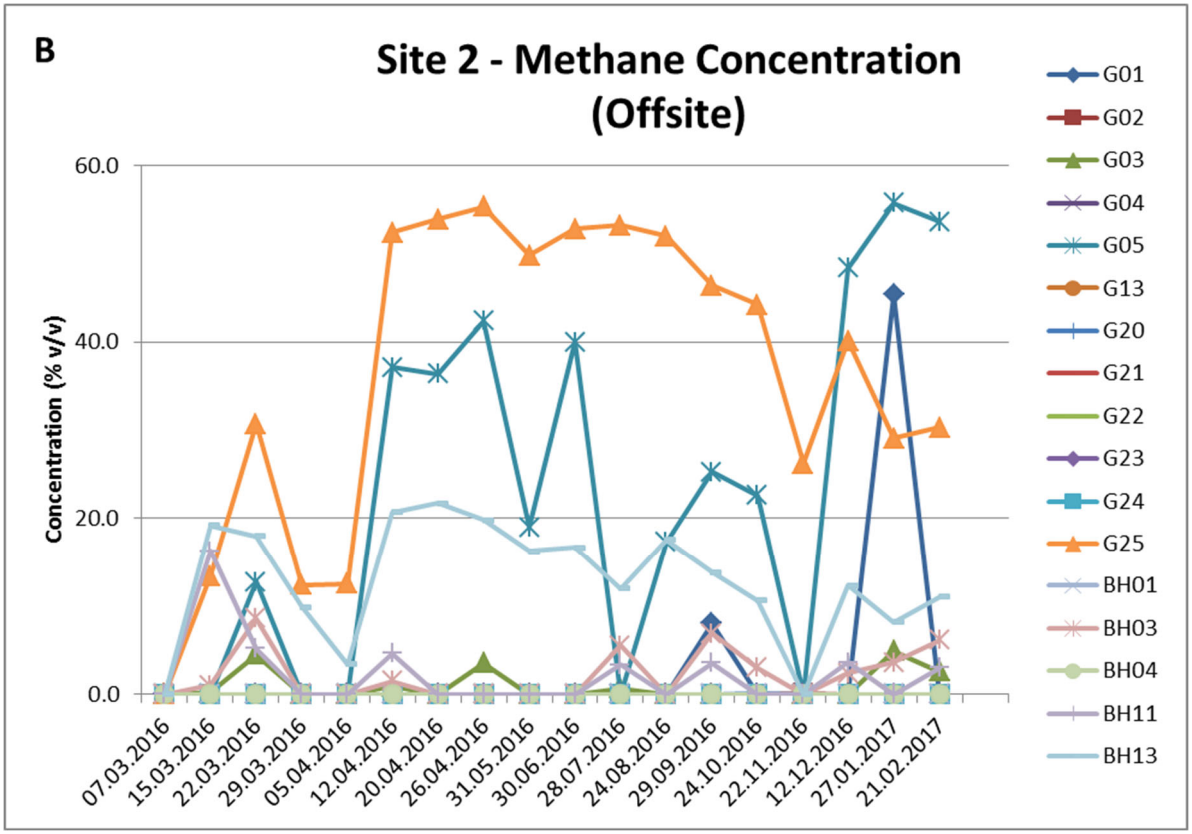
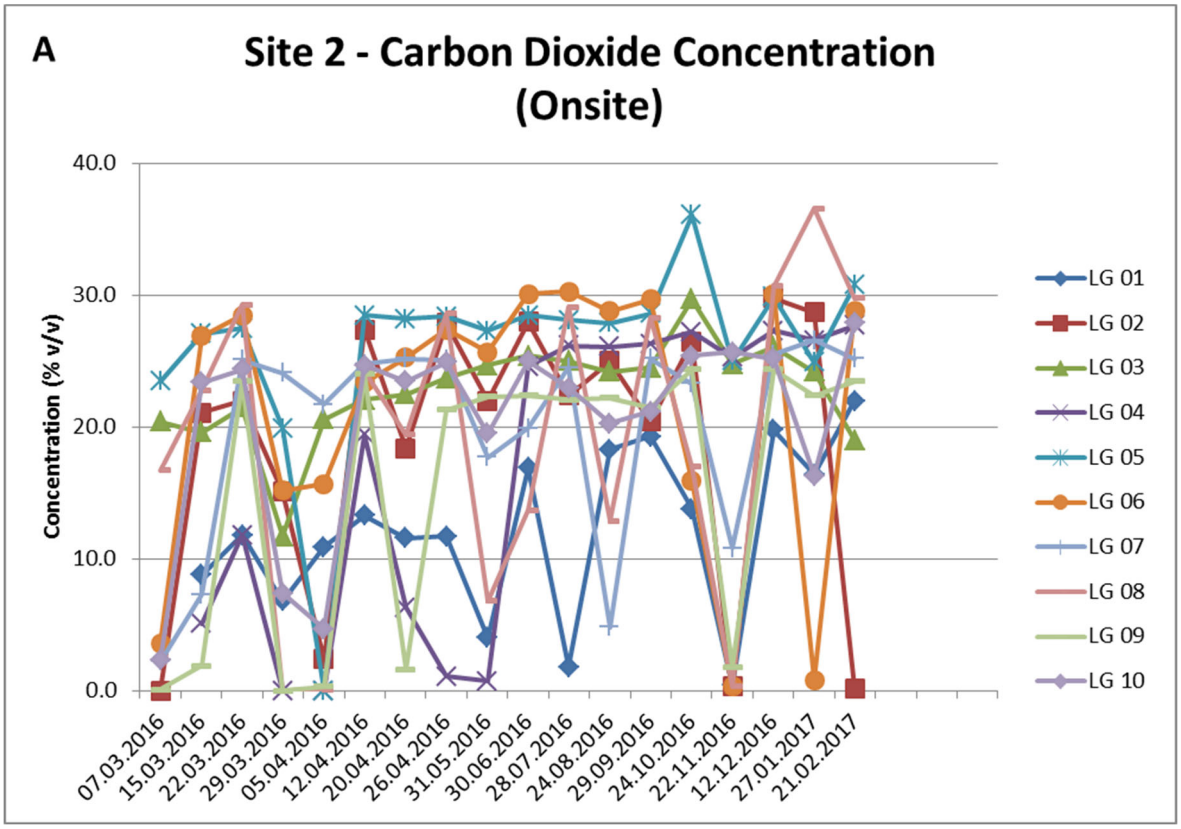
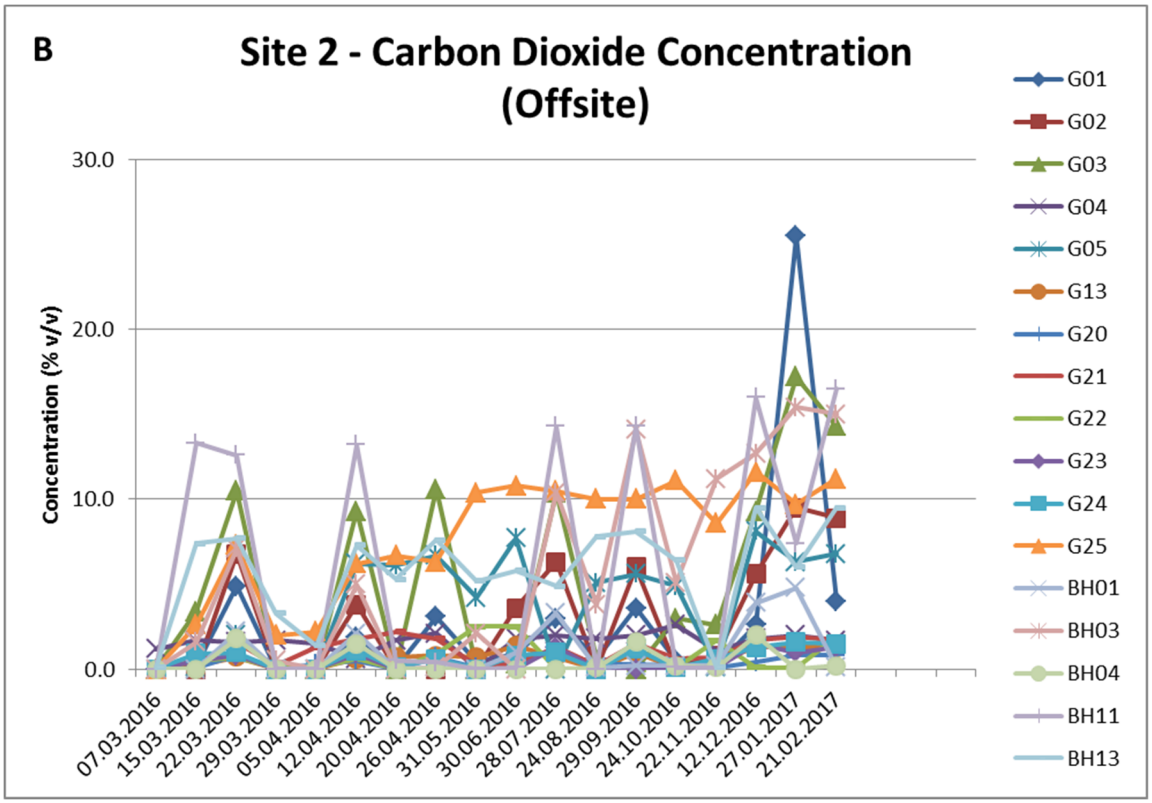


Chart 4-5 – Site 2 Carbon Dioxide Concentrations





Site 2: Pumping Test Results

On-site

4.4.29 Gas extraction was undertaken from on-site wells LG5, LG7, LG9 and LG10 during the pumping trial. The same flare was used as for Site 1.

4.4.30 In LG5, methane and carbon dioxide concentrations remained at high levels (methane: 44.1% - 59.7% v/v; carbon dioxide: 24.5 - 27.4% v/v) with levels stabilising at the lower end of this range in the second half of the trial. Flow rates ranging from 3.19 m^3/hr to 7.65 m^3/hr were observed.

4.4.31 In the other extraction locations, the concentrations also remained highly elevated although generally reduced over time. Methane concentrations of 33.8 - 42.7% v/v (LG7), 51.8 - 64.9% v/v (LG9) and 42.4 - 57.7% v/v (LG10) were encountered, with carbon dioxide concentrations of 24.9 - 26.5% v/v (LG7), 21.5 - 25.2% v/v (LG9) and 24 - 25.4% (LG10). Observed flows ranged from c. 2 m^3/hr to 7 m^3/hr t these locations over the monitoring period. The consistently high gas concentrations indicates that the gas source within the landfill is significant, indicating large stored volumes or ongoing production. The rise in methane concentration on 25th June 2020 appears to be due to the adjustment of the flow rate from the flare and the termination of pumping at wells LG12 and LG13 in site 1 (which were also included in this pumping trial).

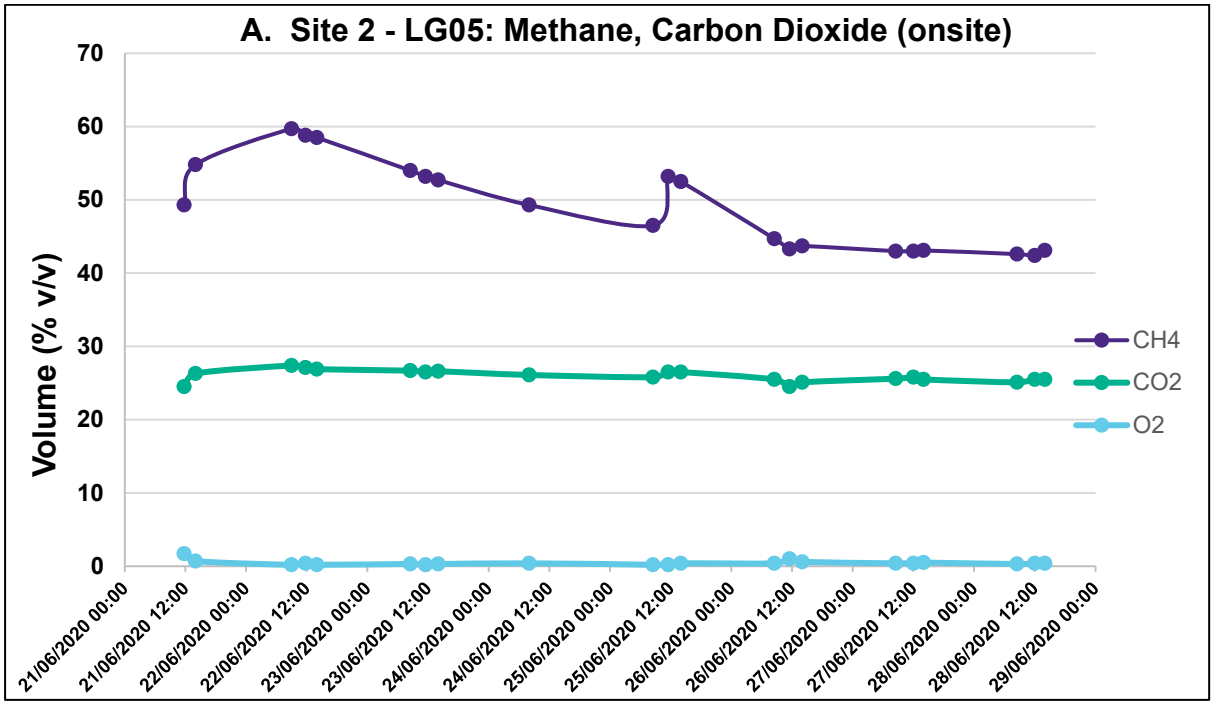
Off-site

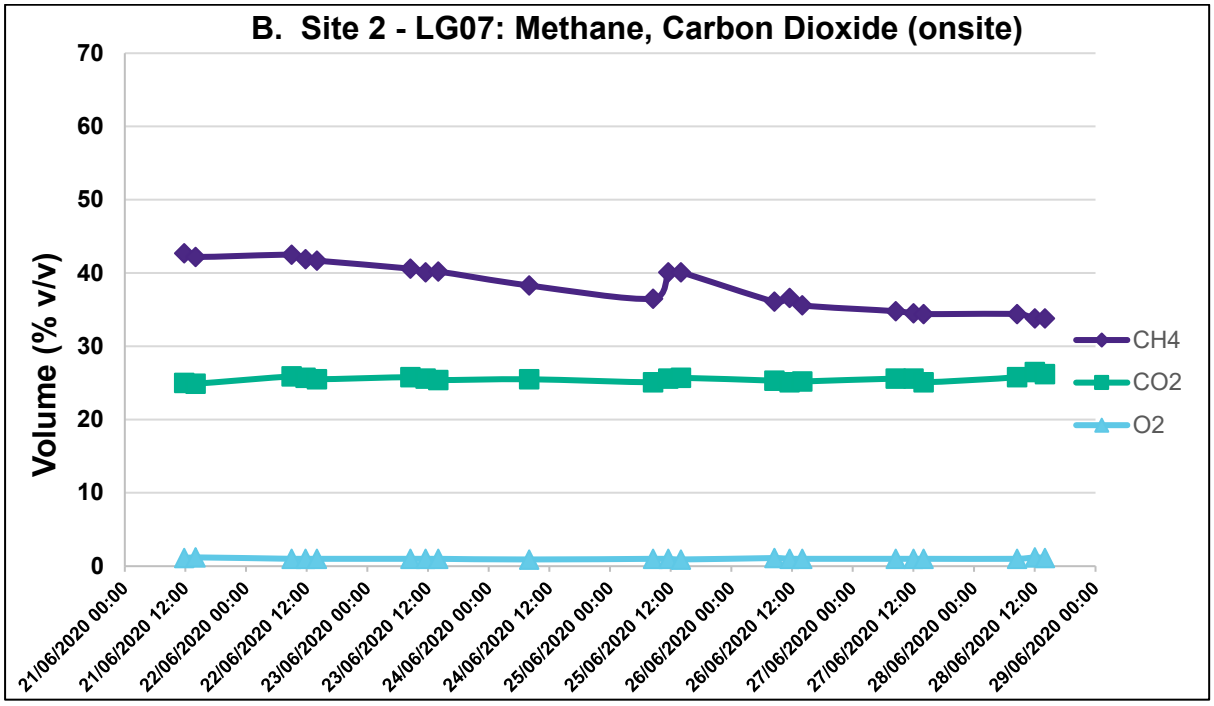
4.4.32 A number of the surrounding off-site boreholes detailed in **Table 4.1** were monitored in the trial with elevated levels of methane and carbon dioxide identified in boreholes G05, G25 and BH13. These appeared to generally increase through the trial with peak concentrations for methane of 22.3% v/v (G25), 35.6% v/v (G05) and 5.5% v/v (BH13), and peak concentrations for carbon dioxide of 8.6% v/v (G25), 8.6% v/v (G05) and 8.9% v/v (BH13). Other than in respects of BH13 the concentrations of methane and carbon dioxide were within the ranges previously identified during the standard monitoring.

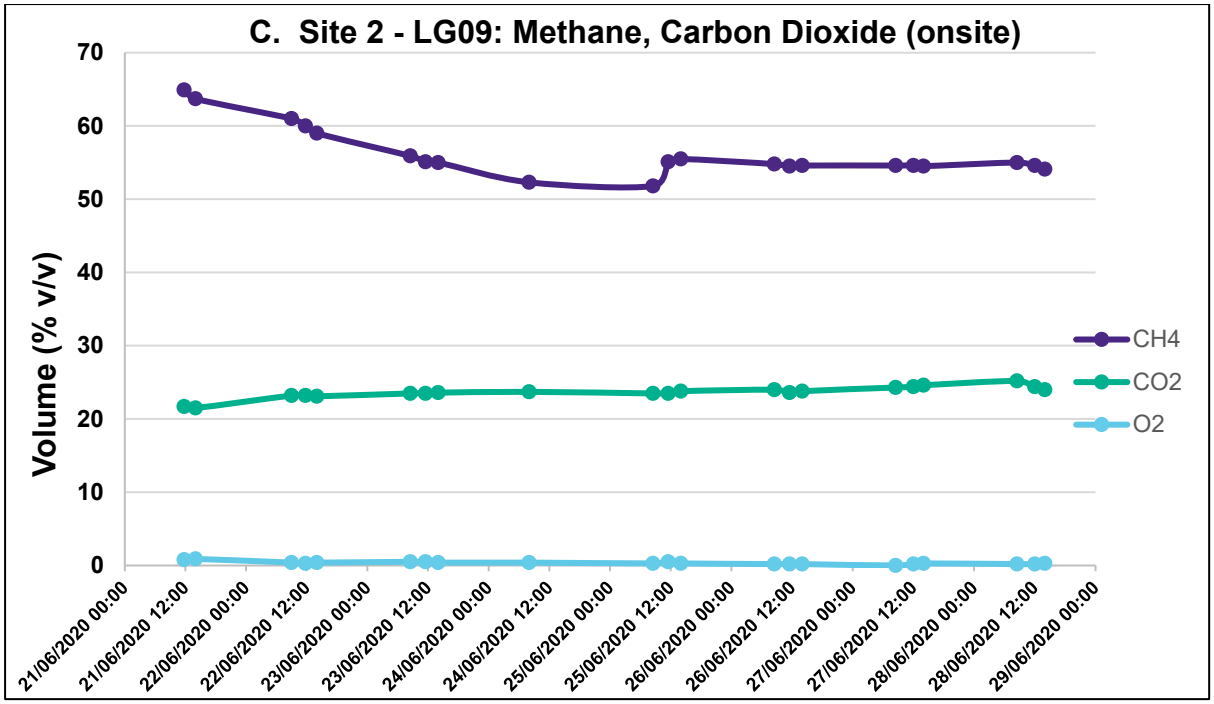
4.4.33 All locations to the southeast of the southern boundary of the landfill site (in area of proposed development) comprising boreholes G01, G02, G03, G20, G21, BH03, BH04 and BH11 were not monitored during the pumping trial.

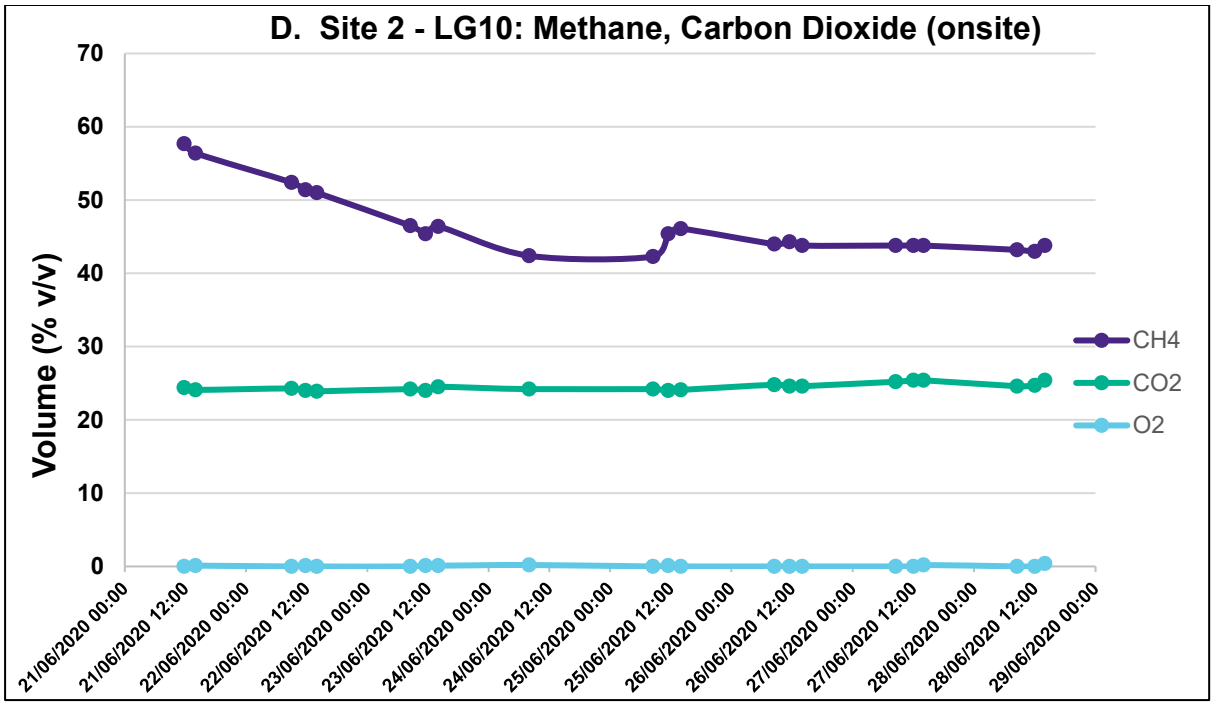
4.4.34 The gas monitoring data is presented graphically in Chart 4.6.

Chart 4-6 – Site 2 Pumping Trial: Methane and Carbon Dioxide









Summary of Site 2 Gas Conditions Onsite

4.4.35 The gas monitoring data collected for onsite monitoring locations within Site 2 over the complete monitoring period recorded methane concentrations ranging from no detection to 73.7% v/v and carbon dioxide concentrations ranging from no detection to 36.6% v/v. Methane concentrations were consistently elevated with peak readings in excess of 60% v/v in LG02, LG03, LG05, LG06, LG07, LG09 and LG10. Flow rates were extremely variable ranging from -6.2 to +7.6 l/hr.

4.4.36 The concentrations of methane in the extraction boreholes during the June 2020 pumping trials indicated elevated levels of methane (maximum of 64.9% v/v at LG9) which reduced

in concentrations over time to lower levels (33.8 - 54.1% v/v). The peak concentrations were generally lower than the 2016 and 2017 monitoring rounds however the high levels were constant during the trial. The carbon dioxide concentrations generally remained stable over the course of the trial (c. 21 - 26% v/v) with similar peak concentrations to those identified in the 2016 and 2017 monitoring rounds however fluctuations to lower levels were observed for the latter. The concentrations within the boreholes during the pumping trials suggest a slightly variable gas regime over the area represented by these boreholes, albeit with similar trends, indicating a level of connectivity. The consistently high gas concentrations indicates that the gas source within the landfill is significant, indicating large stored volumes or ongoing production.

Summary of Site 2 Gas Conditions Offsite

4.4.37 In the 2016 to 2021 static monitoring rounds, the gas monitoring data collected for offsite monitoring locations generally recorded no detections or very low methane concentrations in the majority of monitoring locations (G02, G04, G13, G20-24, BH01 and BH04). The notable exceptions are G25, G05 and BH13 where methane concentrations range from zero up to 55.3% v/v, 55.7% v/v and 21.7% v/v respectively.

4.4.38 Offsite carbon dioxide concentrations are extremely variable ranging from 0 to 16.5 % v/v, but are elevated on occasions at most offsite monitoring locations. Sustained elevated concentrations are characteristic of G25 and BH13 (the latter located between the existing 33" water main and Site 2).

4.4.39 Flow rates are correspondingly variable, ranging between -16 l/hr to +19.8 l/hr.

4.4.40 The pumping trial in June 2020 also showed elevated methane concentrations at G25, G05 and BH13, where a maximum concentration of 35.6% v/v was encountered. Carbon dioxide also reached a maximum concentration of 8.9% v/v (G05). The concentrations appeared to generally increase by the end of the pumping period. The peak concentrations were lower than those observed during the 2016a to 2021 monitoring rounds although the concentrations were similar overall.

4.4.41 None of the boreholes to the southeast of the site boundary (G01, G02, G03, G20, G21, BH03, BH04, BH11) were monitored during the pumping trial. The concentrations in these boreholes during the 2016 and 2017 monitoring ranged from very low concentrations to 16.3% v/v for methane (BH11) and 17.2% v/v for carbon dioxide (G03).

Pumping Trial Recommendations

4.4.42 The AFS report (AFS, July 2020) detailing the results of the pumping trial suggested that a flow rate of a suitable quantity and quantity of gas of 120 m^3/hr could be generated for sites 1 and 2.

4.4.43 Recommendations for a future gas control system at site 2 comprised installation of gas wells to depths just above the water table connected into a common gas main that leads to a small 100m^3/hr Lo-Cal flare. This would be undertaken in conjunction with site 3A.

Site 3A: Standard Monitoring

4.4.44 A total of ten (10) boreholes were monitored for gas at Site 3A; five onsite comprising three combined gas/leachate boreholes and two existing boreholes, five offsite comprising two gas boreholes and three groundwater boreholes. The location of these boreholes with respects to the site are detailed upon Drawing MDR1206-RPS-00-XX-DR-C-DG1002.

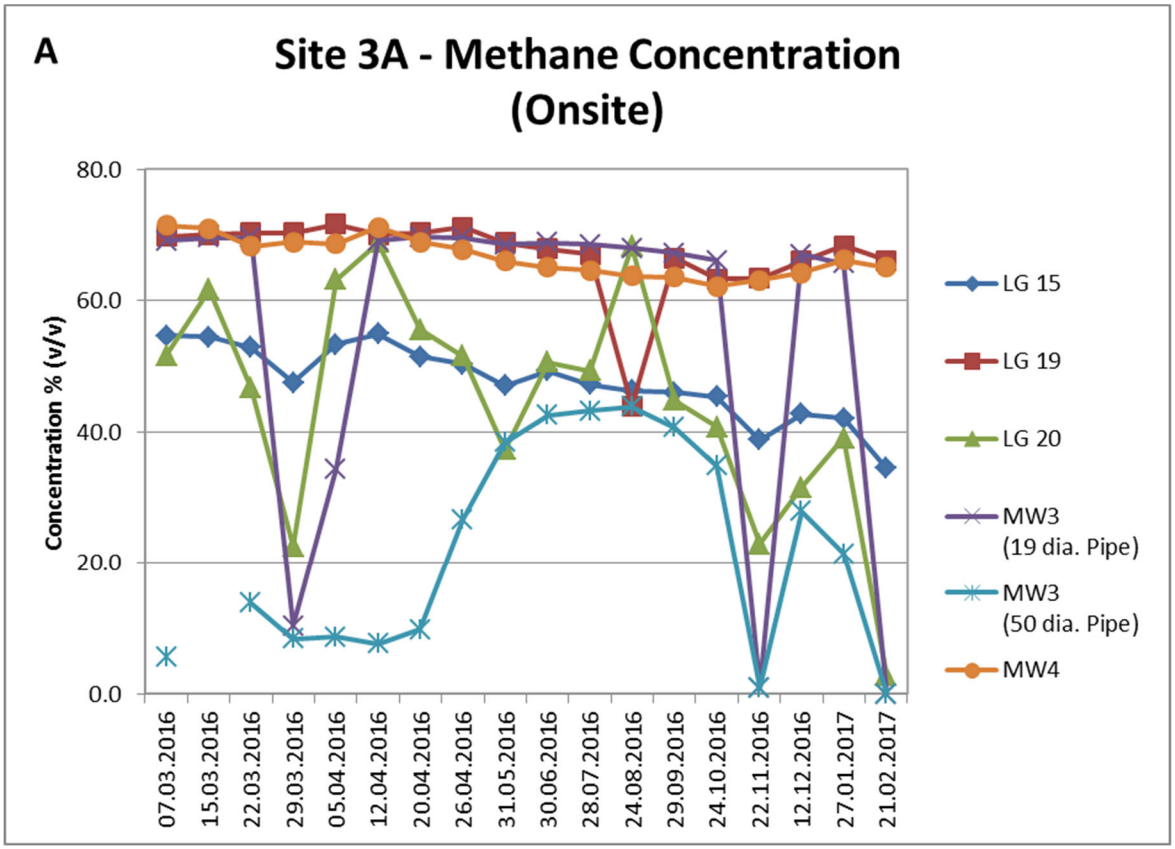
4.4.45 A summary of gas monitoring data is presented in **Table 4.7** below.

Table 4-7 – Site 3A: Summary of Landfill Gas Monitoring Data – Onsite & Offsite 2016 - 2021

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow (l/hr)	Water level (mbgl)	Range of atmospheric pressure (mbar)
Site 3A							
Onsite							
LG15	In waste	24	34.5 - 55	19.4-26.8	0-5.8	6.47-6.97	983-1020
LG19	In waste	24	44.0 - 71.7	21.7-35.9	0-45	6.19-14.3	983-1020
LG20	In waste	24	1.1 - 68.9	0.9-33.1	-1.3 to 26.5	dry	983-1020
MW3 (19mm) **MW3 (50mm)**	In waste	24	0-71.4 0-43.9	0-33.1 0.1-14.4	0-1.5 -0.3 to 4.9	5.95-15.31	983-1020
MW4	In waste	24	62.2-71.5	28.5-37.0	-0.8-43.0	5.9-6.65	983-1020
Offsite^							
G12	No	18	0	0-1.9	0-1.4	10.13-12.58	983-1020
G14	No	18	0	0.8-2.1	0-1.3	7.53-9.15	983-1020
BH07	No	20	0	0-2.1	-0.1 to 1.6	13.71-15.9	983-1020
BH09	No	20	0	0-2.3	-0.2 to 1.6	6.43-8.49	983-1020
BH10	No	23	0	0.1-3.2	-0.3 to 1.6	Dry-9.81	983-1020
^ Water level measurements provided measured from top of borehole casing (2016, 2017 monitoring rounds).							

4.4.46 The gas monitoring data is presented graphically in Chart 4.7 and Chart 4.8.

Chart 4-7 – Site 3A Methane Concentrations



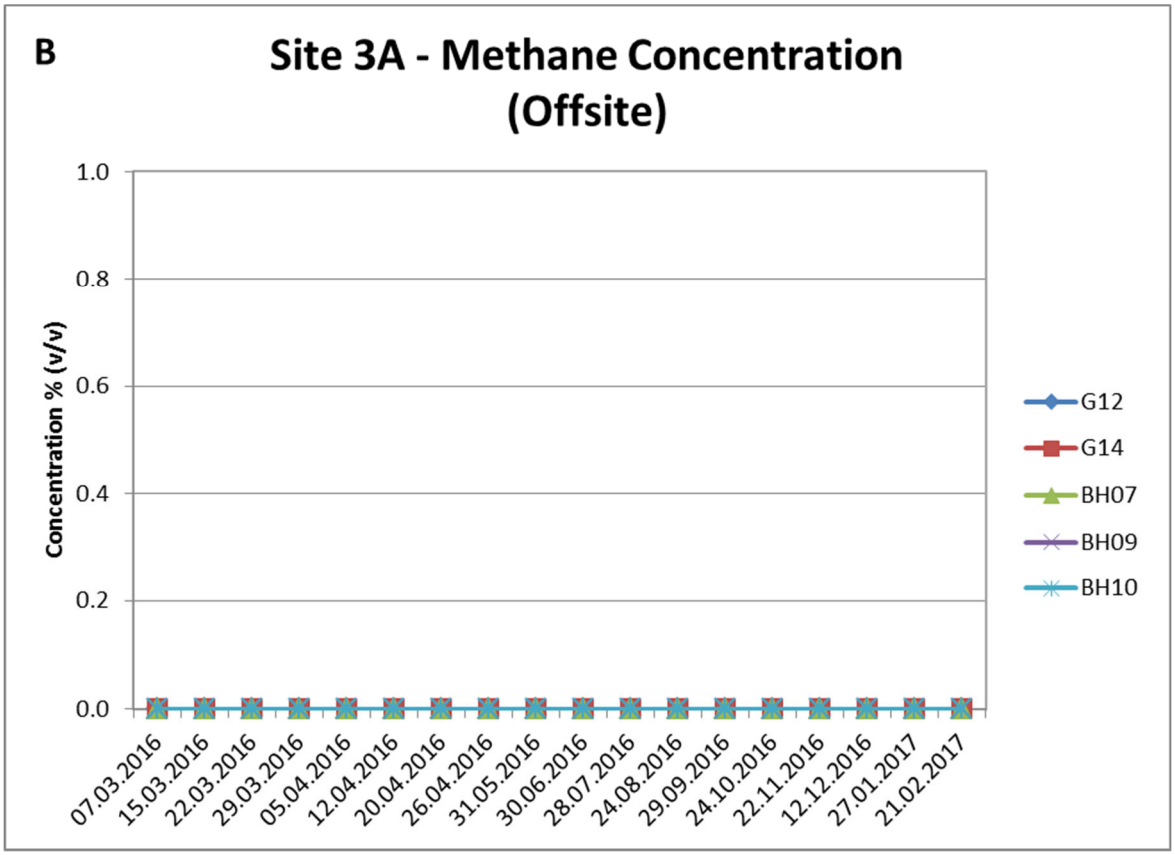
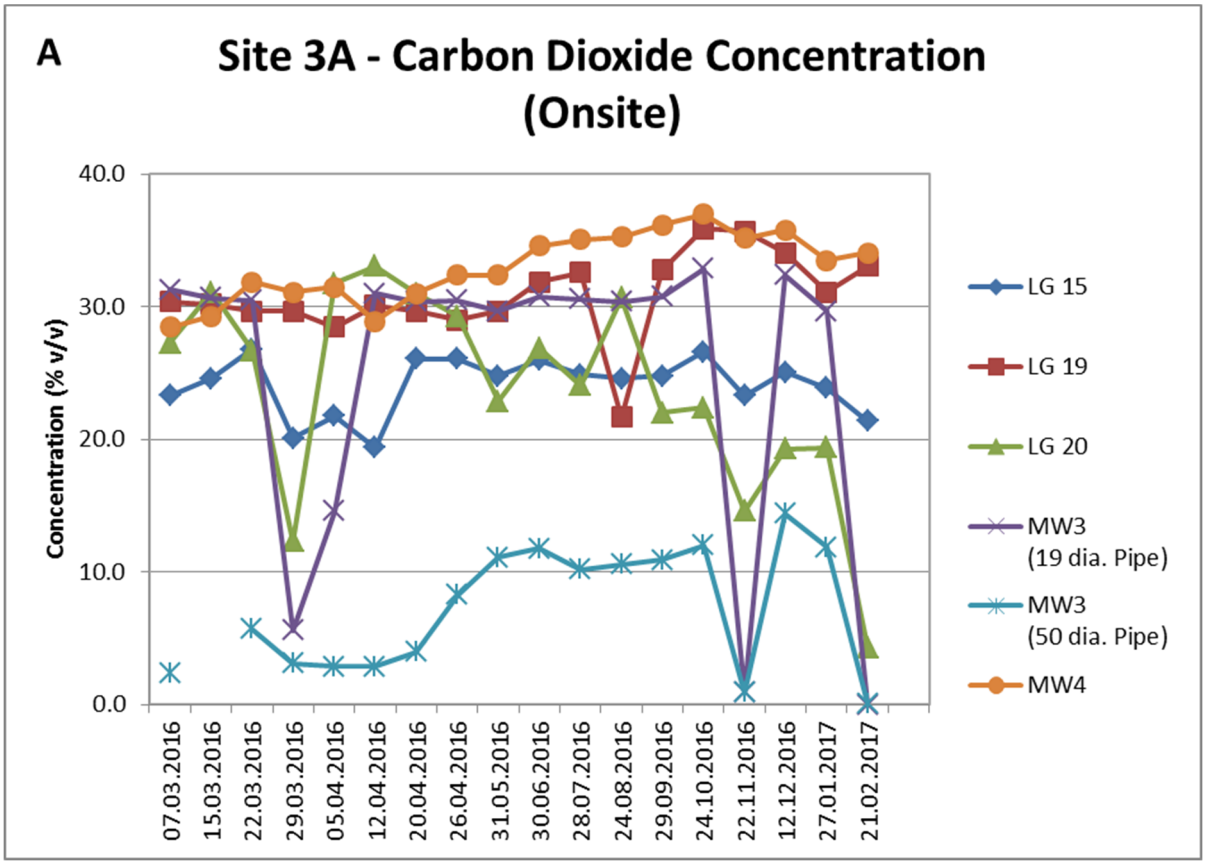
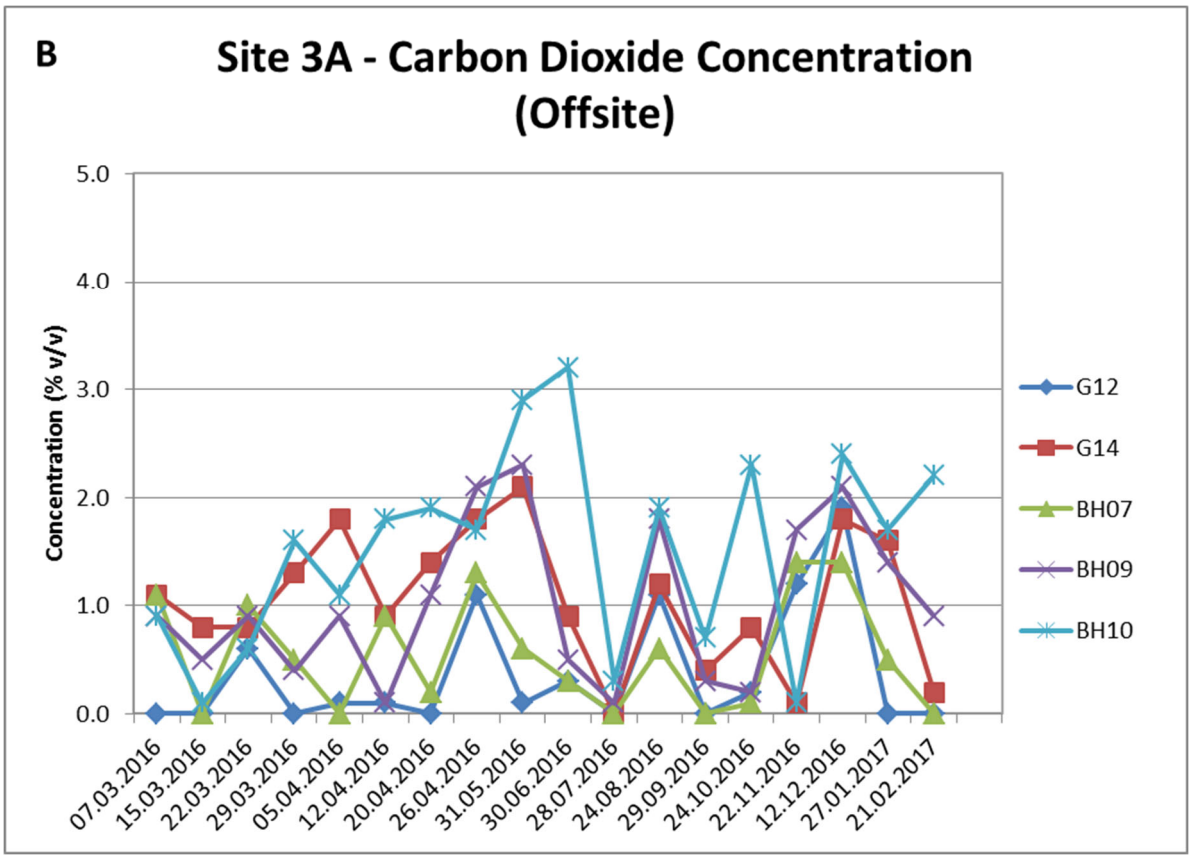


Chart 4-8 – Site 3A Carbon Dioxide Concentrations





Site 3A: Pumping Test Results

On-site

4.4.47 Gas extraction was undertaken from on-site wells LG15, LG19 and LG20 during the pumping trial. Flows from the flare peaked at 176 m^3/hr then quickly dropped to 90 m^3/hr on 14th July (day 1) and then reduced to 70-78 m^3/hr for the remainder of the trial. In LG15 and LG19, methane and carbon dioxide concentrations started at high levels (methane: 46.1% v/v (LG15), 71.5% v/v (LG19); carbon dioxide: 25.2% v/v (LG15), 29.3% v/v (LG19)) with the methane concentrations rapidly reducing over the first day and then falling slowly over subsequent days before stabilising at lower levels (14 - 24% v/v), and carbon dioxide levels reducing more gradually (14.3 - 20.5% v/v). In LG20, there were more fluctuating levels with methane reduced from 25.3% v/v to 14.5% v/v, and carbon dioxide reducing from 13.4% v/v to 2.6% v/v. The concentration of oxygen in LG20 is markedly higher than the other boreholes with correspondently lower concentrations of carbon dioxide.

4.4.48 Observed flows ranged from c. 2 m3/hr to 7 m^3/hr at these locations over the monitoring period.

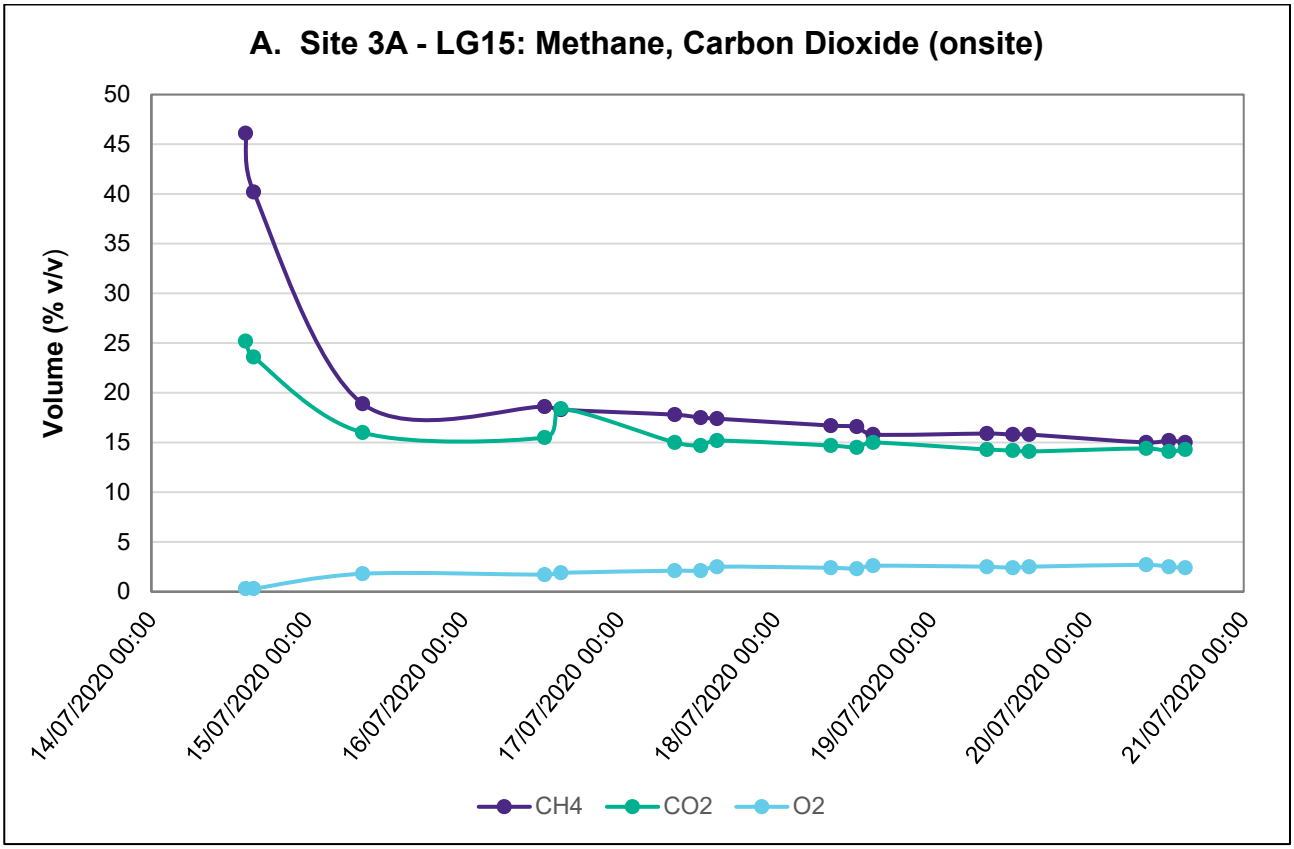
4.4.49 In-waste boreholes MW3 and MW4 were monitored in the trial with elevated levels of methane and carbon dioxide identified. These appeared to decrease at the beginning of the trial (46.8 - 67.4% v/v methane; 10.8-33.1% v/v carbon dioxide) and then remain at elevated levels throughout.

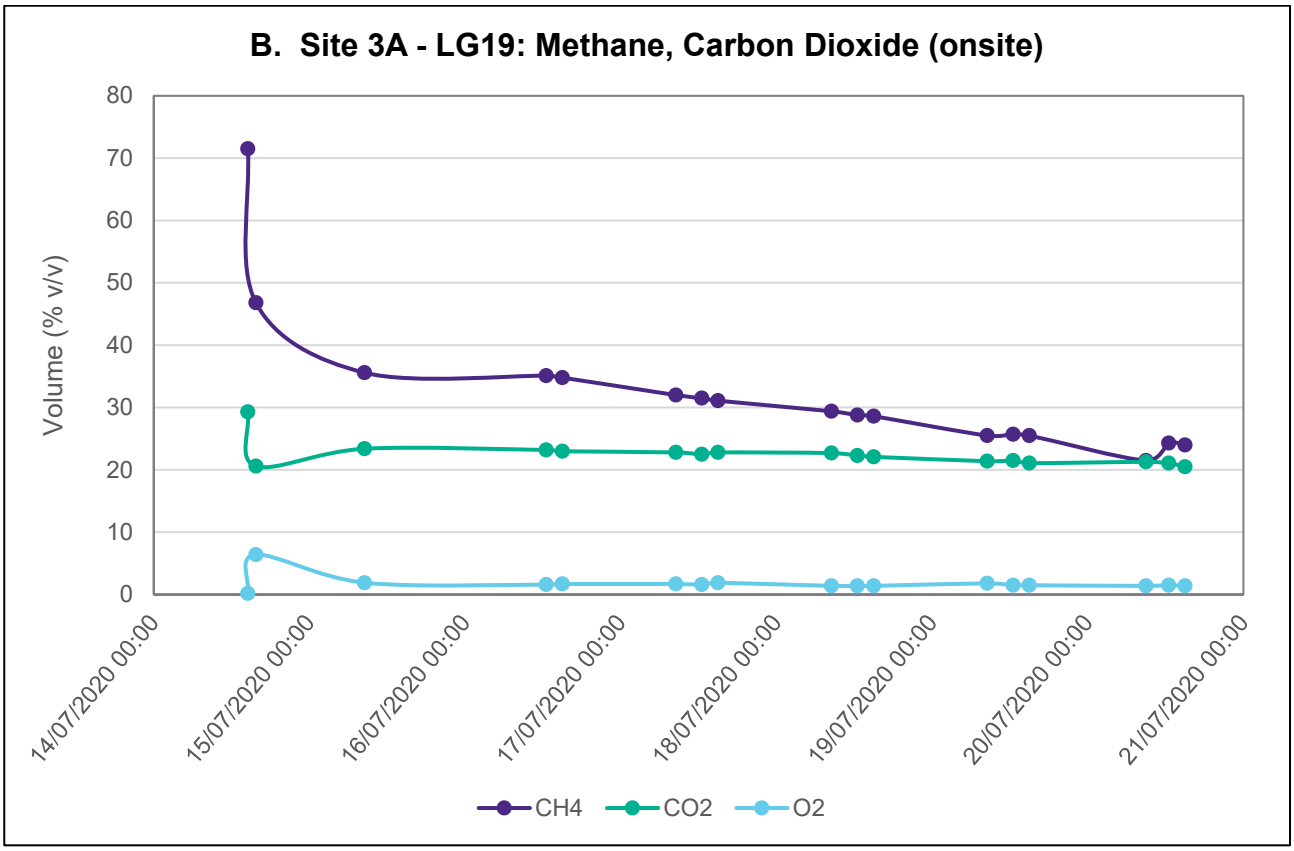
Off-site

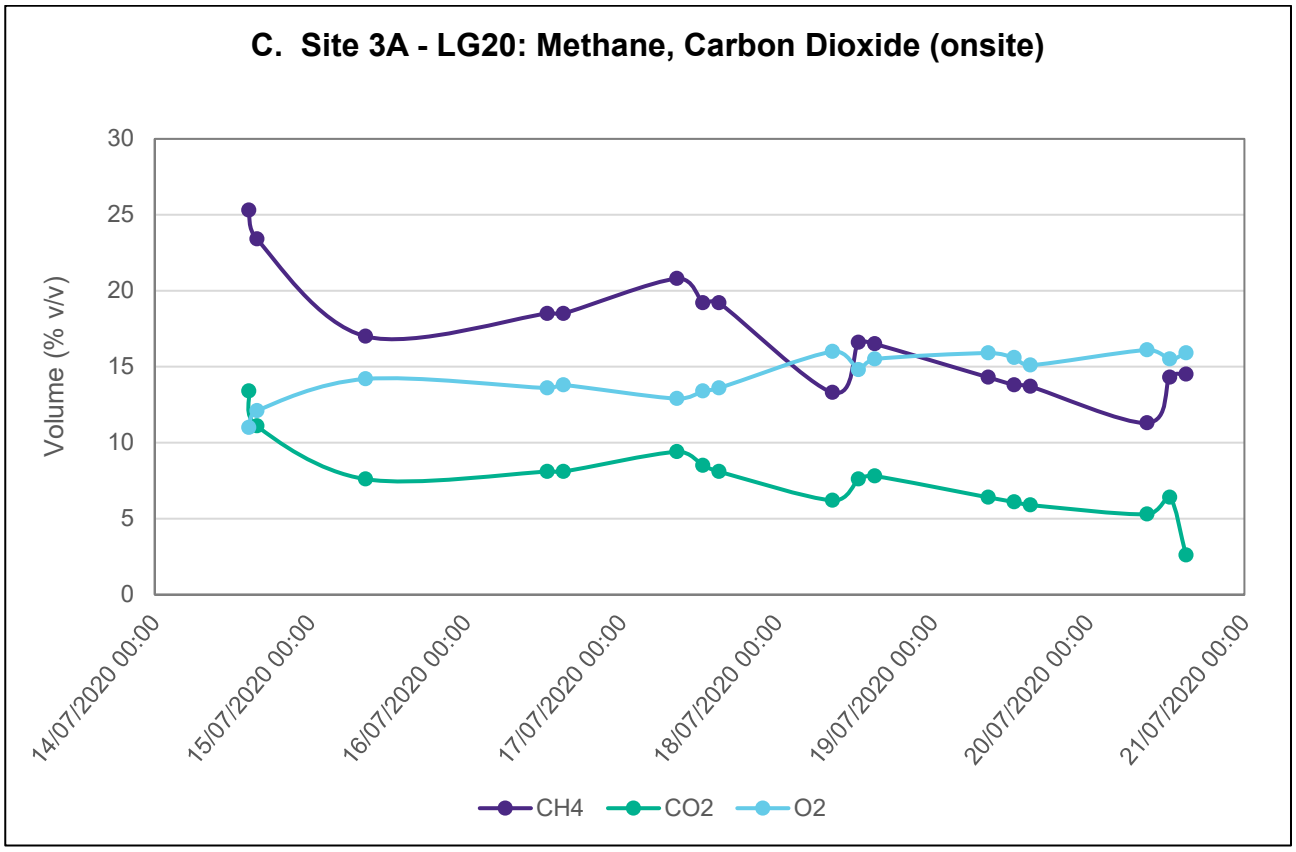
4.4.50 None of the off-site locations in the immediate vicinity of site 3A were monitoring during the pumping trial for the Site 3A. Boreholes BH07 and BH09 located to the south of the southern boundary of the landfill site were monitoring during the pumping trial for site 3B.

4.4.51 The gas monitoring data is presented graphically in Chart 4.9.

Chart 4-9 – Site 3A Pumping Trial: Methane and Carbon Dioxide







Summary of Site 3A Gas Conditions Onsite

4.4.52 The gas monitoring data collected at onsite monitoring boreholes recorded methane concentrations ranging from 0% v/v to 72.8% v/v with carbon dioxide concentrations ranging from 0% v/v to 37% v/v. The lowest gas concentrations were observed at the dual installation within MW3. All other in-waste boreholes demonstrate methane and carbon dioxide concentrations above zero. MW3 is a 19 or 25mm diameter historic standpipe installed within the waste horizon, with the 50mm standpipe is installed within the underlying sands and gravels. Typically methane concentrations are elevated between 30 and 70 % v/v. Similarly carbon dioxide concentrations are continuously elevated between 20 and 30 % v/v.

4.4.53 Flow rates were extremely variable, although high flow rates typically in excess of 30 l/hr have been recorded at all in-waste boreholes. The results of the flow readings are considered to be consistent with a waste mass that is still degrading in pockets or 'hot spots' of the landfill. This is likely to be producing large volumes of gas under pressure driven, advective flow conditions.

4.4.54 The pumping trial in June 2020 showed elevated methane and carbon dioxide concentrations at abstraction boreholes LG15, LG19, LG20 which decreased over time but more gradually as the trial progressed. The concentrations within the boreholes during the pumping trials suggest a slightly variable gas regime over the area represented by these boreholes. Boreholes LG15 and LG19 show different concentrations, albeit with similar trends, indicating a level of connectivity. Borehole LG20 shows different concentrations and a different trend, and significantly higher oxygen concentrations. This may indicate that oxygen was drawn into the landfill at this location. Whilst concentrations are variable the consistently high gas concentrations does indicate that the gas source within the landfill is significant, indicating large stored volumes or ongoing production.

4.4.55 In-waste boreholes MW3 and MW4 were monitored and showed similar elevated concentrations to those observed during the static monitoring rounds from 2016 to 2021. Flow rates of between 2 and 7 m^3/hr were typically recorded in these in-waste boreholes. There were no boreholes monitored in the immediate surrounding area.

Summary of Site 3A Gas Conditions Offsite

4.4.56 The gas monitoring data collected at offsite monitoring locations did not record any methane detections during the course of the monitoring period and carbon dioxide concentrations ranging from no detection to 3.2% v/v.

4.4.57 Flow rates in boreholes located outside the landfill body have remained consistently low, typically below 1.6 l/hr.

4.4.58 There were no boreholes monitored in the immediate surrounding area of the landfill site during the pumping trials in June 2020.

Pumping Trial Recommendations

4.4.59 The AFS report (AFS, July 2020) detailing the results of the pumping trial suggested that a flow rate of a suitable quantity and quantity of gas of 60 m^3/hr could be generated for sites 3A and 3C. Recommendations for a future gas control system at site 3A comprised installation of gas wells to depths just above the water table connected into a common gas main that leads to a small 100m^3/hr Lo-Cal flare. This would be undertaken in conjunction with site 2.

Site 3B: Standard Monitoring

4.4.60 A total of seven (7) boreholes were monitored for gas at Site 3B; three (3) onsite combined gas/leachate boreholes and four (4) offsite boreholes comprising three gas boreholes and one groundwater borehole. The location of these boreholes with respects to the site are detailed upon drawing MDR1206-RPS-00-XX-DR-C-DG1002.

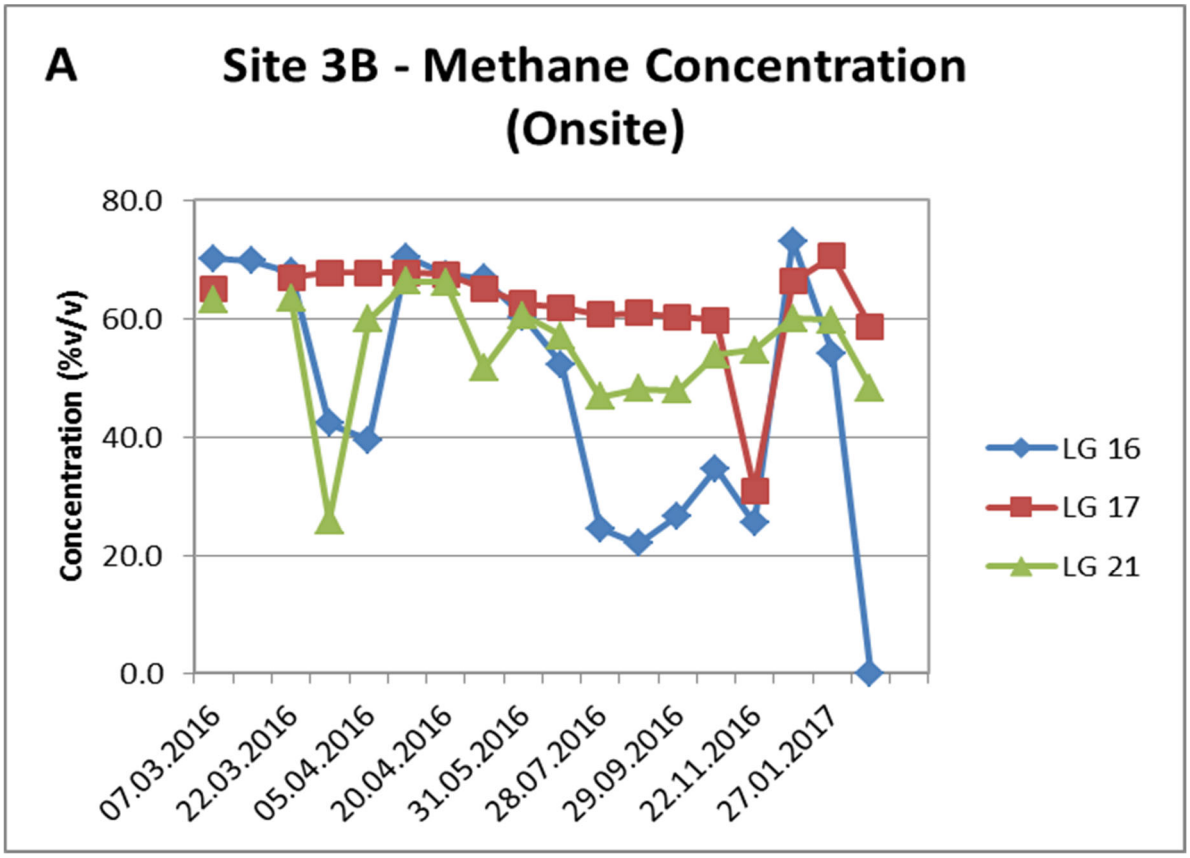
4.4.61 A summary of gas monitoring data is presented in **Table 4.5** below.

Table 4-8 – Site 3B: Summary of Landfill Gas Monitoring Data – Onsite & Offsite, 2016 - 2021

Borehole	Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow (l/hr)	Water level (mbgl)	Range of atmospheric pressure (mbar)
Site 3B							
Onsite							
LG16	In waste	23	0-73.1	0-34.7	0 to 3.3	3.11-3.19	983-1020
LG17	In waste	23	0-70.6	0-39.4	-0.1 to 6.2	3.14-3.29	983-1020
LG21	In waste	23	0-66.2	0-37.4	0 to 2.5	dry	983-1020
Offsite^							
G15	No	18	0	0.8-3.6	0 to 1.3	dry - 5.41	983-1020
G16	No	23	0-2.1	0-3.3	-0.5 to 0.1	dry – 4.08	983-1020
G17	No	24	0	0-4.4	0 to 2.2	dry	983-1020
BH08	No	18	0	0.0-4.2	-1 to 1.4	dry – 6.61	983-1020
^ Water level measurements provided measured from top of borehole casing (2016, 2017 monitoring rounds).							

4.4.62 The gas monitoring data is presented graphically below in Chart 4.10 and Chart 4.11.

Chart 4-10 - Site 3B Methane Concentrations



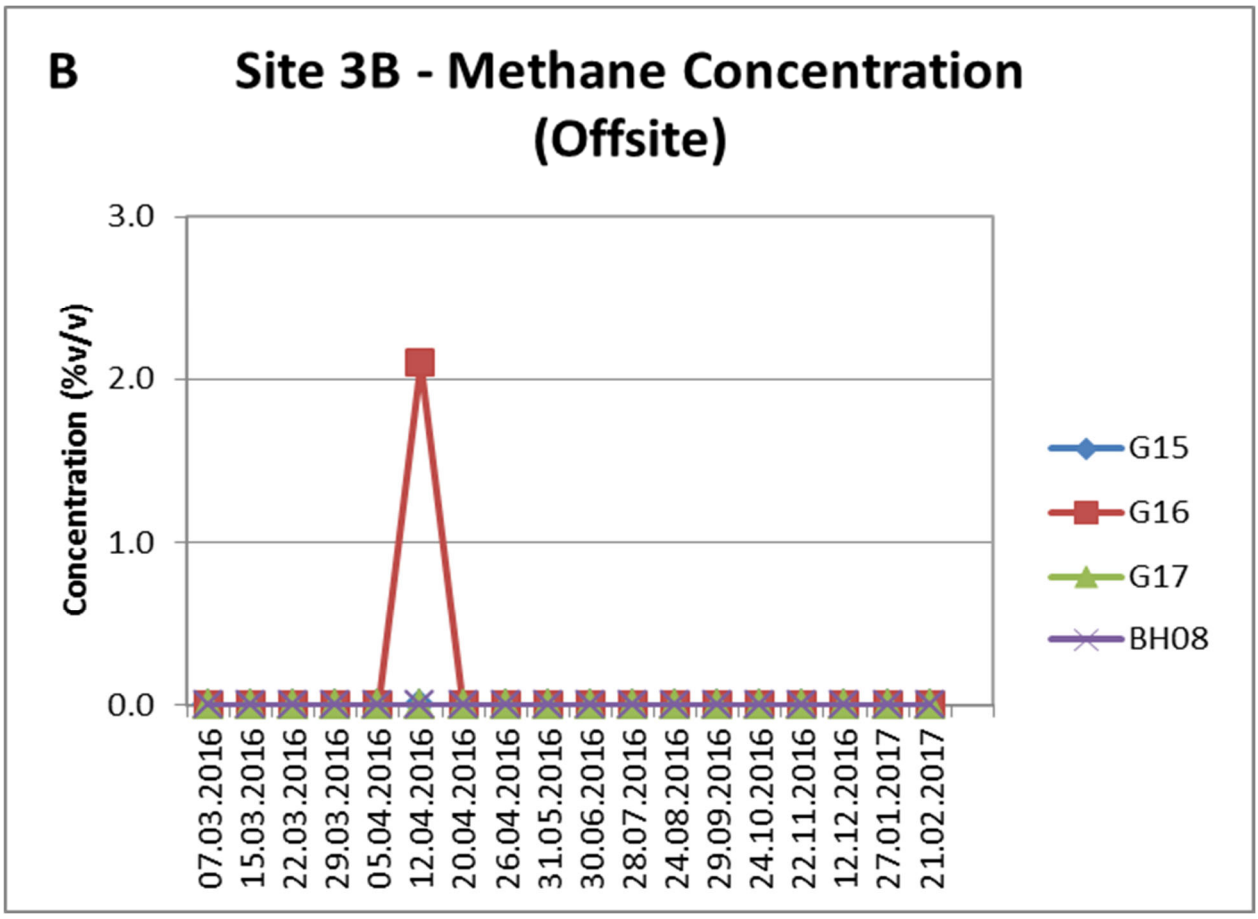
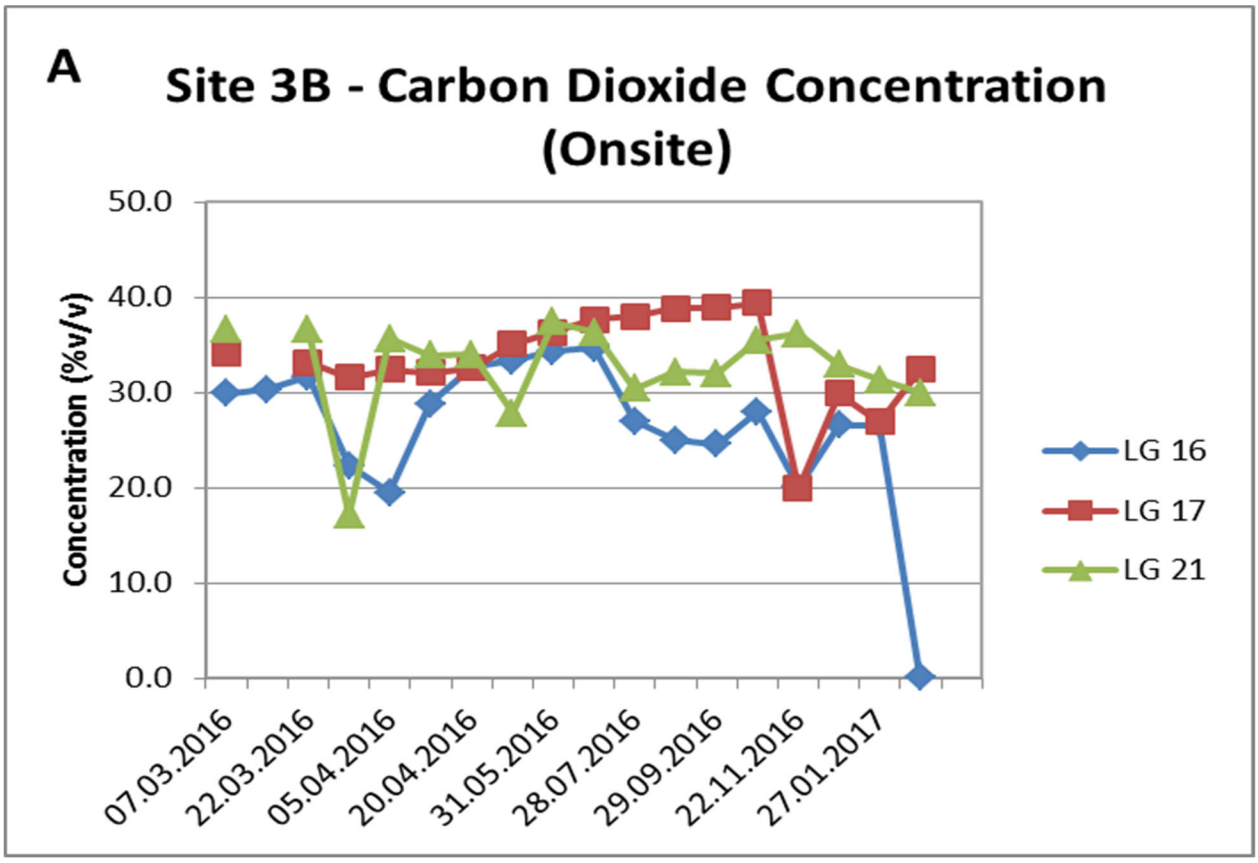
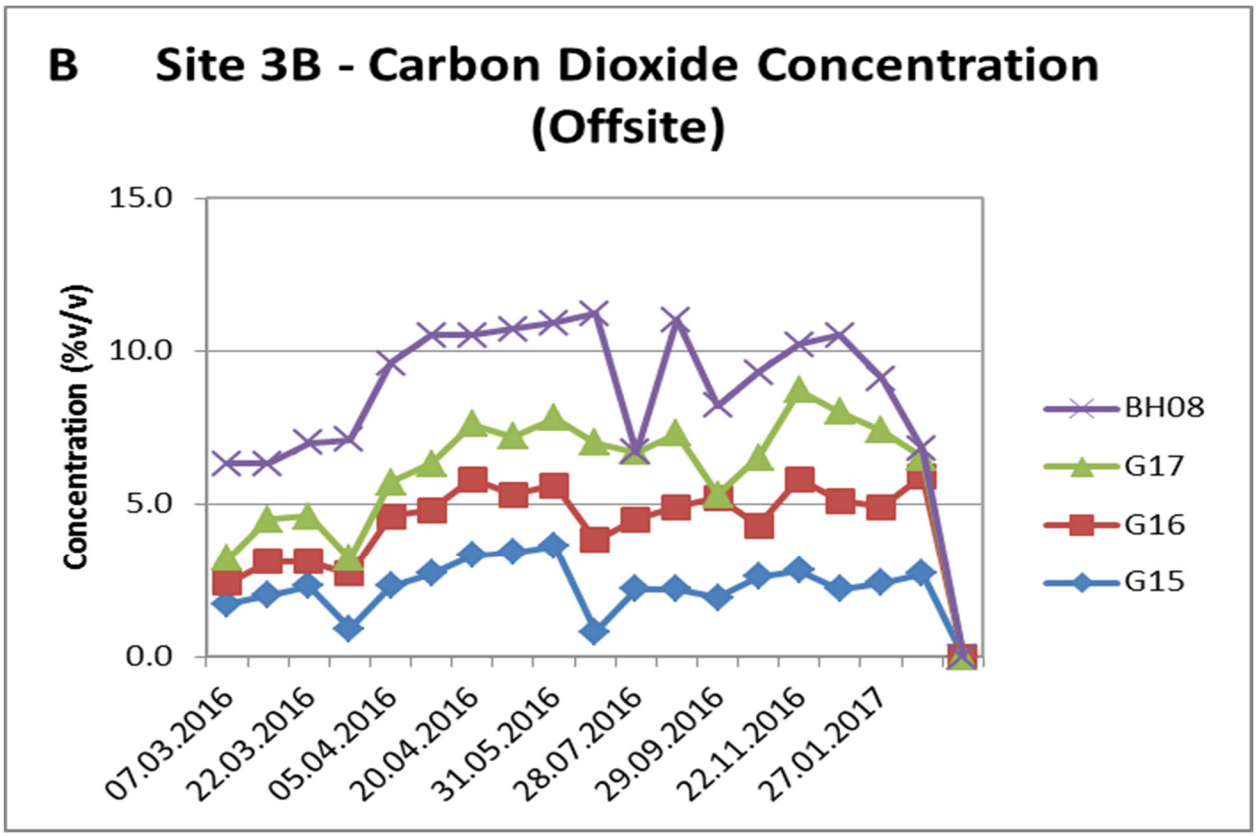


Chart 4.11 – Site 3B Carbon Dioxide Concentrations





Site 3B: Pumping Test Results

On-site

4.4.63 Gas extraction was undertaken from on-site wells LG16, LG17 and LG21 during the pumping trial. Flows from the flare ranged from c. 30 to 40 m^3/hr during the pumping trial. Extraction at well LG16 was terminated on the third day to low methane levels and remained off for the rest of the trial.

4.4.64 In LG16 the concentration of methane was variable with time, but over the three day period it was turned on in the trial it showed a general decline starting at 9.2% v/v terminating at 2.4% v/v. Carbon dioxide concentration was very variable with a high concentration of 20.6% at the start of the trial reducing to 7.9% v/v at the end of day 3. The concentrations of oxygen was also variable and notable higher than at locations LG17 and LG21 and reached 12.3% v/v prior to turn off. The concentrations of methane, carbon dioxide and oxygen were variable for the rest of the trial.

4.4.65 LG17 and LG21 showed a steadier decline, with methane concentrations starting at 57.5% v/v and 34.1% v/v respectively in each of the boreholes and terminating at 26.4% v/v and 6% v/v. Carbon dioxide concentrations in LG27 started at 34.4% v/v and terminated at 25.5% v/v, with those concentrations in LG21 starting and terminating at 28.8% v/v and 16.3% v/v respectively. Observed flows ranged from c. 2 m^3/hr to 6 m^3/hr at these locations over the monitoring period. The peak concentrations of methane identified during the pumping trial were substantially lower than those identified during the standard monitoring. The peak carbon dioxide concentrations were also lower.

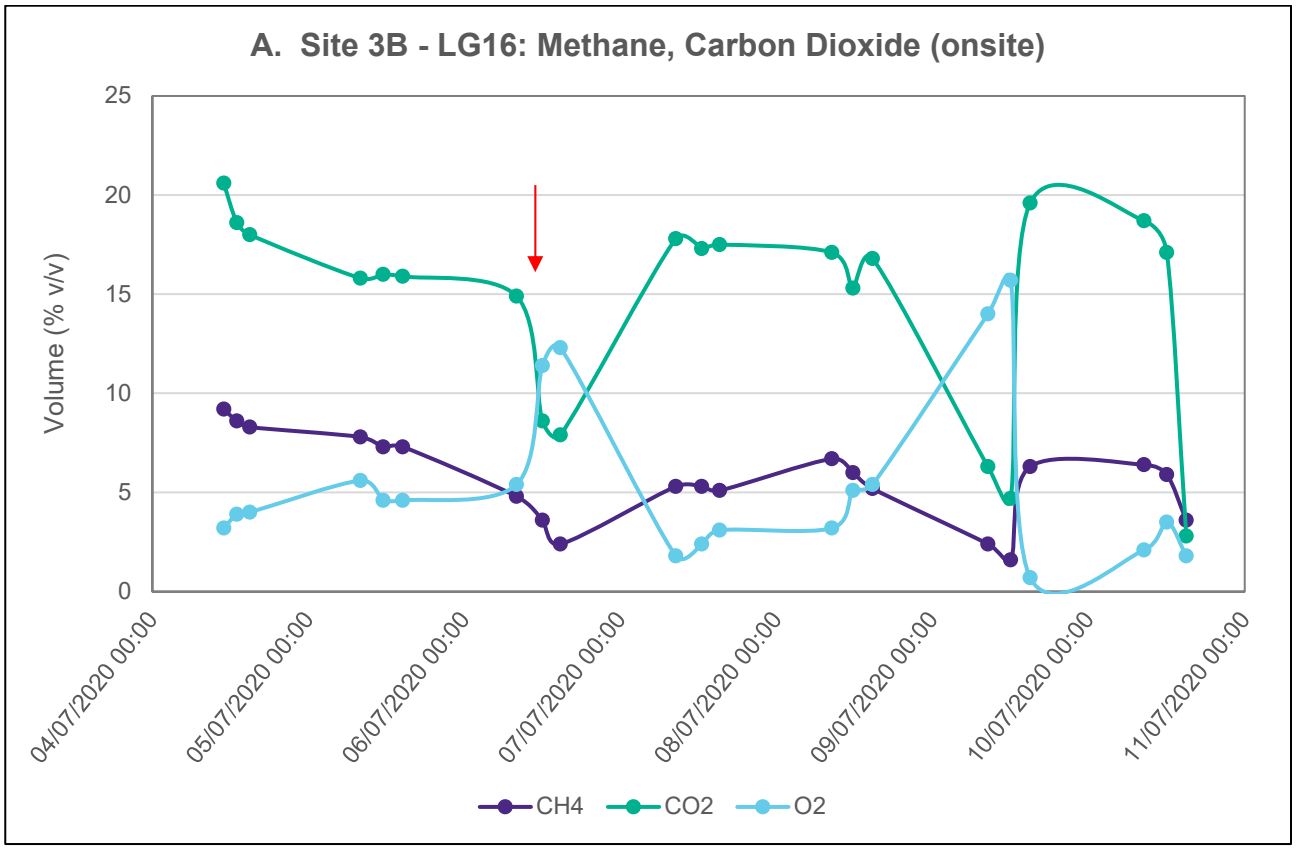
Off-site

4.4.66 Five off-site boreholes (BH07, BH08, BH09, G16 and G17) were monitored during the pumping trial which indicated methane concentrations of zero, and low levels of carbon dioxide peaking at 5.6% v/v (BH08). The concentrations of carbon dioxide fluctuated however they appeared to be slightly higher and more consistent than those from the standard static monitoring. Concentrations

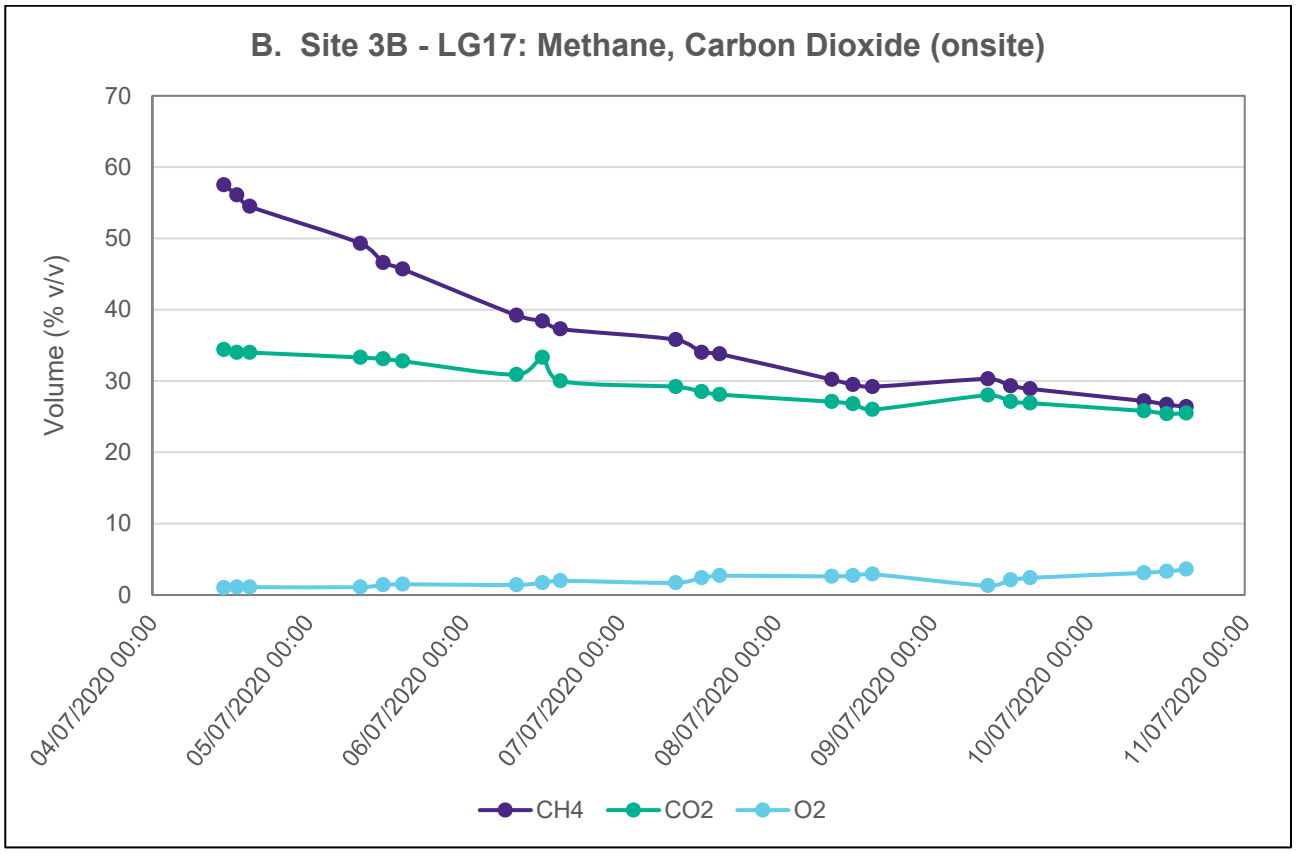
in all boreholes in the pumping trial showed generally higher concentrations than the maximum concentrations observed during these earlier monitoring rounds.

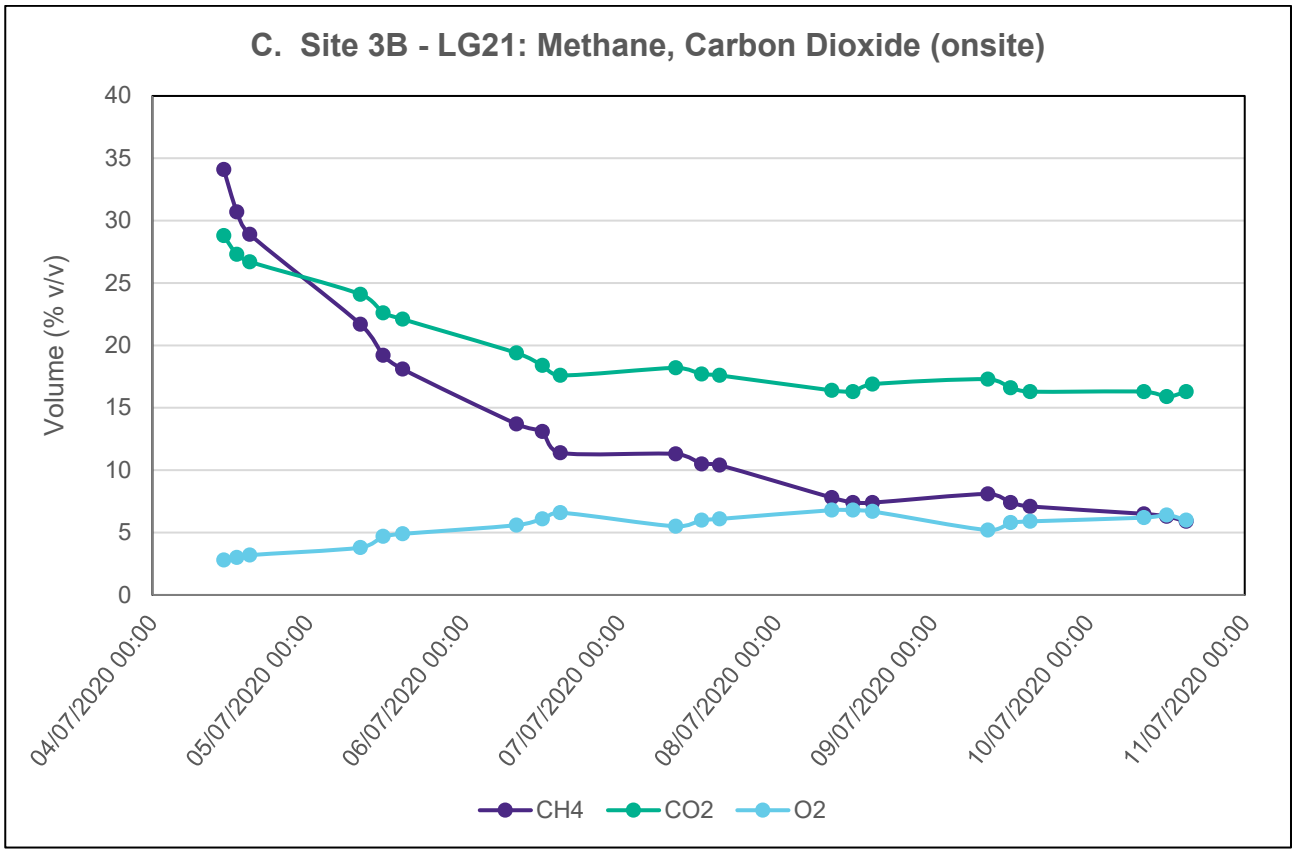
4.4.67 The gas monitoring data is presented graphically in Chart 4.11.

Chart 4-11 – Site 3B Pumping Trial: Methane and Carbon Dioxide



Red arrow indicates approximate date/time at which extraction at wellhead was terminated due to low levels of methane.


B. Site 3B - LG17: Methane, Carbon Dioxide (onsite)
Volume (% v/v)
70
60
50
40
30
20
10
0
04/07/2020 00:00
05/07/2020 00:00
06/07/2020 00:00
07/07/2020 00:00
08/07/2020 00:00
09/07/2020 00:00
10/07/2020 00:00
11/07/2020 00:00
CH4
CO2
O2


C. Site 3B - LG21: Methane, Carbon Dioxide (onsite)
Volume (% v/v)
40
35
30
25
20
15
10
5
0
04/07/2020 00:00
05/07/2020 00:00
06/07/2020 00:00
07/07/2020 00:00
08/07/2020 00:00
09/07/2020 00:00
10/07/2020 00:00
11/07/2020 00:00
CH4
CO2
O2

Summary of Site 3B Gas Conditions Onsite

4.4.68 The gas monitoring data collected at onsite monitoring locations recorded consistently elevated methane concentrations ranging from 22.0% v/v to 73.1% v/v and carbon dioxide ranging from 17.2% v/v and 39.3% v/v. No measurable flow rate was recorded during several monitoring periods with peak readings of 3.3l/hr, 6.2l/hr and 2.5l/hr recorded at LG16, LG17 and LG21 respectively. The concentrations within the boreholes during the pumping trials suggest a variable gas regime over the area represented by these boreholes, with variable concentrations and trends. This indicates a lower level of connectivity than observed in the aforementioned landfills. Borehole LG16 shows different concentrations and a different trend, and significantly higher oxygen concentrations. This may indicate that oxygen was drawn into the landfill at this location. The absolute concentrations and trends indicate lower stored volumes and / ongoing production.

4.4.69 With regard to the pumping trials in June 2020 in LG16, LG17 and LG21, methane and carbon dioxide concentrations appeared to show lower concentrations than the spot monitoring rounds in 2016 and 2017 particularly as the trial progressed and the concentrations continued to lower. The flow rates generated were similar to these spot monitoring rounds.

Summary of Site 3B Gas Conditions Offsite

4.4.70 The gas monitoring data in 2016 and 2017 collected at offsite monitoring locations only recorded methane during one monitoring period at G16 (2.1% v/v on the 12/4/2016). Carbon dioxide concentrations ranged from 0.5% v/v to 4.2% v/v. Flow rates are typically low, albeit variable ranging from -0.5 l/hr to 2.2 l/hr.

4.4.71 In the pumping trials in June 2020, carbon dioxide concentrations slightly elevated above the previous monitoring results where encountered within the boreholes on site with carbon dioxide peaking at 5.6% in BH09. Methane was zero at all locations.

Pumping Trial Recommendations

4.4.72 The AFS report (AFS, July 2020) detailing the results of the pumping trial suggested that a flow rate of a suitable quantity and quantity of gas of 16 m^3/hr could be generated for site 3B. Recommendations for a future gas control system at site were the same as site 1 and comprised a network of vent pipes and rotating cowls to produce a negative suction in the waste mass, with vent trenches around the perimeter of the site.

Site 3C: Standard Monitoring

4.4.73 A total of six boreholes were monitored for gas at site 3C; three onsite boreholes comprising two combined gas/leachate boreholes and one historic borehole and three (3) offsite boreholes comprising two gas boreholes and one groundwater borehole. The location of these boreholes with respects to the site are detailed upon drawing MDR1206-RPS-00-XX-DR-C-DG1002.

4.4.74 A summary of gas monitoring data is presented in **Table 4.9**.

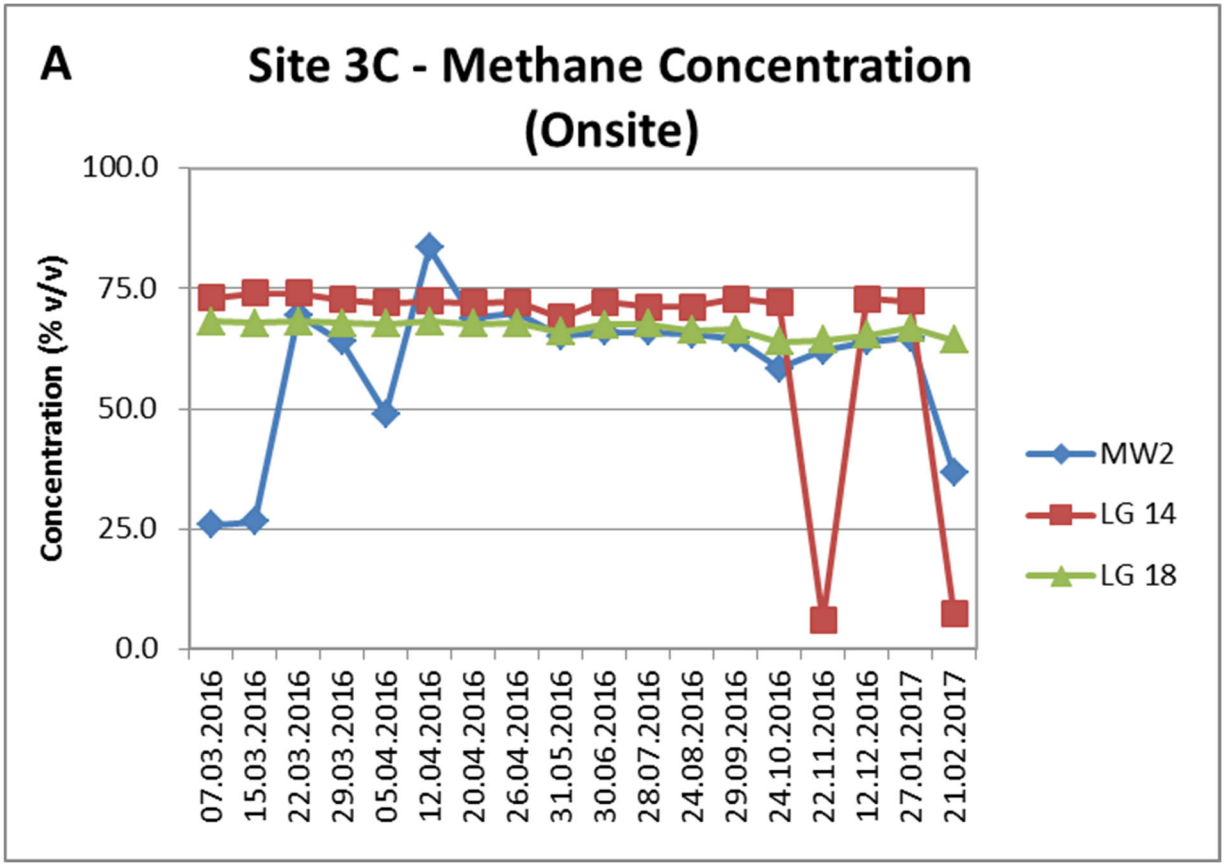
Table 4-9 – Site 3C: Summary of Landfill Gas Monitoring Data – Onsite & Offsite, 2016 – 2021

Borehole		Evidence of contamination	No. of monitoring occasions	Methane (%)	Carbon Dioxide (%)	Flow (l/hr)	Water level (mbgl)	Range of atmospheric pressure (mbar)
	Site 3C							
	Onsite							
MW2		In waste	24	25.8-83.5	7.3-37.2	-2.2 to 11.7~	3.31-4.34	983-1020
LG14		In waste	24	5.9-77.2	4.1-32.5	-0.1 to 1.9	9.11-10.07	983-1020
LG18		In waste	24	59.2-69	28.3-35.6	0.0 to 1.2	9.44-9.58	983-1020
	Offsite^							
G09		No	20	0.0-18.6	0-14.8	0 to 3.1	dry - 12.3	983-1020
G11		No	19	0.0 – 0.1	0-4.5	-0.1 to 1.2	9.87-13.12	983-1020
BH06		No	23	0.0-22.2	0.3-19.6	0 to 0.9	5.53-6.94	983-1020
	^ Water level measurements provided measured from top of borehole casing (2016, 2017 monitoring rounds).							

4.4.75 The gas monitoring data is presented graphically in Chart 4-12 and

4.4.76 Chart 4-13.

Chart 4-12 – Site 3C Methane Concentrations



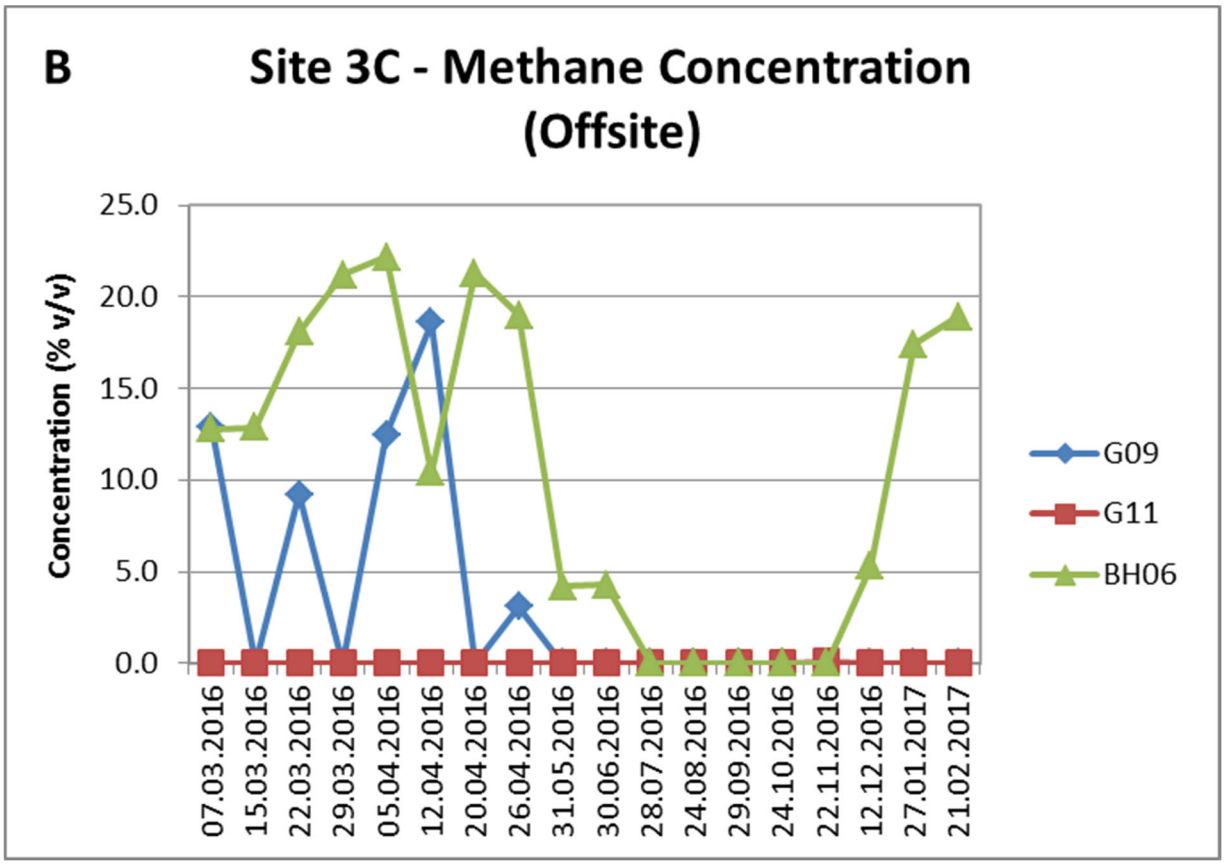
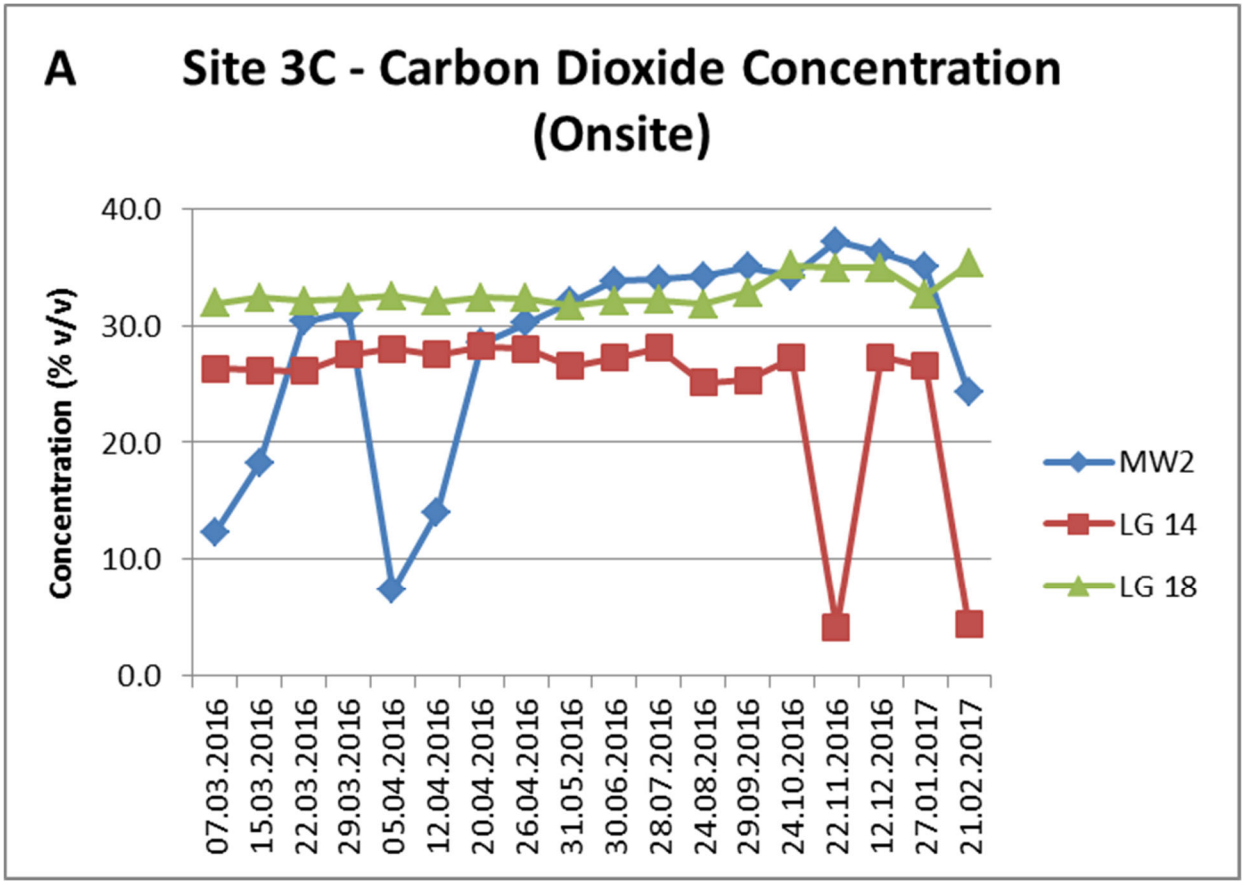
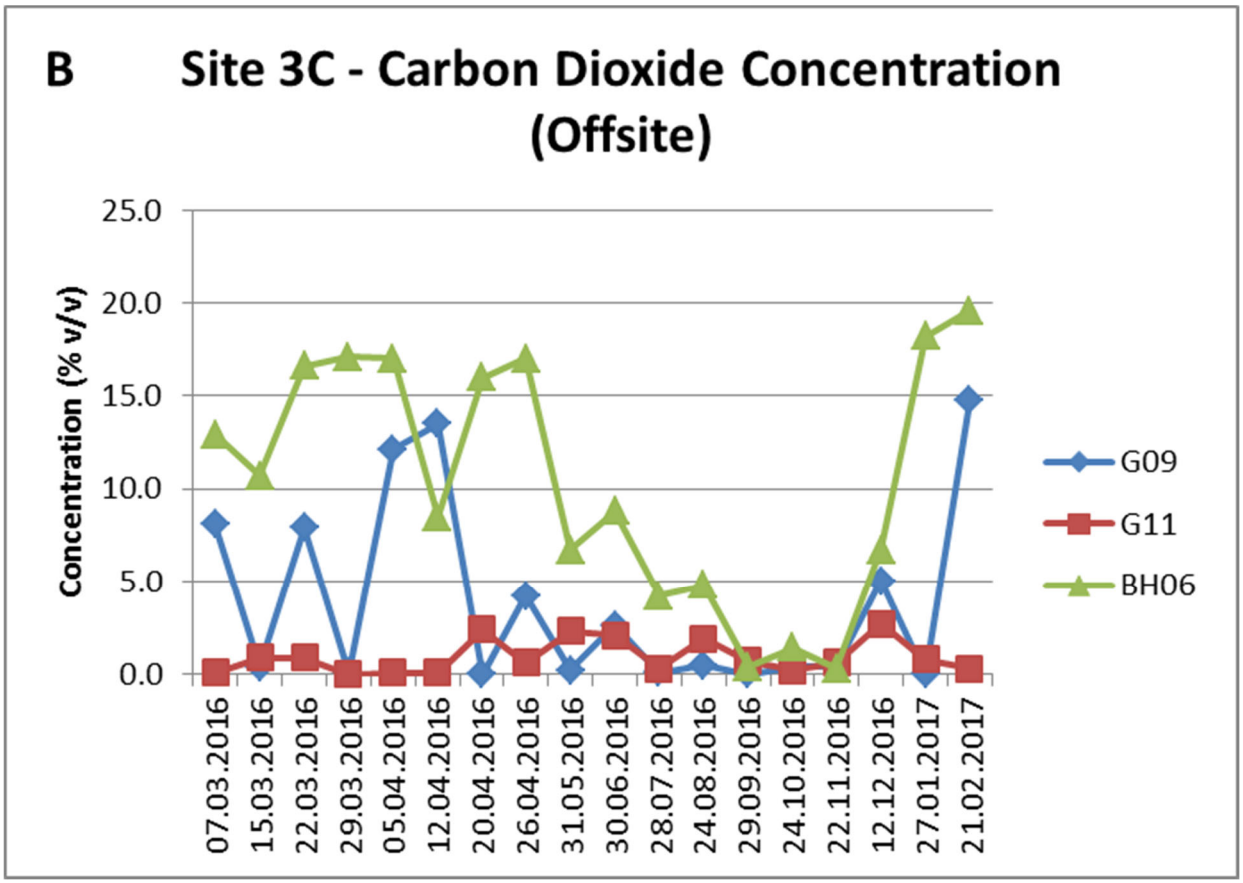


Chart 4-13 - Site 3C Carbon Dioxide Concentrations





Site 3C: Pumping Test Results

On-site

4.4.77 Gas extraction was undertaken from on-site wells LG14 and LG18 during the pumping trial. Flows from the flare peaked at 176 m^3/hr then quickly dropped to 90 m^3/hr on 14th July (day 1) and then reduced to 70-78 m^3/hr for the remainder of the trial. Due to low quality of methane and rising oxygen on day 3, the wellhead valves for LG14 and LG18 was set to 5% (previously at 100%) with the extraction for LG18 being turned off on day 5.

4.4.78 In LG14 and LG18, methane and carbon dioxide concentrations started at high levels (methane: 77.2% v/v (LG14), 59.2% v/v (LG18); carbon dioxide: 25.3% v/v (LG14), 28.3% v/v (LG18)) with the methane concentrations rapidly reducing over the first day and then showing a very low increase or stabilising at low levels with fluctuations evident for LG18. At the end of the pumping trials, methane concentrations were 11% v/v in LG14 and 4.2% v/v in LG18, with carbon dioxide concentrations at 4.5% v/v in LG14, and 8.1% v/v in LG18. Notably, oxygen concentrations were close to ambient concentrations. The absolute concentrations and trends indicate lower stored volumes and / or ongoing production.

4.4.79 Observed flows ranged from c. 2 m^3/hr to 7 m^3/hr at these locations over the monitoring period.

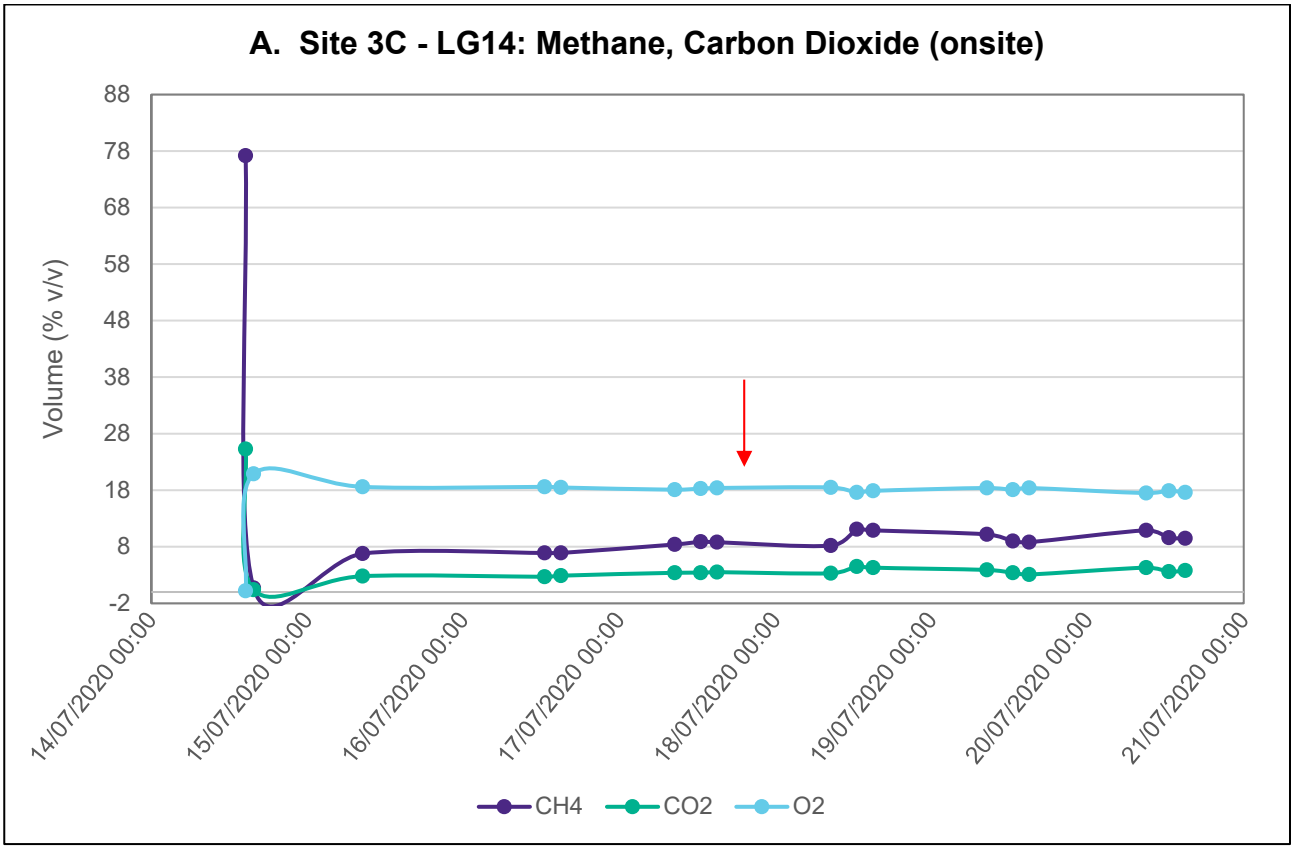
4.4.80 In-waste borehole MW2 was monitored of which showed highly elevated methane (c 60 - 70% v/v) and carbon dioxide (30 - 35% v/v) concentrations which were consistent over time. Flows were not recorded.

Off-site

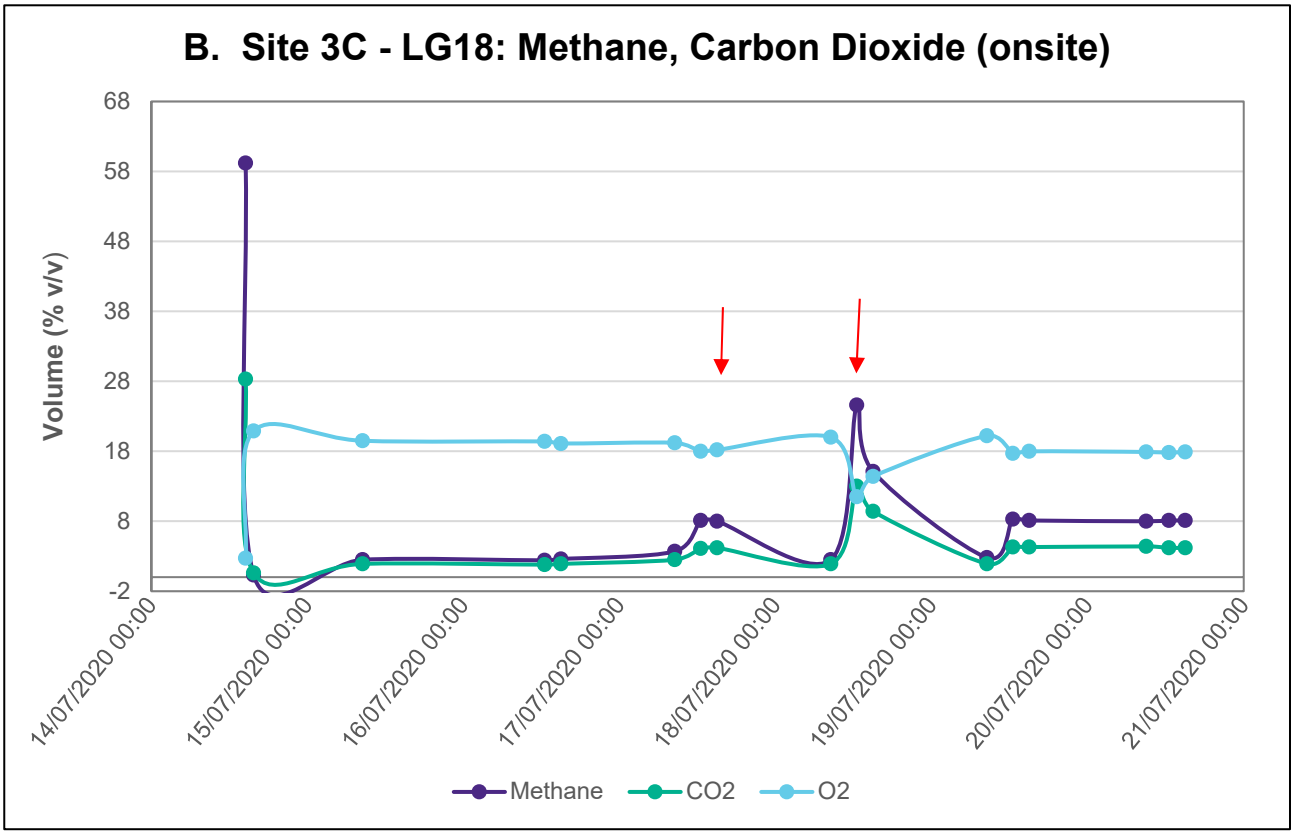
4.4.81 Borehole G09 located to the east of the landfill site showed very low concentrations of methane and carbon dioxide during the pumping trial with maximum concentrations of 1.1% v/v methane and 2.8% v/v carbon dioxide. These did not exceed the maximum concentrations observed during the static monitoring rounds and were similar to the static readings prior to the trial. Flows were not recorded.

4.4.82 The gas monitoring data is presented graphically in Chart 4.14.

Chart 4-14 – Site 3C Pumping Trial: Methane and Carbon Dioxide



Red arrow indicates approximate date/time at which extraction at wellhead valve was reduced to 5%.



First red arrow (left) indicates approximate date/time at which extraction at wellhead valve was reduced to 5%, with second red arrow (right) indicating approximate date/time that extraction was turned off (due to low methane and high oxygen content).

Summary of Site 3C Gas Conditions Onsite

4.4.83 The gas monitoring data collected from onsite monitoring locations recorded methane concentrations ranging from 5.9% v/v to 83.5% v/v with carbon dioxide concentrations ranging from 4.1% v/v to 37.2% v/v. Methane concentrations are typically stable with a concentration between 60% v/v and 75% v/v. Similarly the carbon dioxide concentrations typically exceed 25%. Flow readings are typically low (i.e. below 2 l/hr) with the exception of 11.7 l/hr recorded at MW2 on 12/04/2016. The elevated gas concentrations are consistent with an actively gassing municipal landfill.

4.4.84 The pumping trial in June 2020 showed elevated methane and carbon dioxide concentrations at abstraction boreholes LG14 and LG18 which stabilised at low levels after one day. The stabilised concentrations appeared to be at a consistently low level, without the fluctuations shown in the spot monitoring in 2016 and 2017. Flow rates were 6-9 m^3/hr in these boreholes. The absolute concentrations and trends indicate lower stored volumes and / ongoing production.

4.4.85 In-waste borehole MW2 was monitored and showed similar elevated concentrations to those observed during the static monitoring rounds.

Summary of Site 3C Gas Conditions Offsite

4.4.86 The monitoring of offsite monitoring locations recorded methane concentrations ranging from no detectable concentration to of 22.2% v/v and carbon dioxide concentrations ranging from no detectable concentration to 19.6% v/v. Methane concentrations show significant variability with absence of methane at all locations between July and November 2016. This variability is also seen with carbon dioxide, although non-zero concentrations are typically observed over this period. Measurable flows were not typically recorded, with the exception of 0.4l/hr in G09 and 0.3l/hr in BH06 on 05.04.2016.

4.4.87 G11 located to the west of the site did not record any detectable concentrations of methane for the duration of the monitoring period. G09 and BH06 are located to the east and south of the historic landfill however it should be noted that they are located in close proximity to the lateral extent of the waste body and not c.20m from the waste extent as proposed by best practice. Access was restricted within these locations due to ownership restrictions and minimisation of impact to local crops. Borehole logs for G09 and BH06 did not record the presence of any waste however these monitoring locations could be considered peripheral rather than offsite perimeter locations.

4.4.88 During the pumping trial in June 2020, location G09 to the east of the landfill site showed low concentrations of ground gas which did not exceed the maximum concentrations observed in the static monitoring rounds. The concentrations gradually reduced as the trial progressed.

Pumping Trial Recommendations

4.4.89 The AFS report (AFS, July 2020) detailing the results of the pumping trial suggested that a flow rate of a suitable quantity and quantity of gas of 60 m^3/hr could be generated for sites 3A and 3C. Recommendations for a future gas control system at site were the same as site 1 and comprised a network of vent pipes and rotating cowls to produce a negative suction in the waste mass, with vent trenches around the perimeter of the site.

5 REFINEMENT OF LANDFILL GAS CONCEPTUAL SITE MODEL AND QUANTITATIVE RISK ASSESSMENT

5.1.1 The following gas and groundwater monitoring works were undertaken on site since 2016 when the Environmental Risk Assessment (ERA) first produced. To summarise, these comprised:

- 8 No. weekly gas monitoring rounds between 7th March and 27th April 2016; and
- 10 no. monthly monitoring rounds from 31st May 2016 to 21st February 2017;
- 6 no. quarterly gas monitoring rounds from first quarter of 2020 to second quarter of 2021;
- Pumping trials of approximately 7 day duration for all landfill sites (1, 2, 3A, 3B, 3C) in June and July 2020 to assess the potential requirement for active extraction, including one static gas monitoring round immediately before pumping (quarterly monitoring round).

5.1.2 This further information has been assessed to refine the understanding of the ground gas regime.

5.1.3 The source-pathway-receptor sections for each site have been updated in the following sections which comprised Section 5 of the original report. The updated assessment only considers ground gas and takes account of the specific development proposals.

5.2 Site 1

Source

5.2.1 The waste mass at Site 1 (Source S2) has been well defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The waste material is dominantly comprised of C&D waste with pockets of municipal waste. The maximum measured depth of waste is 14mbgl with an estimated area of 0.53 Ha. There may be a locally perched leachate towards the northern extent of the waste body (Source S1) as indicated by LG13.

5.2.2 Landfill gas (Source S4) was recorded at Site 1 methane concentrations up to 13.6% v/v and carbon dioxide concentrations up to 18.9% v/v during the spot monitoring in 2016 and 2017, with concentrations reaching 37.1% v/v methane and 22.2% v/v carbon dioxide in the monitoring round in 2020 immediately prior to the pumping trials where the concentrations reduced to levels similar to those of the previous monitoring rounds. The pumping trial indicate a relatively consistent gas regime over the area represented by the monitored boreholes. The consistent moderately elevated gas concentrations indicate that the gas source within the landfill is significant, indicating large stored volumes or ongoing production.

5.2.3 The proposed passive extraction and flaring of the landfill mass has the potential to modify the gas source.

Pathway

5.2.4 The data suggested that the waste mass at Site 1 is located above the water-table with an unsaturated zone thickness of over 5 m.

5.2.5 Borehole BH05 is located at c. 50 m to the southwest of the site (in area of proposed development) however none of the gas monitoring boreholes on or in close proximity to the site contained groundwater so the exact thickness of the unsaturated zone is not known.

5.2.6 Based on the further monitoring, this does not change the assessment of unsaturated zone thickness.

5.2.7 The results of the groundwater monitoring as detailed in Section 3.3 do suggest a generally north to northeast groundwater flow however results have suggested that there may be localised variation in groundwater flow as is indicated by the contrasting groundwater elevations in

boreholes G10 and G19 (at c. 100 m to the south of site 1) which suggests a component of flow to the south.

5.2.8 The unsaturated sand and gravel deposits beneath the site provide both a lateral (Pathway P5) and vertical migration pathway (Pathway P7) for landfill gas generated at the source. This is unchanged since the previous ERA. The gas monitoring rounds and the subsequent pumping trials have not shown any significant differences in ground gas concentrations with elevated concentrations at G18 already identified in the static test prior to the pumping trial. Continuity has previously been suggested in location of the watermain near G06, with the gas main acting as a potential source or pathway for ground gas.

5.2.9 Available records do not show the presence of existing services within or in close proximity to site 1, however the proposed SHD development may include services within or near site 1 and they will need to be considered as potential pathways for gas.

5.2.10 The proposed development does include areas of hardstanding within the landfill. The sub base to this hardstanding could act as a preferential pathway.

Receptor

5.2.11 The receptors for Site 1 include existing and future site users (Receptor R7); and existing, and any future off-site buildings and structures (Receptor R9).

5.2.12 Based on the current Strategic Housing development proposals, receptors R7 and R9 still remain in those approximate positions.

5.3 Site 2

Source

5.3.1 The waste mass at Site 2 (Source S2) has been well defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The waste material is dominantly comprised of municipal waste with a maximum measured depth of 19mbgl and an estimated area of 4.5 Ha. An estimated c.340,000 tonnes of waste is present at Site 2 (based on a conversion factor for metres cubed to tonnes of 0.4 for compacted household waste[1]).

5.3.2 The monitoring dataset for landfill gas (Source S4) recorded methane concentrations ranging from no detections to 76.5% v/v and carbon dioxide concentrations ranging from no detection to 36.6% v/v with variable flow rates of between -6.2 l/hr to +7.6 l/hr. The pumping trial results also indicated consistent highly elevated methane and carbon dioxide levels. The concentrations within the boreholes during the pumping trials suggest a slightly variable gas regime over the area represented by these boreholes, albeit with similar trends, indicating a level of connectivity. The consistently high gas concentrations indicate that the gas source within the landfill is significant, indicating large stored volumes or ongoing production.

5.3.3 The proposed active extraction and flaring of the landfill mass has the potential to modify the gas source.

Pathway

5.3.4 The data indicates that most of the waste mass at Site 2 is located above the water-table with an unsaturated zone thickness of greater than 5m and an assumed waste thickness of 19 mbgl.

[1] S.I. No. 189/2015 – Waste Management (landfill Levy) Regulations 2015

5.3.5 The monitoring results indicate that those boreholes located to the south and southeast of the site were dry, of which included boreholes BH11 located to the south of the site with a base depth of 33 m.

5.3.6 Borehole logs from Priority Geotechnical in 2015 do not appear to identify the low permeability bedrock within the aquifer, with sand identified (driller description from rotary open holing) as the lowest layer at between 60.65 mAOD (22 mbgl) to base of the borehole at 49.65 mAOD (33 mbgl). Other boreholes close to the perimeter indicates

5.3.7 These results suggest that the unsaturated zone thickness may be significantly higher than 5 m as it is indicated to be more than 14 m at borehole BH11.

5.3.8 The unsaturated sand and gravel deposits provide both lateral and vertical migration pathways via pore spaces for landfill gas generated at the site (Pathway P5 and Pathway P7 respectively). However it should be noted in Figure 20 of the 2018 ERA ('Revised Conceptual Model – Site 2') (presented in **Appendix E**) that the majority of the new proposed SHD development is planned to the immediate southeast of site 2 so the majority of receptors R7, R8 and R9 will be located to the east and southeast (and not to the southwest where it is shown in the cross-section). The monitoring rounds and pumping trials showed comparable ground gas concentration data however an active gas control and flaring system has been recommended for the site. It should also be noted that there is no up-to-date gas data for boreholes G01, G02, G03, G20, G21, BH03, BH04 and BH11 which are located in the proposed areas of the development to the immediate south and southeast of the site.

5.3.9 The low elevation of the waste body in the north of Site 2 suggests that leachate and groundwater may be in hydraulic continuity. This indicates a potential lateral pathway for soluble gases in groundwater (Pathway P6). Leachate from the landfill site may also contain dissolved gases or may potentially degrade during migration to produce methane and carbon dioxide. Dissolved gas concentrations measured during Round 2 did identify elevated carbon dioxide (30 mg/l in BH1) but the absence of methane. No further gas monitoring has been undertaken to our knowledge.

5.3.10 Available records do not show the presence of existing services within or in close proximity to site 2, however the proposed development may include services within or near site 2 and they will need to be considered as potential pathways for gas. The proposed access road crossing the southwest corner of the landfill is considered a preferential pathway. Where the proposed ponds constructed within this area have piped connections these could also act as preferential pathways, as could any sub base to the proposed cycle route.

Receptors

5.3.11 The receptors for site 2 include: current and future site users (Receptor R7); and existing and proposed offsite buildings and structures (Receptor R9). The detailed development proposals include development to the east and southeast of the landfill boundary. It should be noted that the proposed future site users include users of a playground, ponds, picnic areas and an amphitheatre within the landfill site. It is assumed that these structures will comprise a series of non-enclosed structures and therefore they are not considered to represent an additional receptor for ground gas, except if they are constructed within depressions where carbon dioxide could accumulate.

5.4 Site 3A

Source

5.4.1 The waste mass at Site 3A (Source S2) has been defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The waste material is dominantly comprised of municipal waste, with a maximum measured depth of 16 mbgl and an estimated area of 1.9 Ha. An estimated c.120,000 tonnes of waste is present at Site 3A (based on a conversion factor for metres cubed to tonnes of 0.4 for compacted household waste).

5.4.2 The monitoring dataset for Landfill Gas for Site 3A (excluding MW3 and LG20) identified methane concentrations between approximately 30 and 70 % v/v and carbon dioxide concentrations between approximately 20 and 35% v/v. Flow rates are extremely variable, although high flow rates typically in excess of 30 l/hr have been recorded at all in-waste boreholes. These results are considered to be consistent with a waste mass which is still degrading and producing large volumes of gas under pressure driven conditions (Source S4). The subsequent pumping trials in 2020 indicated elevated levels of ground gas similar to the maximum concentrations encountered during earlier monitoring rounds. Based on the high flow rates and ground gas concentrations an active gas control and flaring system has been recommended.

5.4.3 The proposed active extraction and flaring of the landfill mass has the potential to modify the gas source.

Pathways

5.4.4 The waste body at Site 3A generally appears to be unsaturated with leachate restricted to the north of the site. Groundwater appears to be located immediately beneath the landfill site, although a thin unsaturated zone may be present, with leachate mixing with groundwater at the water table. An unsaturated zone within the sand and gravel would provide both lateral and vertical migration pathways via pore spaces for the landfill gas generated at the site (Pathway P5 and P7).

5.4.5 In the north of Site 3A, leachate and groundwater may be in hydraulic continuity. This is also suggested by groundwater monitoring in surrounding boreholes which indicate groundwater at depths of c. 6 – 14 mbgl (compared to waste mass depth of 16 mbgl). This indicates a potential lateral pathway for soluble gases in groundwater (Pathway P6). Dissolved gas analysis undertaken in Round 2 did not identify dissolved gases in groundwater although the dataset is limited (i.e. BH7, BH9 and BH10).

5.4.6 Landfill 3A is designated as Public Open Space under the current development proposals, with the details to be confirmed as part of further detailed planning applications. Any structures that are proposed in any future planning applications should be considered with respects to the pathways they could introduce.

Receptors

5.4.7 The receptors for site 3A include: current and future site users (Receptor R7): and offsite buildings and structures (Receptor R9). This is unchanged since the 2018 ERA.

5.4.8 Landfill 3A is designated as Public Open Space under the current SHD application proposals, with the details to be confirmed as part of further detailed planning applications. Any future structures should be considered as potential preferential pathways. Where possible future development proposals include enclosed structures or the creation of depressions within the landfill these should be considered as potential receptors.

5.5 Site 3B

Source

5.5.1 The waste mass at Site 3B (Source S2) has been well defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The relatively shallow waste material is dominantly comprised of municipal waste with a maximum measured depth of 4.9 mbgl with an estimated area of 0.44 Ha. An estimated c.8,500 tonnes of waste is present at Site 3B, based on a conversion factor for metres cubed to tonnes of 0.4 for compacted household waste.

5.5.2 The landfill gas monitoring dataset collected for onsite monitoring locations recorded consistently elevated methane concentrations ranging from no detection to 73.1% v/v and carbon dioxide ranging from and 39.3% v/v (Source S4). No measurable flow rate was recorded during several monitoring periods with peak reading of 3.3 l/hr, 6.2 l/hr and 2.5 l/hr recorded at LG16, LG17 and LG21 respectively. Elevated ground gas concentrations were also identified in the pumping trials in 2020 which exceeded the maximum concentrations identified during earlier monitoring rounds.

5.5.3 The proposed active extraction and flaring of the landfill mass has the potential to modify the gas source.

Pathways

5.5.4 The groundwater table at Site 3B is indicated to be located at shallow depth with perimeter boreholes (G15, G16, G17) also showing relatively low groundwater levels of c. 4 – 5 mbgl compared to the waste mass depth of 4.9 mbgl. However it appears that the waste body is perched above the water table. Some deeper portions of the waste body are expected to be saturated to the north, where groundwater is intercepted. The unsaturated sand and gravel deposits can provide both lateral and vertical migration pathways for generated landfill gas at the site (Pathway P5 and P7). The saturated waste located to the north of the site could result in the migration of dissolved gas in groundwater (Pathway P6).

5.5.5 Landfill 3B is designated as Public Open Space under the current development proposals, with the details to be confirmed as part of further detailed planning applications. Any future structures should be considered as potential preferential pathways. Where any future development proposals include enclosed structures or the creation of depressions within the landfill these should be considered as potential receptors.

5.5.6 The proposed access road bisecting the landfill is considered a preferential pathway.

Receptors

5.5.7 The receptors for site 3B comprise: existing and proposed site users (Receptor R7); adjacent site users (Receptor R7); existing and any future offsite buildings and structures (Receptor R9). This is unchanged since the previous 2018 ERA.

5.5.8 Landfill 3B is designated as Public Open Space under the current SHD development proposals, with the details to be confirmed as part of further detailed planning applications. Where any future development proposals include enclosed structures or the creation of depressions within the landfill these should be considered as potential receptors.

5.6 Site 3C

Source

5.6.1 The waste mass at Site 3C (Source S2) has been well defined though a series of site investigations including the site walk-over, trial pits, boreholes and geophysical surveys. The waste material is dominantly comprised of municipal waste with a maximum measured depth of 13 mbgl and an estimated areal extent of 0.9 Ha. An estimated c. 47,000 tonnes of waste is present at Site 3C, based on a conversion factor for metres cubed to tonnes of 0.4 for compacted household waste[2].

[2] S.I. No. 189/2015 – Waste Management (landfill Levy) Regulations 2015

5.6.2 The monitoring dataset for Landfill Gas (Source S4) recorded methane concentrations ranging from 5.9% v/v to 83.5% v/v with carbon dioxide concentrations ranging from 4.1% v/v to 37.2% v/v. Methane concentrations typically stable with a concentration between 60% v/v and 75% v/v. Similarly the carbon dioxide concentration typically exceeds 25%. Flow readings are typically low (i.e. below 2 l/hr). Whilst the pumping trials undertaken in 2020 showed similar initial concentrations of methane and carbon dioxide, these reduced significantly during the pumping trial indicating a limited source of gas or low rate of production from this landfill.

5.6.3 The proposed passive extraction and flaring of the landfill mass has the potential to modify the gas source

Pathways

5.6.4 The base of the waste mass appears situated beneath the water table in the underlying sand and gravel aquifer. This concurs with data from surrounding boreholes where groundwater is encountered at the shallowest depths of c. 6 mbgl (BH06 on southern boundary of site 3C). The saturated aquifer therefore provides both lateral and vertical migration pathways for leachate migration (Pathway P2) and dissolved gas through groundwater (Pathway P6).

5.6.5 Landfill 3C is designated as Public Open Space under the current SHD development proposals, with the details to be confirmed as part of further detailed planning applications. Any future structures should be considered as potential preferential pathways. Where any future development proposals include enclosed structures or the creation of depressions within the landfill these should be considered as potential receptors.

Receptors

5.6.6 The receptors for Site 3C include: existing and future site users and existing (including adjacent occupied properties) (Receptor R7); any future offsite buildings and structures (Receptor R9). This is unchanged since the previous 2018 ERA.

5.6.7 Landfill 3C is designated as Public Open Space under the current development proposals, with the details to be confirmed as part of further detailed planning applications. Where any future development proposals include enclosed structures or the creation of depressions within the landfill these should be considered as potential receptors.

5.6.8 Although the location of the proposed development has changed since the previous assessment, the risk ratings for the Revised Risk Site Wide Model (Baseline Conditions – No Development and with Development) as provided in Tables 5.1 and 5.2 of the 2018 ERA are not considered to require modification. These are presented in **Appendix D**.

6 QUANTITATIVE GAS RISK ASSESSMENT

6.1 Introduction

6.1.1 The generic quantitative risk assessment (GQRA) has been updated to take account of additional ground gas monitoring data of boreholes across the landfill sites. The full dataset comprises the static gas monitoring rounds from 2016 to 2021, of which includes a static monitoring round in 2020 prior to pumping trials. The pumping trial results have also been discussed in relation to the passive monitoring in the context of the GQRA. Additionally, the GQRA takes account of the specific development proposals.

6.2 Background

6.2.1 The Department of the Environment (United Kingdom) published a document '*Protection of New Buildings and Occupants from Landfill Gas'* in 1994. This document outlines the high level requirements for landfill gas assessment and guidelines that should be considered.

6.2.2 The guidelines include a recommendation that *houses with private gardens should not be erected within 50m of any landfill site where the concentration of methane exceeds one per cent (1%) by volume or where the concentrations of carbon dioxide exceeds one-half per cent (0.5%) by volume or where the landfill still has the potential to produce large quantities of gas*. This recommendation is not based on a risk assessment approach.

6.2.3 It is now considered that this document is out of date, although it is noted that it has not been withdrawn and is still referenced as a guidance document. It has been superseded by CIRIA Report C665 which represents the current best practice guidance in relation to ground gas assessment. It should be noted that this document does not make any reference to minimum offset distances for developments. The purpose of the risk assessment based approach is to determine the appropriate mitigation measures to appropriately deal with the risk posed by the gas.

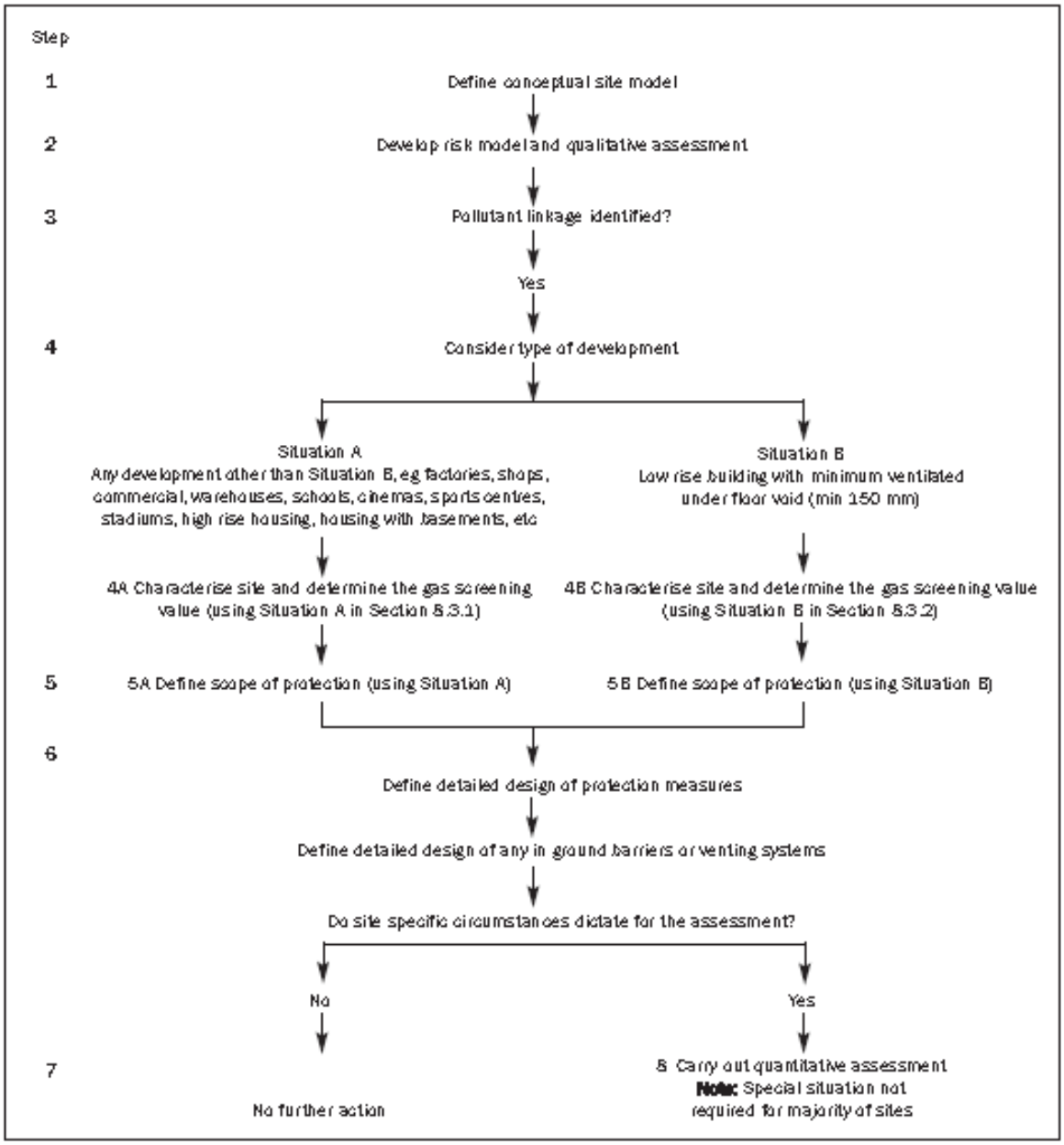
6.2.4 CIRIA Report C665 proposes a holistic approach to gas risk assessment, taking account of the following factors:

- Nature of source and migration pathway;
- Borehole flow rate and surface emission rate;
- Frequency and distribution of elevated gas concentrations;
- Nature of any future development; and
- Confidence and reliability of results.

6.2.5 In accordance with Section 8.1.2 of CIRIA C665 for closed landfill sites and Made Ground:

The risk assessment approach discussed in Section 8.2 can be adopted to screen potential risks or classify the ranges of measured gas concentrations and emission rates. This will determine the type of protective measures in buildings, calculate the vent trench dimensions, or determine that development is not suitable for the location.

Figure 6-1 - Risk Assessment Process for Methane and Carbon Dioxide (from CIRIA C665)



6.3 Gas Source and Migration Pathways

6.3.1 The main gas source is considered to be the waste within each of the five historic landfills Site 1, 2, 3A, 3B and 3C. There are several pathways for the gas to migrate including:

- Lateral migration subsoil;
- Lateral migration groundwater;
- Vertical migration subsoil;
- Existing and proposed services routes; and
- Proposed access roads, cycle paths and hardstanding.

6.3.2 Production phases of typical landfill gas is described in the 1997 EPA Report gas production and divided into 4 phases, Phase I is aerobic with phases II – IV anaerobic. The EPA Section 22 Register dates the end date for site 2 as 1991 and sites 3B and 3C as 1995. There are no known

records detailing the end dates for site 1 and site 3A. Given the waste is over 20 years old with a low to moderate flow production, this suggests the gas production is in the later stages of degradation and in line with Phase IV.

6.3.3 The source and pathways for each site are discussed below.

Site 1

6.3.4 As discussed in section 5.2.1. the waste material within site 1 is dominantly C&D waste with pockets of municipal waste with a maximum depth of waste of 14 mbgl.

6.3.5 The waste is located above the water-table with an unsaturated zone thickness of over 5 m (suggested at 5 – 6.5 m thickness in neighbouring borehole BH05). These unsaturated unconsolidated sands and gravel deposits are considered to represent the primary gas migration pathway, providing both lateral and vertical migration pathways for landfill gas. Gas migration may also occur at depth within the bedrock deposits, but this is considered a secondary pathway given its depth, permeability and position with respect to the groundwater table. As the waste is located above the water-table it is considered a secondary pathway as dissolved gas could travel laterally through groundwater. Migration of dissolved gases (due to the saturation limit) would be considered a secondary gas migration pathway.

6.3.6 Available records do not show the presence of existing services within or in close proximity to site 1, however the proposed development may include services within or near site 1 and they will need to be considered as potential pathways for gas. The proposed development does include areas of hardstanding within the landfill. The sub base to this hardstanding could act as a preferential pathway.

Site 2

6.3.7 The waste material for site 2 is dominantly municipal with a maximum measured depth of 19 mbgl.

6.3.8 Following the site investigations and as detailed in section 4.3.1, the majority of the waste body is located above the water-table within an unsaturated zone with a thickness of greater than 5m (which may be more than 14 m as suggested in nearby borehole BH11). The unsaturated sands and gravel deposits provide both a lateral and vertical migration pathway for gas via the pore spaces.

6.3.9 The majority of the waste is located above the water table, however, the lowest levels of the waste body are saturated and may possibly be in hydraulic connection with the underlying water-table. This could result in a potential pathway for soluble gases in the groundwater.

6.3.10 Available records do not show the presence of existing services within or in close proximity to site 2, however the proposed development may include services within or near site 2 and they will need to be considered as potential pathways for gas. The proposed access road crossing the southwest corner of the landfill is considered a preferential pathway. Where the proposed ponds constructed within this area have piped connections these could also act as preferential pathways, as could any sub base to the proposed cycle route.

Site 3A

6.3.11 For site 3A the waste material is dominantly comprised of municipal waste with a maximum measured depth of 16 mbgl.

6.3.12 As detailed in section 5.4.1 the waste body at site 3A appears to be mainly unsaturated with only a minor depth of leachate head to the north of the site. The groundwater elevation is considered to be located directly underneath the site but there may be a marginal unsaturated zone between the two (depths of 9-14 mbgl groundwater depth implied by surrounding boreholes). The unsaturated

sands and gravel zone can provide both lateral and vertical migration pathways via pore spaces for generated landfill gas at the site.

6.3.13 Based on current records of existing services at site 3A the only known services are overhead and therefore do not create a pathway for the landfill gas to travel. Landfill 3A is designated as Public Open Space under the current development proposals, with the details to be confirmed as part of further detailed planning applications. Any structures that are proposed should be considered with respects to the pathways they could introduce.

Site 3B

6.3.14 The waste material at site 3B is relatively shallow and is comprises mainly municipal waste with a maximum measured depth of 4.9mbgl.

6.3.15 The water-table is relatively shallow (4-5 mbgl) but it would appear the majority of the waste body is perched above the water-table. Some deeper portions of the waste body are saturated to the north. This would suggest dissolved landfill gas could migrate laterally through the groundwater.

6.3.16 The unsaturated sands and gravel zone can provide both lateral and vertical migration pathways for landfill gas.

6.3.17 Current records do not show any existing services present at site 3B. The proposed access road bisecting the landfill is considered a preferential pathway.

6.3.18 Landfill 3B is designated as Public Open Space under the current development proposals, with the details to be confirmed as part of further detailed planning applications. Any structures that are proposed should be considered with respects to the pathways they could introduce.

Site 3C

6.3.19 The waste material in site 3C is dominantly municipal waste with a maximum depth of 13 mbgl. The base of the waste would appear to be saturated and in direct connection with the water table in the underlying sand and gravel deposits providing both lateral and vertical pathways for dissolved gas through groundwater. Borehole BH06 on the southern boundary encountered groundwater at about 6 mbgl during the monitoring.

6.3.20 Based on current records there are no known services at site 3C. Landfill 3C is designated as Public Open Space under the current development proposals, with the details to be confirmed as part of further detailed planning applications. Any structures that are proposed should be considered with respects to the pathways they could introduce.

6.3.21 West of Site 2 and east of the existing water main, pockets of waste along the water main line were identified by the geophysical survey.

6.4 Production Phases of Typical Landfill Gas

6.4.1 Based on the 1997 EPA Report gas production is divided into 4 phases, Phase I is aerobic with phases II – IV anaerobic. The EPA Section 22 Register dates the end date for Site 2 as 1991 and Sites 3B and 3C as 1995. There are no known records detailing the end dates for site 1 and site 3A. Given the waste is over 20 years old with a low to moderate flow production, this suggests the gas production is in the later stages of degradation and in line with Phase IV.

6.5 Hydrogen Sulphide and Carbon Monoxide

6.5.1 A review of the hydrogen sulphide and carbon monoxide results were also completed for each site. A summary of the dataset is presented in **Table 6.1**. The results include the static monitoring undertaken in June and July 2020 prior to the pumping trials by AFS. Hydrogen sulphide and carbon monoxide were not monitored as part of the other static monitoring rounds undertaken in 2020 and 2021.

Table 6-1 - Summary of Hydrogen Sulphide and Carbon Monoxide Monitoring Results

Location	Count of H2S	Max of H2S (ppm)	Count of CO	Max of CO (Ppm)
Site 1				
Offsite				
BH05	17	0	17	0
G06	18	0	18	0
G07	19	0	19	1
G08	19	0.013	19	0
G10	18	0	18	0
G18	19	0	19	0
G19	19	0	19	0
Onsite				
LG 11	19	0	19	10
LG 12	19	0	19	7
LG 13	19	0	19	6
Site 2				
Offsite				
BH01	19	0	19	0
BH03	18	0	18	0
BH04	18	0	18	0
BH11	18	0	18	0
BH13	19	0	19	0
G01	18	0	18	0
G02	18	0	18	0
G03	18	0	18	0
G04	19	0	18	0
G05	18	0	18	0
G13	18	0	18	0
G20	18	0	18	0
G21	18	0	18	0
G22	18	0	18	0
G23	18	0	18	0
G24	18	0	18	0
G25	19	0	19	0
Onsite				
LG 01	18	0	18	0
LG 02	19	0	19	0
LG 03	19	0	19	0
LG 04	18	50	18	10
LG 05	19	0	19	0
LG 06	18	0	18	0
LG 07	19	0	19	10
LG 08	19	0	19	14
LG 09	19	0	19	2
LG 10	18	0	18	7
Site 3A				
Offsite				
BH07	19	0	19	0
BH09	19	0	19	0
BH10	18	0	18	0
G12	18	0	18	0
G14	18	0	18	0
Onsite				
LG 15	18	1	18	10

Location	Count of H2S	Max of H2S (ppm)	Count of CO	Max of CO (Ppm)
LG 19	18	30	18	12
LG 20	19	87	19	10
MW3 (25 dia. Pipe)	18	25	18	0
MW3 (50 dia. Pipe)	18	3	17	3
MW4	19	40	19	3
Site 3B				
Offsite				
BH08	19	0	19	0
G15	18	0	18	0
G16	19	0	19	0
G17	19	0	19	0
Onsite				
LG 16	20	0	19	32
LG 17	19	0	18	10
LG 21	19	0	18	0
Site 3C				
Offsite				
BH06	18	0	18	0
G09	19	2	19	1
G11	18	0	18	10
Onsite				
LG 14	19	50	19	1
LG 18	19	40	19	2
MW2	19	210	18	1

6.5.2 Full details of hydrogen sulphide and carbon monoxide monitoring are in **Appendix B**.

6.6 Borehole Flow Rate

6.6.1 A review of the borehole flow rates results from the 2016 and 2017 dataset is presented in **Table 6-2**. Flow rates were not provided in the static monitoring rounds undertaken in 2020 and 2021.

Table 6-2 - Summary of Flow Monitoring Results (peak and steady)

Location	Number of Flow measurement (Peak)	Max of Flow Measurement (Peak) (l/hour)	Number of Flow measurement (Steady)	Max of Flow Measurement (Steady) (l/hour)
Site 1				
Offsite				
BH05	16	9	17	9
G06	18	6.6	18	3.5
G07	18	7.1	18	6.9
G08	17	6.5	18	6.3
G10	16	3.4	18	3.1
G18	16	0.4	18	0.3
G19	17	1.2	18	0.6
Onsite				
LG 11	16	0.4	18	0
LG 12	16	2.8	18	0.7
LG 13	16	4	18	0

Location	Number of Flow measurement (Peak)	Max of Flow Measurement (Peak) (l/hour)	Number of Flow measurement (Steady)	Max of Flow Measurement (Steady) (l/hour)
Site 2				
Offsite				
BH01	16	3.6	18	3.4
BH03	17	10.2	18	10.2
BH04	17	11.4	18	10.8
BH11	17	7.5	18	7.2
BH13	17	5.2	18	4.7
G01	15	3.9	18	3.8
G02	18	3.9	18	5
G03	17	5.4	18	4.7
G04	18	0.4	18	0.1
G05	16	6.5	17	6.3
G13	18	6.7	18	6.4
G20	16	13.8	18	13.6
G21	16	6.5	18	5.8
G22	17	20	18	19.8
G23	17	3.5	18	3.4
G24	17	11	18	10.5
G25	17	9.3	18	9
Onsite				
LG 01	17	3.1	17	2.5
LG 02	17	7.4	18	7
LG 03	17	5.4	18	4.3
LG 04	16	10.8	17	7.6
LG 05	18	7.1	18	7
LG 06	17	7.3	18	3.3
LG 07	18	3.9	18	3.9
LG 08	18	4.9	18	4.6
LG 09	18	7.8	18	6
LG 10	18	5.5	18	4.8
Site 3A				
Offsite				
BH07	17	5.9	18	1.6
BH09	17	2.2	18	1.6
BH10	17	4.2	18	1.6
G12	17	1.9	18	1.4
G14	16	4	18	1.3
Onsite				
LG 15	19	6.4	19	5.8
LG 19	18	45.6	18	45
LG 20	19	26.7	19	26.5

Location	Number of Flow measurement (Peak)	Max of Flow Measurement (Peak) (l/hour)	Number of Flow measurement (Steady)	Max of Flow Measurement (Steady) (l/hour)
MW3 (25 dia. Pipe)	13	1.6	10	1.5
MW3 (50 dia. Pipe)	16	5	16	4.9
MW4	18	44.8	18	43.5
Site 3B				
Offsite				
BH08	16	3.7	18	1.4
G15	16	3.1	18	1.3
G16	16	0.3	18	0.1
G17	16	2.2	18	2.2
Onsite				
LG 16	18	4.3	18	3.3
LG 17	16	6.6	16	6.2
LG 21	16	3.1	16	2.5
Site 3C				
Offsite				
BH06	16	3.4	18	0.9
G09	17	4	18	3.1
G11	16	3.4	18	1.2
Onsite				
LG 14	19	2.8	19	1.9
LG 18	19	3.7	19	1.2
MW2	16	19.5	17	11.7

6.6.2 Full details of flow rates are provided in **Appendix B**.

6.7 Nature of the Proposed Development

6.7.1 The future development will comprise a mixed commercial and residential development. The landfill areas are to be developed as public open space with limited structures comprising play areas, ponds, cycle paths and an amphitheatre. It is understood that none of the proposed structures upon the landfills are enclosed. Whilst this is the case some of the features (the amphitheatre and pond) may be constructed in depressions where gases could accumulate. Additionally, the 'foundations' to these structures could act as preferential pathways. It is also evident that there is a road planned to cross the southwestern corner of Site 2 of which also passes through the northern section of Site 3B.

6.8 Confidence and Reliability of Results

6.8.1 It should be noted that the gas risk assessment is based upon 24 no. rounds of monitoring and provides an initial indication of gas risks only. The monitoring period covers a wide range in weather conditions and atmospheric pressure. The current dataset complies with minimum monitoring requirement stated by CIRIA C665 guidance, in excess of 10 rounds although it could be extended to 24 months due to very high generation potential and high sensitivity of development.

6.9 Gas Risk Assessment

6.9.1 Any future development will include mixed use development including low rise housing. Given the proposed mixed use of the development the Wilson and Card has been utilised for Situation A and the NHBC traffic light classification has also been used for low rise residential development (Situation B)[3].

Wilson and Card Methodology

6.9.2 As detailed in CIRIA C665 the Wilson and Card method is used for all development types except those in Situation B. This method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flow for methane and carbon dioxide. The limiting borehole gas volume flow is renamed as the gas screening value (GSV).

6.9.3 Gas screening value (litres/hour) = max borehole flow rate (l/hr) x max gas concentration (%) / 100.

6.9.4 **Table 6.3** presents the Gas Screening Value calculation carried out for both methane and carbon dioxide. The maximum steady flow rate has been used and the worst case screening value between methane and carbon dioxide is adopted for the classification.

Table 6-3 - Gas Screening Value Calculation (Wilson and Card Methodology)

Location	Max of Flow (Peak)	Max of CH4 (%)	Max of CO2 (%)	Gas Screening Value	Class
Site 1					
Onsite	0.7	37.1	22.2	0.26	CS2
Offsite	9	23.9	8.1	2.15	CS3
Site 2					
Onsite	7.6	76.5	36.6	5.81	CS4
Offsite	19.8	55.7	25.5	11.03	CS4
Site 3A					
Onsite	45	72.8	37	32.76	CS5
Offsite	1.6	0	3.2	0.05	CS1
Site 3B					
Onsite	6.2	73.1	39.4	4.53	CS4
Offsite	2.2	2.1	4.4	0.096	CS2
Site 3C					
Onsite	11.7	83.5	37.2	9.77	CS3
Offsite	3.1	22.2	19.6	0.69	CS2

6.9.5 The Characteristic Situations given for each site have not changed since the previous assessment presented within the 2018 ERA.

6.9.6 However, with regard to the pumping trials, higher maximum concentrations of carbon dioxide were identified during the pumping in the following locations:

- Site 1 (offsite): G18, 6.8% v/v and G19, 3.5% v/v;

[3] Low rise residential development is considered to be a non flat/apartment development consisting of one to three stories in height.

- Site 3B (offsite): BH08, 4.6% v/v, BH7, 4.6% v/v, G17, 3.9% v/v, G16, 3.6% v/v. BH9, 2.6% v/v.

6.9.7 However only the carbon dioxide concentration at BH08 (4.6% v/v) exceeds the maximum concentration used in the assessment for site 3B (offsite) of 4.2% v/v of which would not alter the Characteristic Situation calculated for this site. Flows were not recorded during the pumping trials in the offsite boreholes so this information cannot be utilised in the assessment.

NHBC Traffic Light System

6.9.8 The NHBC has developed a characterisation system that is similar to the Wilson and Card system, but is specific to low-rise housing development with a clear ventilated underfloor void. This is a risk- based approach that is designed to allow an identification of gas protection for low-rise housing developments by comparing the measured gas emission rates to generic “traffic lights” scenarios. The traffic lights include “typical maximum concentrations” and are provided for initial screening purposes and risk-based gas screening values (GSVs) for consideration in situations where the typical maximum concentrations are exceeded.

6.9.9 This method is carried out for both methane and carbon dioxide.

6.9.10 It should be noted that the method used to develop the GSV thresholds in Table 8.7 of CIRIA C665 is based on a number of assumptions regarding the proposed structures. For the purpose of this assessment it is assumed the low rise development for the site is as per CIRIA guidance

6.9.11 Following the completion of the Wilson and Card screening it was decided to complete NHBC traffic light system for all sites due to the potential of low rise housing in the proposed development.

6.9.12 Using table 8.7 from CIRIA C665 Assessing risks posed by hazardous ground gases to buildings along with peak methane, carbon dioxide and GSV (calculated using Modified Wilson and Card), the following tables detail the Traffic Light Classification for all sites.

Table 6-4 – Traffic Light Classification - Methane

Site Number	Position	Peak methane (% v/v)	GSV (l/hr)	Traffic Light Classification
1	Onsite	37.1	0.16	Green (Red*)[Amber 2]
	Offsite	23.9	2.15	Red
2	Onsite	76.5	5.81	Red
	Offsite	55.7	11.03	Red
3A	Onsite	72.8	32.76	Red
	Offsite	0.0	0.0	Green
3B	Onsite	73.1	4.53	Red
	Offsite	2.1	0.05	Green
3C	Onsite	83.5	9.77	Red
	Offsite	22.2	0.69	Amber2

* Maximum concentration is above threshold of ‘typical maximum concentration’ for ‘Green’ and would be indicative of ‘Red’ classification.

6.9.13 It should be noted that for site 1 (onsite) the peak methane encountered exceeds the typical maximum concentration threshold for all categories except ‘Red’ which would place this into the ‘Red’ classification. However, this value appears to be anomalous and was recorded immediately prior to the pumping trial in 2020. During the spot monitoring rounds, concentrations were rarely above 10% v/v so it is considered that an Amber 2 classification should be considered.

Table 6-5 – Traffic Light Classification – Carbon Dioxide

Site Number	Position	Peak carbon dioxide (% v/v)	GSV (l/hr)	Traffic Light Classification
1	Onsite	22.2	0.15	Green (Amber 2*) [Amber 2]
	Offsite	8.1	0.73	Green
2	Onsite	36.6	2.78	Amber2
	Offsite	25.5	5.05	Amber2
3A	Onsite	37.0	16.65	Red
	Offsite	3.2	0.05	Green
3B	Onsite	39.4	2.44	Amber2
	Offsite	4.40	0.096	Green
3C	Onsite	37.2	4.35	Red
	Offsite	19.6	0.61	Green

* Maximum concentration is above threshold of 'typical maximum concentration' for 'Green' and would be indicative of 'Amber 2' classification.

6.9.14 It should be noted that for site 1 (onsite) the peak carbon dioxide encountered is more representative of an 'Amber 2' classification. However, this value appears to be anomalous and was recorded immediately prior to the pumping trial in 2020 as was the case for methane at this location. During the spot monitoring rounds, concentrations were rarely above 15% v/v.

Proposed Protection Measures

Wilson and Card

6.9.15 The guidance set out within Table 8.6 of CIRIA C665 (presenting a typical scope of gas protection measures for each characteristic situation) has now been superseded and replaced by BS 8485:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BSI, 2019). BS8485 defines the minimum gas protection score of each characteristic situation within Figure 4, recreated as Figure 6-2 below.

Figure 6-2 - Gas Protection Score by CS and Type of Building (from BS8485)

CS	Minimum gas protection score (points)			
	High risk		Medium risk	Low risk
	Type A building	Type B building	Type C building	Type D building
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 A)	5.5 A)	4.5	3.5
5	— B)	[A1] 6 [A1] A)	5.5	4.5
6	— B)	— B)	[A1] — B) [A1]	[A1] 6 [A1]

A) Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

B) The gas hazard is too high for this empirical method to be used to define the gas protection measures.

6.9.16 The proposed development comprises building type A (private ownership with no building management controls), building type B (private or commercial property with central building management control), and building type C (commercial building with central building management control). Based on this, gas protection scores ranging from 0 to5.5 will be required.

6.9.17 Measures can include Structural Barriers, Ventilation Measures, Membranes and IN-ground Pathway Intervention. BS8485 defines the number of gas protection points provided by each measure. Design measures can be selected based on the gas protection points required and the specific nature of the structures. The detailed gas protection system shall be designed in accordance with relevant guidance, including but not limited to:

- BS 8485:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BSI, 2019);
- Protecting development from methane (CIRIA, 1995); and
- Assessing risks posed by hazardous ground gases to buildings (CIRIA. 2007).

6.9.18 Where these standards conflict, the most up to date relevant guidance will be applied.

Traffic Light System

6.9.19 Based on the traffic light classification for each site for low rise housing development only, the scope of protections measures as defined in Box 8.4 of CIRIA C665 are presented in **Table 6.6**.

Table 6-6 – Proposed Protection Measures – Traffic Light System

Traffic light classification	Site Number	Protection measures required
Green	Site 3A offsite Site 3B offsite	Negligible gas regime identified and gas protection measures are not considered necessary
Amber 1		Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414 (Johnson, 2001). Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Site 1 onsite	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414 (Johnson, 2001). Membranes should always be fitted by a specialist contractor. As with amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	Site 1 Offsite Site 2 onsite & offsite Site 3A onsite Site 3B onsite Site 3C onsite & offsite	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further gas risk assessment and/ or possible remedial migration measures to reduce and/or remove the source of gas.

6.9.20 As set out above, detailed gas protection system shall be designed in accordance with relevant guidance, including but not limited to:

- BS 8485:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BSI, 2019);
- Protecting development from methane (CIRIA, 1995); and
- Assessing risks posed by hazardous ground gases to buildings (CIRIA. 2007).

6.9.21 Where these standards conflict, the most up to date relevant guidance will be applied.

Summary of Gas Risk Assessment

6.9.22 The Fassaroe Historic Landfill sites lie within the area of Fassaroe, Bray, Co. Wicklow which is zoned for major new development under the Bray Municipal District Local Area Plan 2018. The

lands are zoned for residential high density (R-HD) new development with existing residential (RE), open space (OS1 and OS2), active open space (AOS), and neighbourhood centre (NC).

6.9.23 A review of the gas regime at the site (based on the currently available information) suggests that the main gas generation at the site is the waste within the landfills. The main pathway for gas migration from the waste materials is considered to be through the permeable superficial deposits, with limited contributions through groundwater and the deeper bedrock deposits which are considered to be of a lower permeability.

6.9.24 Following the completion of the Wilson & Card and the Traffic Light assessments the sites have been characterised. The characterisation indicates that protection measures will be required and will need to include gas barriers to prevent migration of gases from the landfills where further monitoring cannot dismiss the risk from gas within the proposed development areas.

6.9.25 We would recommend that the current gas management strategy is further detailed as part of the detailed design process, as further data becomes available from the further proposed monitoring and as the technical construction details of the properties are finalised. The detailed design will confirm the technical details for delivery of the measures to limit gas migration from the landfills and the protection measures that will be required to properties, as already set out in principle in the Gas Management Strategy prepared for this application.

7 REMEDIAL OPTIONS APPRAISAL

7.1.1 The further data does not alter the remedial option considered previously (Section 7 of the 2018 ERA) with respects to ground gas which have been approved by EPA as part of the CoA process.

7.1.2 A gas management strategy has been updated (RPS, 2022) for the site based on the updated information provided which has regard to it's proposed mixed residential and commercial zoning. This strategy identifies the gas protection measures that can be installed to limit gas migration from the landfills and the protection measures that will be required to properties, supported by relevant appraisal / assessment. The strategy considers the potential impact of the proposed active and passive gas venting on the gas regime.

7.1.3 Whilst not a remedial consideration, the design of any structures located upon the waste mass should avoid the creation of low points within which gas could accumulate. The current design has taken this into account by including public open space features (ponds and amphitheatre) of relatively low depth that are located in open areas. It is understood that the base of these features is at an elevation above the upper surface of the waste mass.

REFERENCES

BRE Report 414. Protective measures for housing on gas-contaminated land. 2001.

BS 8485:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.

CIRIA Report 149 - Protecting Development from Methane. January 1995.

CIRIA Report C665. Assessing risks posed by hazardous ground gases to buildings. 2007.

RPS, Environmental Risk Assessment, Fassaroe Historic Landfills, 2018 (Ref. DR1206Rp0007).

RPS, Gas Management Strategy, Fassaroe Historic Landfills, 2016 (Ref. MDR1206Rp0005).

RPS, Gas Management Strategy, Fassaroe Historical Landfills, December 2021 (updated in March 2022).

Drawings

SITE INVESTIGATION CO-ORDINATES

Drill Rig	ID	X Co-ordinate	Y Co-ordinate
Existing Boreholes			
	MW2	723021.66	718380.78
	MW3	722762.91	718368.44
	MW4	722696.61	718368.44
Gas Monitoring Boreholes			
Rotary	G01	723757.16	718233.48
Rotary	G02	723906.63	718311.72
Rotary	G03	723983.99	718344.07
Rotary	G04	723640.81	718281.92
Rotary	G05	723638.54	718344.71
Rotary	G06	723574.12	718441.70
Rotary	G07	723368.29	718433.97
Rotary	G08	723306.94	718326.45
Rotary	G09	723094.22	718349.85
Rotary	G10	723333.19	718171.75
Rotary	G11	722977.05	718343.28
Rotary	G12	722830.39	718345.89
Rotary	G13	724005.86	718058.15
Rotary	G14	722815.16	718240.44
Rotary	G15	722795.09	718080.09
Rotary	G16	722652.69	718073.96
Rotary	G17	722714.71	718133.46
Rotary	G18	723510.87	718384.05
Rotary	G19	723436.56	718295.62
Rotary	G20	723622.36	718199.82
Rotary	G21	723750.29	718164.27
Rotary	G22	724131.18	717889.25
Rotary	G23	723934.27	717921.64
Rotary	G24	723786.25	718048.22
Rotary	G25	723664.69	718398.81

SITE INVESTIGATION CO-ORDINATES

Drill Rig	ID	X Co-ordinate	Y Co-ordinate
Combined Gas/Leachate Monitoring Boreholes			
Rotary	LG01	723643.770	718221.920
Cable Percussive/Rotary	LG02	723692.440	718261.440
Rotary	LG03	723751.300	718307.500
Cable Percussive/Rotary	LG04	723728.580	718362.080
Rotary	LG05	723787.000	718340.400
Rotary	LG06	723716.450	718432.320
Cable Percussive/Rotary	LG07	723798.300	718404.520
Rotary	LG08	723854.760	718376.730
Rotary	LG09	723827.260	718410.840
Cable Percussive/Rotary	LG10	723905.210	718400.280
Cable Percussive/Rotary	LG11	723425.300	718455.260
Rotary	LG12	723436.860	718445.090
Rotary	LG13	723466.520	718463.670
Cable Percussive/Rotary	LG14	723040.800	718343.190
Cable Percussive/Rotary	LG15	722726.870	718288.020
Rotary	LG16	722747.850	718100.420
Cable Percussive/Rotary	LG17	722707.076	718059.122
Rotary	LG18	723040.160	718381.470
Cable Percussive/Rotary	LG19	722742.400	718394.040
Rotary	LG20	722760.540	718333.710
Cable Percussive/Rotary	LG21	722746.330	718045.610
Combined Groundwater/Gas Monitoring Boreholes			
Rotary	BH01	723751.990	718464.300
Rotary	BH03	723833.940	718313.090
Rotary	BH04	723658.950	718159.830
Rotary	BH05	723381.970	718381.360
Rotary	BH06	723028.340	718310.420
Rotary	BH07	722641.500	718220.000
Rotary	BH08	722752.550	718129.880
Rotary	BH09	722746.090	718179.230
Rotary	BH10	722791.600	718279.040
Rotary	BH11	723802.550	718268.990
Rotary	BH13	723633.990	718448.250

LEGEND

- ESB Overhead (38 kv)
- ESB Overhead (110kv)
- ESB Overhead (220kv)
- ESB Overhead (400kv)
- ESB Overhead (LV)
- ESB Overhead (MV)
- ESB Underground (38kv)
- ESB Underground (MV & LV)
- ESB Underground (Spare)
- Extent of Waste
- Special Areas of Conservation (SAC's)

Site Investigation

- MW1 Existing Boreholes
- G01 Gas Monitoring Borehole
- LG01 Combined Gas/Leachate Monitoring Boreholes (Rotary)
- LG02 Combined Gas/Leachate Monitoring Boreholes (Cable Percussive)
- Combined Gas/Leachate Monitoring Boreholes (Cable Percussive with Rotary follow on)
- BH01 Combined Groundwater/Gas Monitoring Boreholes

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Client

Wicklow County Council
County Buildings,
Whitegates,
Wicklow Town

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Rev	Date	Drn	Chk	Amendment / Issue	App
D01	25/02/20	PH	KG	AMENDMENTS	KG
F01	May'16	RH	LD	FINAL ISSUE	CC

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Model File Identifier

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Created on	May 2016
Sheets	01 OF 01
Project	FASSAROE HISTORIC LANDFILL
Title	PLAN SHOWING WASTE EXTENTS & BOREHOLE LOCATIONS
File Identifier	MDR1206-RPS-00-XX-DR-C-DG1002
Status	S3
Rev	D01

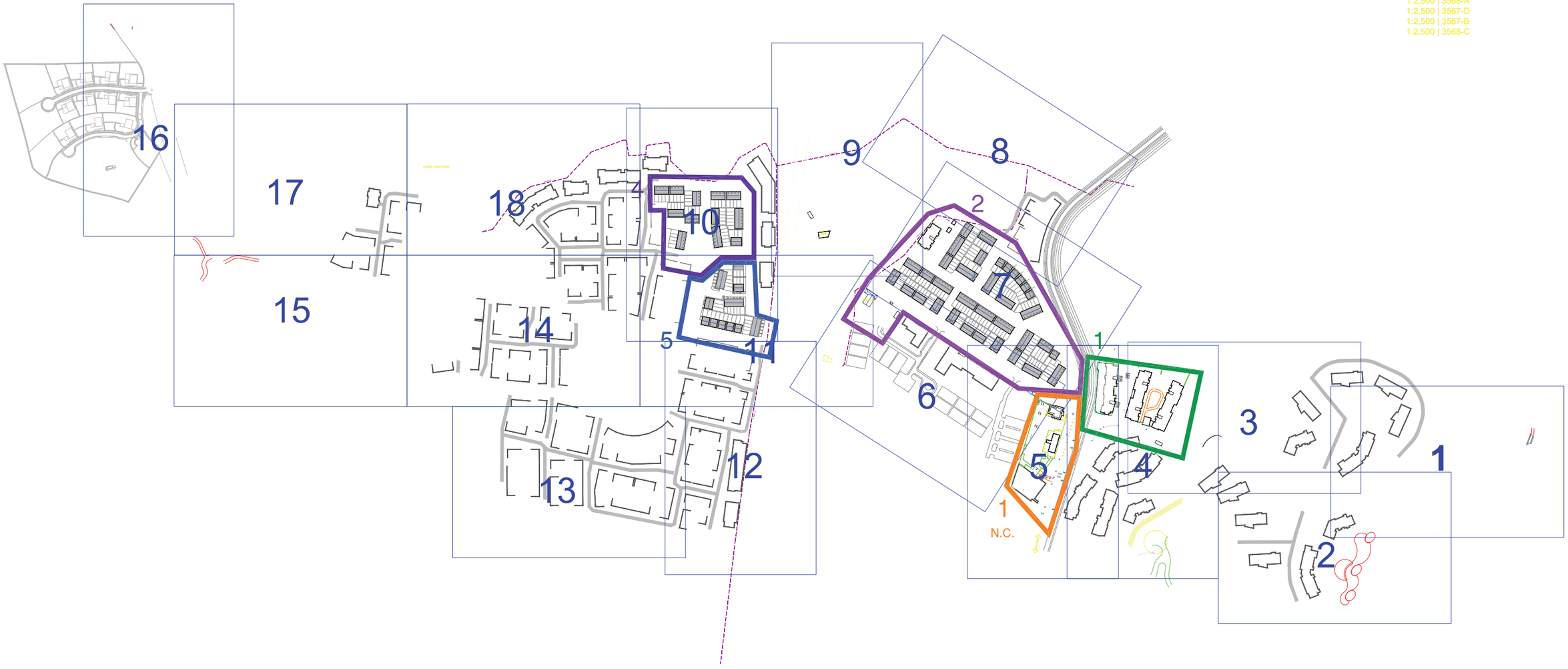
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Appendices

Appendix A

Proposed Development Plans



Proposed Character Areas

Character Area 1

Character Area 1
Neighbourhood Centre

Character Area 2

Character Area 3*
**(Does not form part of this application, for information purposes only.)*

Character Area 4*
**(Partially forms part of this application, future proposal will extend south of Berryfield Lane.)*

Character Area 5*
**(Partially forms part of this application, future proposal will extend south of Berryfield Lane.)*

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LEGEND

- LANDS IN CONTROL OF APPLICANT AND LANDOWNER
- SITE BOUNDARY OF PLANNING APPLICATION
- ZONING LINE
- PROVISION FOR FUTURE BUSWAY / LINK TO OLD CONNA
- INDICATIVE FUTURE DEVELOPMENT
- INDICATIVE FUTURE HOUSING CELL
- LANDFILL REMEDIATION ZONES
- APARTMENT CORE ACCESS
- EXISTING TOPO SURVEY IN GREY

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DATE:	JAN 22
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SCALE:	NTS
REVISION:	-
JOB NO:	15011.1
DRAWING NO:	PL 07

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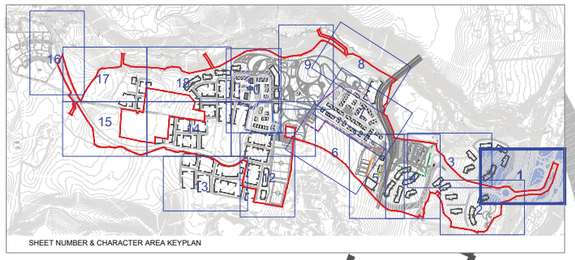
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EXISTING TOPO SURVEY IN GREY



SHEET NUMBER & CHARACTER AREA KEYPLAN

INDICATIVE FUTURE
COMMERCIAL DEVELOPMENT

SUBJECT TO FUTURE PLANNING



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INDICATIVE FUTURE
COMMERCIAL DEVELOPMENT

SUBJECT TO FUTURE PLANNING

INDICATIVE FUTURE
COMMERCIAL DEVELOPMENT

SUBJECT TO FUTURE PLANNING

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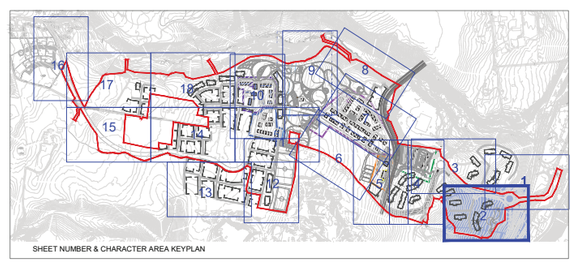
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EXISTING TOPO SURVEY IN GREY



SHEET NUMBER & CHARACTER AREA KEYPLAN

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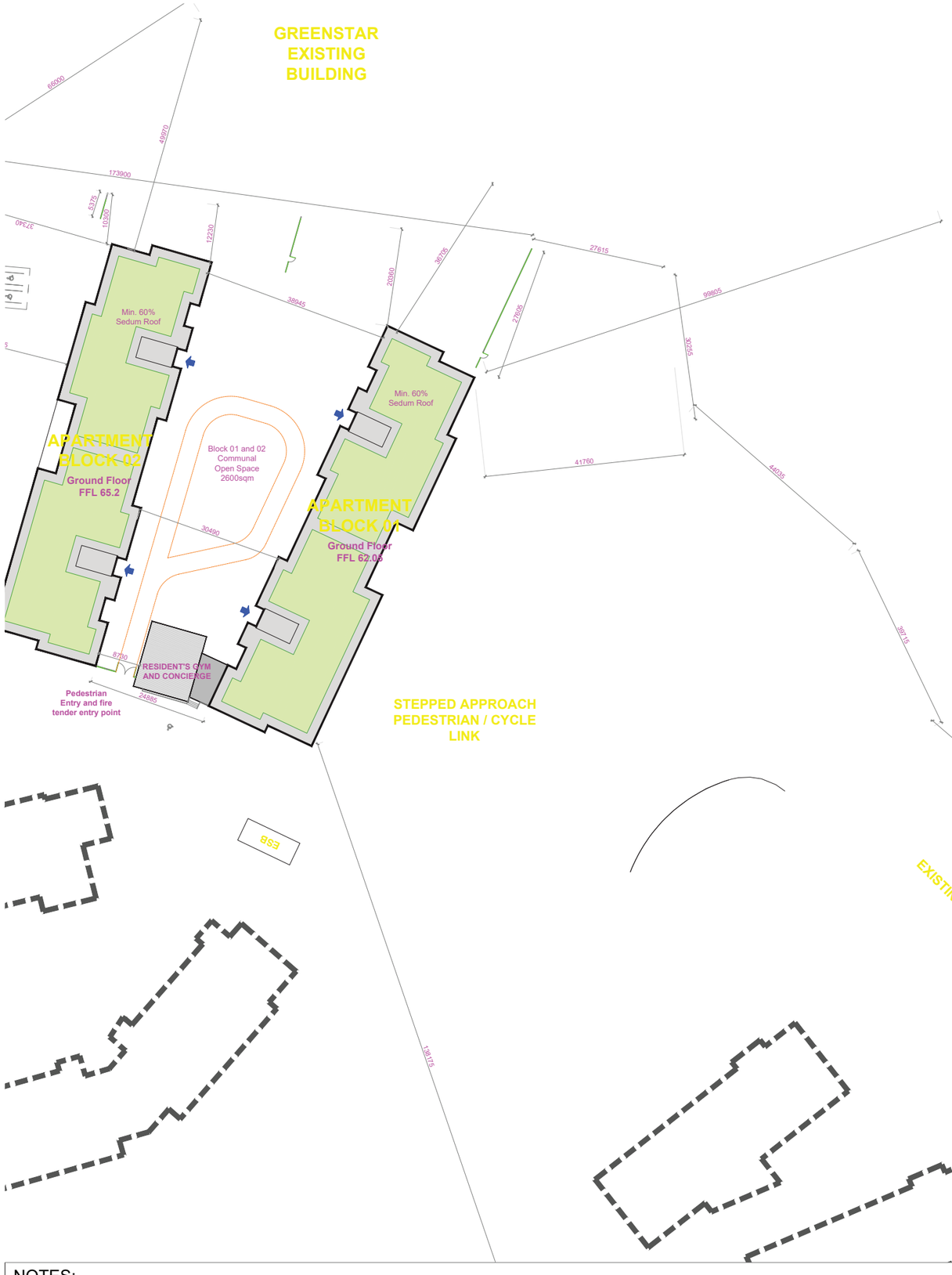
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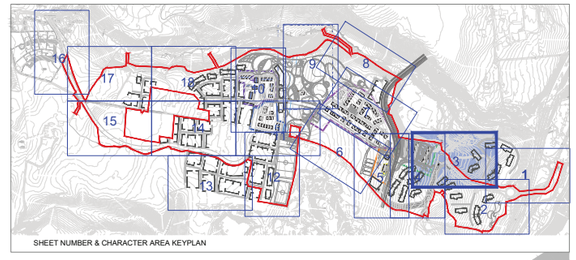
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BUILDING

PROVISION FOR FUTURE BUSWAY AND CONNECTION TO OLD CONNA

Block 03 Communal Open Space 950sqm

Min. 60% Sedum Roof

APARTMENT BLOCK 03

Lower Ground Floor 65.45

Street 02

Min. 60% Sedum Roof

APARTMENT BLOCK 02

Ground Floor FFL 65.2

Block 01 and 02 Communal Open Space 2600sqm

Min. 60% Sedum Roof

APARTMENT BLOCK 01

Ground Floor FFL 62.05

RESIDENT'S GYM AND CONCIERGE

Pedestrian Entry and fire tender entry point

Street 01

STEPPED APPROACH PEDESTRIAN / CYCLE LINK

FUTURE PUBLIC PLAZA SUBJECT TO FUTURE PLANNING APPLICATION

ESB

INDICATIVE FUTURE DEVELOPMENT

SUBJECT TO FUTURE PLANNING APPLICATION

EXISTING WAYLEAVE

LOCATION OF EXISTING ROUNDABOUT TO BE REMOVED

FOR FURTHER DETAILS ON ROADS RECONFIGURATION REFER TO CIVIL DRAWINGS

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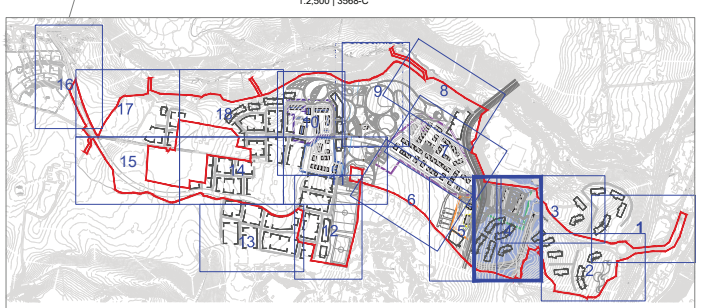
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DRAWING NO: PL11

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Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

TURE SCHOOL
BY OTHERS

ND EDUCATION LANDS

S FOR FUTURE SCHOOL
VELOPMENT

PROVISION FOR FUTURE BUSWAY AND CONNECTION TO OLD CONNA

Street 01

Street 02

Block 03
Communal Open Space 950sqm

Min. 60% Sedum Roof

APARTMENT BLOCK 03

Lower Ground Floor 65.45

ESB

NEIGHBOURHOOD CENTRE

GROUND FLOOR RETAIL
+ 63o. APARTMENTS
ABOVE

Lower Ground Floor / retail 71.05

FUTURE PUBLIC PLAZA
SUBJECT TO FUTURE
PLANNING APPLICATION

FUTURE PHASE 2
NEIGHBOURHOOD
CENTRE

SUBJECT TO FUTURE
PLANNING APPLICATION

INDICATIVE FUTURE
DEVELOPMENT

SUBJECT TO FUTURE
PLANNING APPLICATION

LOCATI
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FOR FURTH
ROADS REC
REFER TO C

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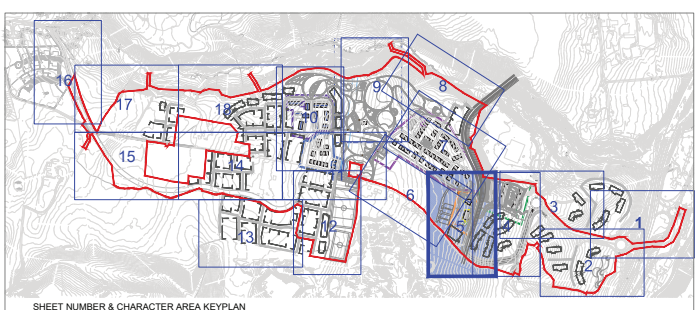
FOR PRIVATE OPEN SPACE (REAR GARDENS) SIZES AND DETAILED INFORMATION ON SPACE PROVISIONS WITHIN HOUSES REFER TO McCrossan O'Rourke Manning architects Design Statement DOCUMENT

LEGEND

- LANDS IN CONTROL OF APPLICANT AND LANDOWNER
- SITE BOUNDARY OF PLANNING APPLICATION
- ZONING LINE
- PROVISION FOR FUTURE BUSWAY / LINK TO OLD CONNA
- INDICATIVE FUTURE DEVELOPMENT
- INDICATIVE FUTURE HOUSING CELL
- LANDFILL REMEDIATION ZONES
- APARTMENT CORE ACCESS

OS Map Series | Map Sheets
1:1,000 | 3568-17
1:1,000 | 3568-22
1:2,500 | 3568-A
1:2,500 | 3567-D
1:2,500 | 3567-B
1:2,500 | 3568-C

EXISTING TOPO SURVEY IN GREY



SHEET NUMBER & CHARACTER AREA KEYPLAN

NOTES:

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REVISIONS

DATE	DESCRIPTION	No.

McCORM
McCROSSAN O'ROURKE MANNING ARCHITECTS

PROJECT TITLE: Fassaroe Phase 1,Co. Wicklow
DRAWING TITLE: PROPOSED SITE LAYOUT PLAN Sheet 5 -Character Area 1-N.C
DATE: JAN 22
DRAWN BY: RS
SCALE: 1:500
REVISION:
JOB NO: 15011.1
DRAWING NO: PL12

1 Grantham Street, Dublin 8, D08 A49Y, Ireland.
Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

Street 02

Street 01

Street 03

CRECHE

FFL 86.880

CRECHE PLAY AREA

creche proposed parking

Vehicular Entry

Bin Store

ESB

FUTURE SCHOOL BY OTHERS

FUTURE SCHOOL BY OTHERS

COMMUNITY AND EDUCATION LANDS

4.27 HECTARES FOR FUTURE SCHOOL DEVELOPMENT

EXISTING BUNGALOW TO BE DEMOLISHED

17800

22200

18395

79795

46460

66150

111315

42020

143110

16705

LEGEND

- LANDS IN CONTROL OF APPLICANT AND LANDOWNER
- SITE BOUNDARY OF PLANNING APPLICATION
- ZONING LINE
- PROVISION FOR FUTURE BUSWAY / LINK TO OLD CONNA
- INDICATIVE FUTURE DEVELOPMENT
- INDICATIVE FUTURE HOUSING CELL
- LANDFILL REMEDIATION ZONES
- APARTMENT CORE ACCESS
- EXISTING TOPO SURVEY IN GREY

OS Map Series | Map Sheets
1:1,000 | 3568-17
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1:2,500 | 3568-C

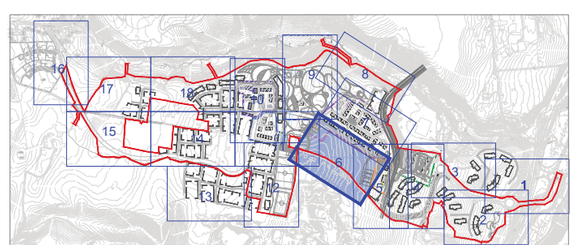
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SHEET NUMBER & CHARACTER AREA KEYPLAN

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DATE	DESCRIPTION	No.

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MK CROSSAN O'ROURKE MANNING ARCHITECTS

PROJECT TITLE: Fassaroe Phase 1, County Wicklow

DRAWING TITLE: PROPOSED SITE LAYOUT PLAN Sheet 6 Character area 2

1, Grantham Street, Dublin 2, Ireland.
Tel: 01-4788700 E-Mail: arch@mcorm.com

DATE:	DRAWN BY:
JAN 22	RS
SCALE: 1:500	REVISION: -
JOB NO: 15011.1	DRAWING NO: PL 13

LEGEND

- LANDS IN CONTROL OF APPLICANT AND LANDOWNER
- SITE BOUNDARY OF PLANNING APPLICATION
- ZONING LINE
- PROVISION FOR FUTURE BUSWAY / LINK TO OLD CONNA
- INDICATIVE FUTURE DEVELOPMENT
- INDICATIVE FUTURE HOUSING CELL
- LANDFILL REMEDIATION ZONES
- APARTMENT CORE ACCESS
- EXISTING TOPO SURVEY IN GREY

OS Map Series | Map Sheets
1:1,000 | 3568-17
1:1,000 | 3568-22
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1:2,500 | 3568-C

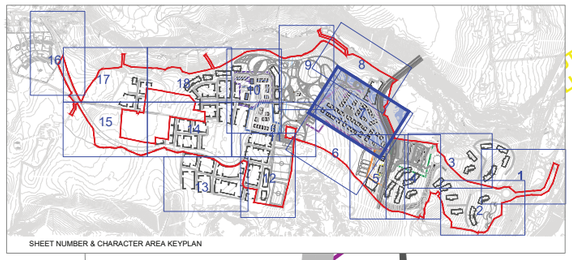
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PROVISION FOR FUTURE BUSWAY AND CONNECTION TO OLD CONNA

ZONING LINE

APARTMENT BLOCK 04
Ground Floor FFL 79.8
Min. 60% Sedum Roof

Visitor Bike Store

Bike / BIN Store

Street 02

Street 03

Street 04

Street 05

Street 06

NODAL HARD LANDSCAPING URBAN PARK 01 0.58 HECTARES

Vehicular Entry

Bin Store

ESB

Min. 60% Sedum Roof

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DATE	DESCRIPTION	No.

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Tel: 01-4788700 E-Mail: arch@mcorm.com

PROJECT TITLE: Fassaroe Phase 1, County Wicklow
DRAWING TITLE: PROPOSED SITE LAYOUT PLAN Sheet 7 Character area 2
DATE: JAN 22
DRAWN BY: RS
SCALE: 1:500
REVISION: -
JOB NO: 15011.1
DRAWING NO: PL 14

LEGEND

- LANDS IN CONTROL OF APPLICANT AND LANDOWNER
- SITE BOUNDARY OF PLANNING APPLICATION
- ZONING LINE
- PROVISION FOR FUTURE BUSWAY / LINK TO OLD CONNA
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- INDICATIVE FUTURE HOUSING CELL
- LANDFILL REMEDIATION ZONES
- APARTMENT CORE ACCESS
- EXISTING TOPO SURVEY IN GREY

OS Map Series | Map Sheets
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1:1,000 | 3568-22
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1:2,500 | 3567-D
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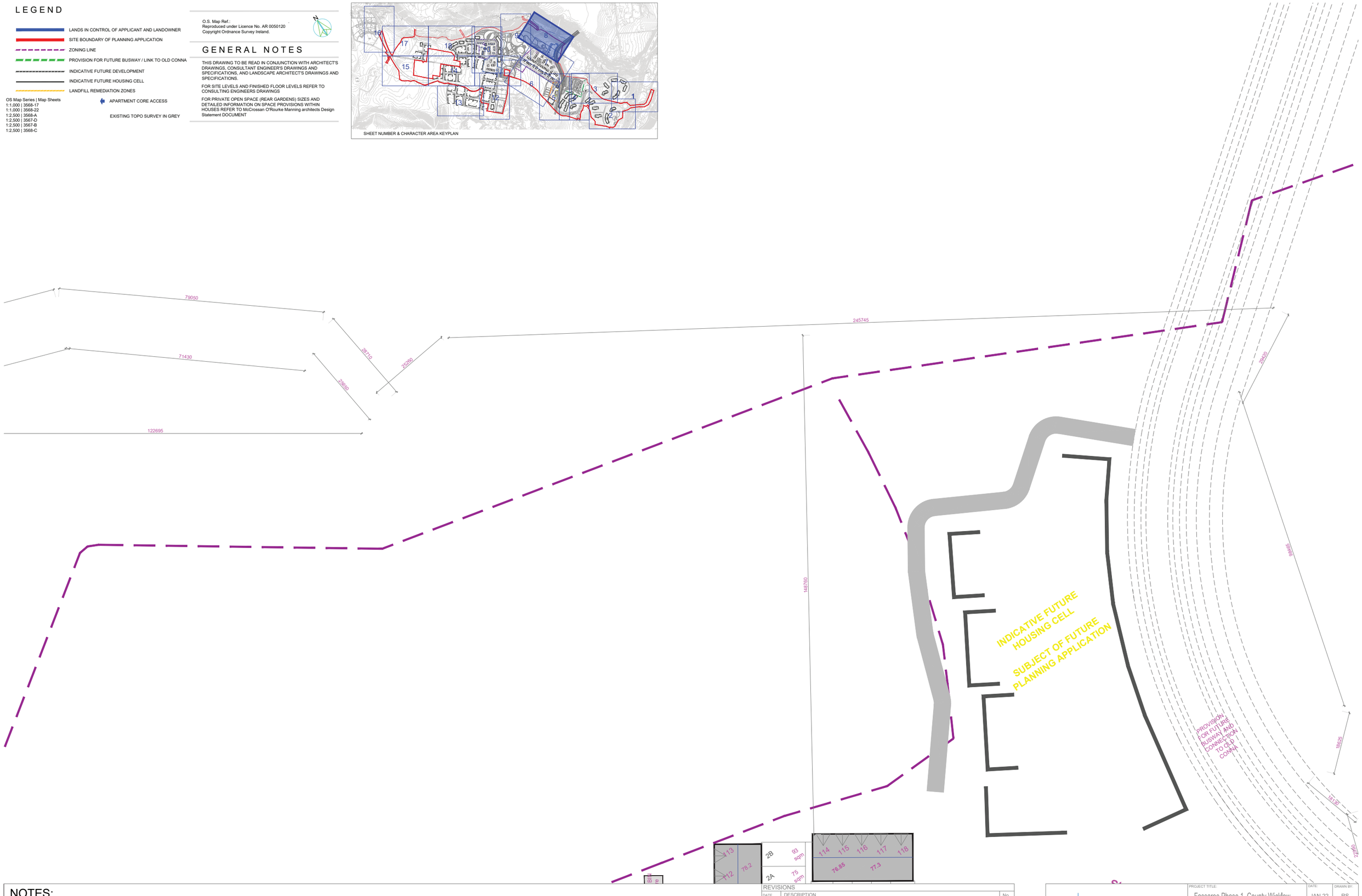
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DRAWING TITLE: PROPOSED SITE LAYOUT PLAN Sheet 8 Character area 2

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Tel: 01-4788700 E-Mail: arch@mcorm.com

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SCALE: 1:500	REVISION: -
JOB NO: 15011.1	DRAWING NO: PL 15

LEGEND

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- SITE BOUNDARY OF PLANNING APPLICATION
- ZONING LINE
- PROVISION FOR FUTURE BUSWAY / LINK TO OLD CONNA
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- INDICATIVE FUTURE HOUSING CELL
- LANDFILL REMEDIATION ZONES
- APARTMENT CORE ACCESS
- EXISTING TOPO SURVEY IN GREY

OS Map Series | Map Sheets
1:1,000 | 3568-17
1:1,000 | 3568-22
1:2,500 | 3568-A
1:2,500 | 3567-D
1:2,500 | 3567-B
1:2,500 | 3568-C

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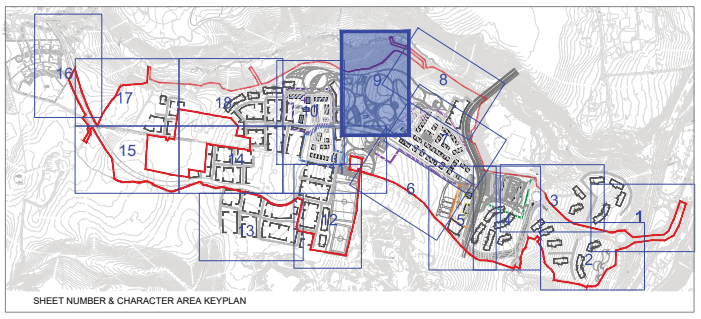
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SHEET NUMBER & CHARACTER AREA KEYPLAN

12960
21845
63750
68845
25920
18015
57130
53270
81605
74975
Proposed pylons
ZONING LINE
EXISTING WAYLEAVE
PROPOSED DISTRICT PARK
PUBLIC OPEN SPACE
INDICATIVE FUTURE
DEVELOPMENT
SUBJECT TO FUTURE
LANNING APPLICATION
ESB
Bring
centre
33 parking spaces including
4 disabled
4 E-char
KIOSK
FFL 87.500
ZONING LINE
79
80
82.9
81
82
83
82.45
2B
2A
2A
93
sqm
78

NOTES:

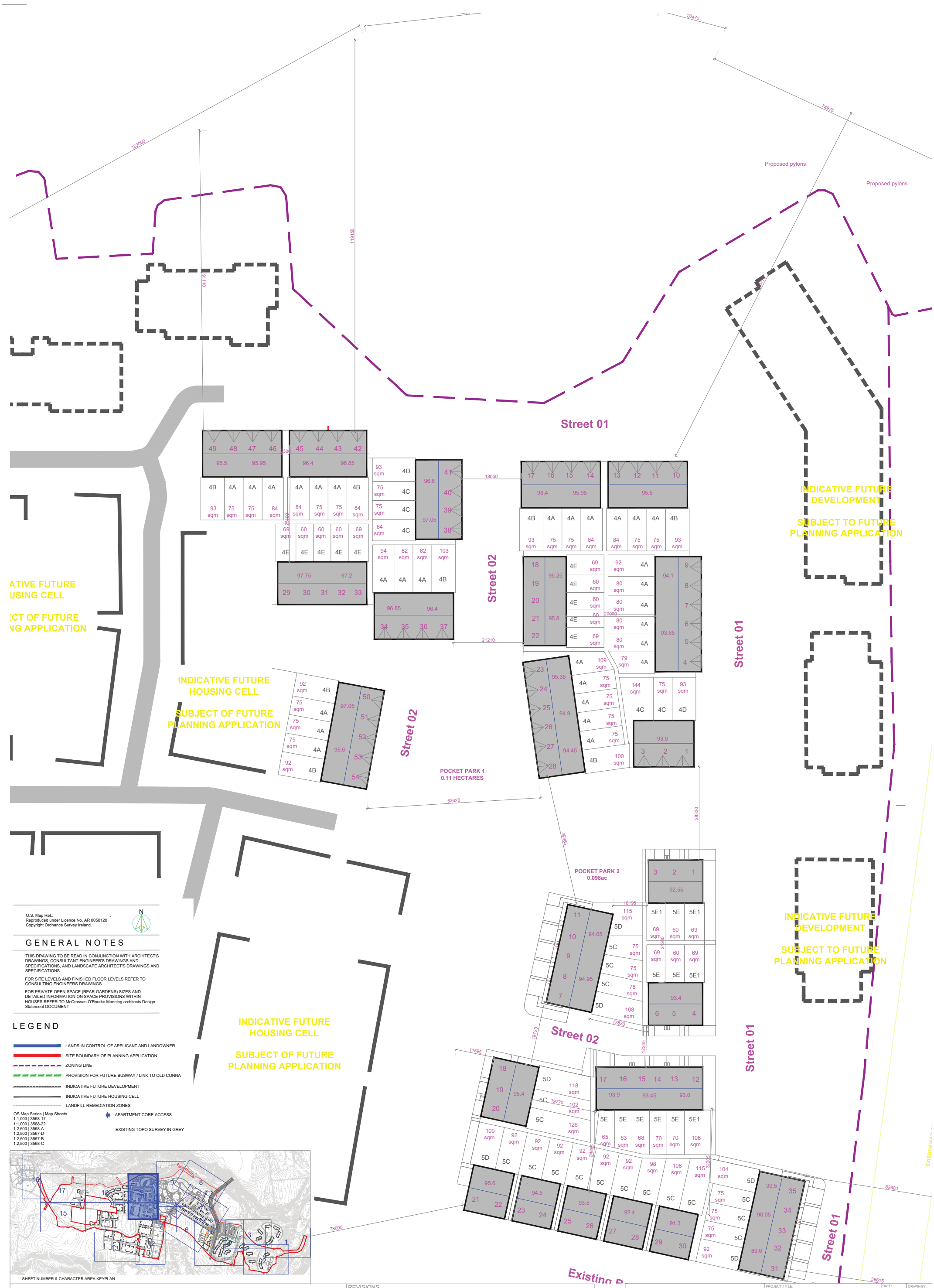
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1 Grantham Street, Dublin 8. D08 A49Y, Ireland.
Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

PROJECT TITLE: Fassaroe phase 1, Co. Wicklow
DRAWING TITLE: PROPOSED SITE LAYOUT PLAN Sheet 9
DATE: JAN 22
DRAWN BY: RS
SCALE: 1:500
REVISION:
JOB NO: 15011.1
DRAWING NO: PL16



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- LANDFILL REMEDIATION ZONES
- APARTMENT CORE ACCESS
- EXISTING TOPO SURVEY IN GREY

OS Map Series | Map Sheets
1:1,000 | 3568-17
1:1,000 | 3568-22
1:2,500 | 3568-A
1:2,500 | 3567-D
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DATE	DESCRIPTION	No.

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Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

PROJECT TITLE:	Fassaroe Phase 1, Co. Wicklow
DRAWING TITLE:	PROPOSED SITE LAYOUT PLAN Sheet 10 -Character Area 4 &5
DATE:	JAN 22
DRAWN BY:	RS
SCALE:	1:500
REVISION:	
JOB NO:	15011.1
DRAWING NO:	PL17

Appendix B

Ground Gas Monitoring and Pumping Trial Results

Day Monday & Tuesday

NOTE: Flow sampling tube is damaged

Date 07/08th March 2016

Weather as per Met Eireann:

Location		Wind		Weather	Temp	Humidity	Rain	Pressure	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Accuweather (Enniskerry)		NNW	15km/h	Mostly cloudy with some rain	3 to 7		1	1004/1005	Monday
Met Eireann (Dub Airport)			9.2	Cloudy			4.1	996	Tuesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady								
Site 1														
Onsite														
LG 11		0	1.4	6.2		9.4	0.082	0.0	10.0	32.7	1.7	0.32	13	
LG 12		0	0.0	6.1		12.7	0.022	0.0	0.0	0.0	1	0.25	12	
LG 13		0	2.1	4.7		14.1	0.114	0.0	0.0	47.9	2.1	0.36	9	
Offsite														
G06	1.8	0.4	16.7	7.6		0.3	0.429	0.0	0.0	>>>	>>	0.21	11	
G07	7.1	6.9	0.0	2.1		17.1	0.011	0.0	0.0	0.0	1	0.2	14	
G08	6.5	6.3	0.0	0.3		19.9	0.011	0.0	0.0	0.0	1	0.26	14	
G10		0	0.0	0.8		19.2	0.011	0.0	0.0	0.0	1	0.12	18	
G18		0	0.0	0.2		19.7	0.014	0.0	0.0	0.0	1	0.13	14	
G19	0.4	0	0.0	0.2		20.0	0.014	0.0	0.0	0.0	1	0.2	14	
BH05		0	0.0	0.0		20.5	0.012	0.0	0.0	0.0	1	0.21	29	
Site 2														
LG 02		0	0.0	0.0		20.0	0.015	0.0	0.0	0.0	1	0.18	9	
LG 03	1.8	0	59.6	20.4		1.0	0.833	0.0	0.0	>>>	>>	0.16	18	
LG 04												0.1	15	Could not open
LG 05	0.9	-4.2	52.9*	23.5		2.3	0.008	0.0	0.0	>>>	>>	0.1	14	Stopped at 5mins
LG 06		0	6.8*	3.6		17.8	0.264	0.0	0.0	>>>	5.3	0.33	6.4	stopped at 6mins
LG 07	0.4	0	9.2*	2.2		16.0	0.003	0.0	10.0	>>>	8		17	stopped at 5mins
LG 08	0.9	0.4	31.4*	16.7		8.6	0.006	0.0	0.0	>>>	>>	0.1	8	Stopped at 5mins
LG 09	1.8	0	0.0	0.1		20.3	0.016	0.0	0.0	0.0	1	0.1	17	
LG 10	0	0	4.8	2.3		18.6	0.213	0.0	0.0	>>>	3.8	0.22	18	Stopped at 5mins
Offsite														
G01		-3.4	0.0	0.0	20.3	20.2	0.014	0.0	0.0	0.0	1	0.44	17.1	
G02	3.9	0	0.0	0.0	20.3	20.1	0.015	0.0	0.0	0.0	1	ground level	19.5	
G03	1	0	0.0	0.0	20.3	20.2	0.014	0.0	0.0	0.0	1	0.15	19.5	
G04	0.4	0	0.0	1.2		14.2	0.016	0.0	0.0	0.0	1	0.35	20	
G05												0.1	20	No gas tap
G13	3.1	-3.6	0.0	0.0		20.0	0.016	0.0	0.0	0.0	1	0.16	20	
G20		0	0.0	0.0		20.1	0.015	0.0	0.0	0.0	1	0.28	20	
G21	4.6	range -0.5 to -3.4	0.0	0.1	20.3	20.0	0.015	0.0	0.0	0.0	1	0.43	17	
G22	20	19.8	0.0	0.0	20.0	19.8	0.017	0.0	0.0	0.0	1	0.33	15	
G23	-1	-6.3	0.0	0.0		20.0	0.016	0.0	0.0	0.0	1	0.1	20	Gas tap open
G24	1.6	-9.4	0.0	0.0		20.0	0.015	0.0	0.0	0.0	1	0.1	20	
G25	0	-0.1	0.0	0.0		20.0	0.021	0.0	0.0	0.0	1	0.3	20	
BH01		0	0.0	0.0		20.1	0.017	0.0	0.0	0.0	1	0.22	21	
BH03	0	-3.8	0.0	0.0	20.3	20.1	0.014	0.0	0.0	0.0	1	0.1	19.5	
BH04	0.4	-11.7	0.0	0.0		20.1	0.015	0.0	0.0	0.0	1	0.27	25.5	
BH11	3.5	-6.4	0.0	0.0	20.4	20.1	0.015	0.0	0.0	0.0	1	0.12	33	
BH13		0	0.0	0.1		20.0	0.021	0.0	0.0	0.0	1	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady								
Site 3A														
Onsite														
LG 15	6.4	5.8	54.7	23.3		-0.2	0.835	0.0	0.0	>>>	>>	0.2	8	Odour noted
LG 19	45.6	45	69.8	30.4		-0.2	0.989	0.0	0.0	>>>	>>	0.36	15	Odour noted
LG 20	7.6	7.5	51.7	27.3		2.6	0.806	0.0	0.0	>>>	>>	0.49	12	
MW3 (19 dia. Pipe)			69.1	31.3		-0.3	0.981	0.0	0.0	>>>	>>	~0.5	11	No gas tap
MW3 (50 dia. Pipe)			5.6	2.4		18.2	0.236	0.0	0.0	>>>	4.3	1.04	18.1	Gas tap broken - no flow taken
MW4	44.8	43.5	71.5	28.5		-0.3	0.998	0.0	0.0	>>>	>>	1	10	Odour noted
Offsite														
G12	0.4	0	0.0	0.0		20.6	0.016	0.0	0.0	0.0	1	0.2	14	
G14		0	0.0	1.1		18.1	0.014	0.0	0.0	0.0	1	0.38	14	
BH07	1.6	0.6	0.0	1.1		17.9	0.014	0.0	0.0	0.0	1	0.26	21	
BH09	1.9	0	0.0	0.9		16.7	0.015	0.0	0.0	0.0	1	0.19	12	
BH10	2.2	1.6	0.0	0.9		18.4	0.016	0.0	0.0	0.0	1	0.19	14	
Site 3B														
Onsite														
LG 16	3.4	3.3	70.1	29.9		-0.1	0.976	0.0	0.0	>>>	>>	0.24	3.5	
LG 17			65.1	34.2		-0.2	0.931	0.0	10.0	>>>	>>	0.26	3.9	No gas tap therefore no flow taken. Sample taken with cap removed
LG 21			63.0	36.6		-0.2	0.912	0.0	0.0	>>>	>>	0.28	4	No gas tap - no flow. Sample taken with tap off
Offsite														
G15		0	0.0	1.7		18.0	0.014	0.0	0.0	0.0	1	0.28	6	
G16		0	0.0	0.7		19.4	0.015	0.0	0.0	0.0	1	0.34	6	
G17		0	0.0	0.8		18.4	0.015	0.0	0.0	0.0	1	0.37	6	
BH08		0	0.0	3.1		16.1	0.018	0.0	0.0	0.0	1	0.8	13.5	
Site 3C														
Onsite														
MW2			25.8	12.3		12.4	0.542	0.0	0.0	>>>	>>	0.75	5	Old coroded gas tap. Rubber bung taken off when monitoring. Odour noted
LG 14	2.8	0.6	73.0	26.3		-0.1	0.997	0.0	0.0	>>>	>>	0.37	12	Flow still fluctuating. Odour noted
LG 18	2.1	1	68.2	31.9		-0.2	0.971	25.0	0.0	>>>	>>	0.38	10	Tap open - closed and left for 10mins and then measurements taken. Odour noted
Offsite														
G09	0.3	0	12.9	8.1		2.4	0.374	0.0	0.0	>>>	>>	0.42	14	
G11		0	0.0	0.1		20.1	0.013	0.0	0.0	0.0	1	0.27	15	
BH06		0	12.8	12.9		4.5	0.373	0.0	0.0	>>>	>>	ground level	14	

Day Tuesday & Wednesday
Date 15/16th March 2016
Weather as per Met Eireann:

Location		Wind		Weather	Temp	Humidity	Rain	Pressure (measured on site)		
								Morning	Evening	
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)		
Accuweather (Enniskerry)		E	10mph	cloudy, mild, dry	9.00	62	0	1018		Tuesday
Met Eireann (Dublin Airport)		NE	12Kts	Cloudy	8	81	0	1020	1020	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11		0	0.0	0.7	20.1	19.2	0.021	0.0	0.0	0.0	1	11.77	0.32	13	
LG 12		0	0.0	1.9	18.9	18.7	0.012	0.0	0.0	0.0	1	dry	0.25	12	
LG 13		0	0.6	2.4	19.9	16.8	0.049	0.0	0.0	14.6	1.2	9.47	0.36	9	
Offsite															
G06	0.9	0	14.1	8.1		-0.3	0.389	0.0	0.0	>>>	>>	dry	0.21	11	silty
G07	0	-0.3 to -0.7	0.0	0.0		20.2	0.014	0.0	0.0	0.0	1	dry	0.2	14	
G08		-3.1	0.0	0.1		20.2	0.013	0.0	0.0	0.0	1	dry	0.26	14	sand
G10		0	0.0	0.9		18.8	0.013	0.0	0.0	0.0	1	9.22	0.12	18	
G18		0	0.0	0.3		19.8	0.013	0.0	0.0	0.0	1	dry	0.13	14	
G19		0	0.0	0.5		19.4	0.013	0.0	0.0	0.0	1	7.94	0.2	14	
BH05	1.6	0	0.0	0.0		20.2	0.014	0.0	0.0	0.0	1	20.43	0.21	29	
Site 2															
LG 02	2.8	2.4	51.3	21.1		1.5	0.794	0.0	0.0	>>>	>>	8.1	0.18	9	
LG 03	4	4	62.9	19.6		0.4	0.902	0.0	0.0	>>>	>>	12.93	0.16	18	
LG 04		0	5.0	5.1		13.4	0.218	0.0	10.0	>>>	3.9	11.92	0.1	15	
LG 05	6.5	6.3	66.1	27.1		-0.2	0.929	0.0	0.0	>>>	>>	13.91	0.1	14	
LG 06	2.8	2.7	56.7	26.9	17.7	1.7	0.846	0.0	0.0	>>>	>>	cap stuck - no wl reading	0.33	6.4	
LG 07	2.1	1.5/1.6 (fluctuating)	22.2	7.3		11.6	0.492	0.0	0.0	>>>	>>	~10.4		17	leachate - reading inconsistent
LG 08	4.3	4	42.4	22.8		3.5	0.701	0.0	0.0	>>>	>>	~7.73	0.1	8	leachate - reading inconsistent
LG 09	0.9	0	1.9	1.9		18.3	0.108	0.0	0.0	45.2	1	~9.75	0.1	17	leachate - reading inconsistent
LG 10	3.9	3.5	52.4	23.4	17.3	0.1	0.804	0.0	0.0	>>>	>>	~12.2	0.22	18	leachate - reading inconsistent
Offsite															
G01		0	0.0	0.2	20.3	19.9	0.014	0.0	0.0	0.0	1	dry	0.44	17.1	sand on probe
G02	3.3	3.2	0.0	2.1 (still rising)	19.7	16.9	0.013	0.0	0.0	0.0	1	dry	ground level	19.5	
G03	4.2	4	0.2	3.4	16.4	12.4	0.038	0.0	0.0	5.2	1	dry	0.15	19.5	
G04	0.1	0	0.0	1.7		11.8	0.014	0.0	0.0	0.0	1	8.76	0.35	20	
G05		0	0.0	0.1		20.4	0.018	0.0	0.0	0.0	1	16.06	0.1	20	
G13	5.8	5.6	0.0	0.2	20.2	19.9	0.014	0.0	0.0	0.0	1	dry	0.16	20	
G20		0	0.0	0.1		20.2	0.014	0.0	0.0	0.0	1	14.43	0.28	20	
G21		0	0.0	0.4	20.0	19.8	0.015	0.0	0.0	0.0	1	dry	0.43	17	
G22		0	0.0	0.5	19.9	19.1	0.013	0.0	0.0	0.0	1		0.33	15	gas tap stuck
G23	3.5	3.4	0.0	0.5	20.0	19.6	0.012	0.0	0.0	0.0	1		0.1	20	gas tap stuck
G24	7.9	7.4	0.0	0.9		18.3	0.012	0.0	0.0	0.0	1	dry	0.1	20	
G25		0	13.4	2.6		14.1	0.378	0.0	0.0	0.0	1	dry	0.3	20	
BH01		0	0.0	0.0		20.1	0.014	0.0	0.0	0.0	1	14.38	0.22	21	
BH03	6	5.8	1.0	1.6	18.8	17.5	6.400	0.0	0.0	23.8	1.5	dry	0.1	19.5	
BH04	0	-3.3	0.0	0.0		20.1	0.015	0.0	0.0	0.0	1	dry	0.27	25.5	probe silty
BH11	6.9	6.3	16.3	13.3	12.4	3.0	0.420	0.0	0.0	>>>	>>	dry	0.12	33	
BH13	2.4	1.5	19.2	7.4		-0.3	0.456	0.0	0.0	>>>	>>	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	3.3	1.5	54.5	24.6		-0.3	0.826	0.0	0.0	>>>	>>	7.08	0.2	8	
LG 19	31.3	29.4	70.1	30.2		-0.3	0.989	0.0	0.0	>>>	>>	14.48	0.36	15	
LG 20	4.2	4	61.7	31.1		-0.1	0.892	0.0	0.0	>>>	>>	dry	0.49	12	
MW3 (19 dia. Pipe)			69.6	30.7		-0.3	0.980	25.0	0.0	>>>	>>		~0.5	11	unable to take flow measurement due to sample tube not long enough
MW3 (50 dia. Pipe)													1.04	18.1	not sampled
MW4	29.2	26.9	71.0	29.3		-0.3	0.992	25.0	0.0	>>>	>>	7.63	1	10	
Offsite															
G12		0	0.0	0.0	20.3	20.2	0.013	0.0	0.0	0.0	1	10.13	0.2	14	
G14		0	0.0	0.8		18.7	0.012	0.0	0.0	0.0	1	7.53	0.38	14	
BH07		-0.1	0.0	0.0		20.0	0.015	0.0	0.0	0.0	1	13.71	0.26	21	
BH09		0	0.0	0.5		18.8	0.013	0.0	0.0	0.0	1	6.43	0.19	12	
BH10		0	0.0	0.1	20.1	20.0	0.013	0.0	0.0	0.0	1	8.43	0.19	14	
Site 3B															
Onsite															
LG 16	1.3	0.6/0.7	69.8	30.3		-0.1	0.963	0.0	0.0	>>>	>>	3.33	0.24	3.5	
LG 17													0.26	3.9	not sampled
LG 21													0.28	4	not sampled
Offsite															
G15		0	0.0	2.0		17.4	0.013	0.0	0.0	0.0	1	5.41	0.28	6	fence posts damaged by cattle in field
G16		0	0.0	1.1		18.4	0.012	0.0	0.0	0.0	1	4.08	0.34	6	
G17		0	0.0	1.4		15.9	0.013	0.0	0.0	0.0	1	dry	0.37	6	silty
BH08		0	0.0	1.8		17.5	0.012	0.0	0.0	0.0	1	6.61	0.8	13.5	
Site 3C															
Onsite															
MW2		0	26.5	18.2		10.0	0.540	40.0	0.0	>>>	>>	5	0.75	5	replaced old seized tap - left for 10 mins and sampled
LG 14	1.6	1	74.0	26.2		-0.3	1.016	25.0	0.0	>>>	>>	9.66	0.37	12	flow fluctuating
LG 18	1.3	0/0.1	67.8	32.4		-0.3	0.966	30.0	0.0	>>>	>>	10	0.38	10	silty
Offsite															
G09		0	0.0	0.4		19.8	0.023	0.0	0.0	0.0	1	12.3	0.42	14	
G11		0	0.0	0.9		17.4	0.013	0.0	0.0	0.0	1	9.83	0.27	15	
BH06		0	12.9	10.7		7.2	0.370	0.0	0.0	>>>	>>	5.53	ground level	14	

Day Tuesday & Wednesday
Date 22/23rd March 2016
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured on site) Morning (hPa)	Evening (hPa)	
Dublin airport (met eireann)		E	4	Cloudy	8.00	69	0	1005	1003	Tuesday
Dublin airport (met eireann)		SW	13	Fair	10	68	0	1003	1005	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11	0	0	1.7	5.6	20.0	11.8	0.095	0.0	0.0	39.6	1.8	11.91	0.32	13	
LG 12	0	0	1.5	13.4	19.3	4.1	0.086	0.0	0.0	34.7	1.7	Dry	0.25	12	
LG 13	0	0	6.9	14.7	19.2	4.7	0.265	0.0	0.0	100+	5.4	9.4	0.36	9	
Offsite															
G06	3.1	3	13.8	7.9	18.0	-0.2	0.388	0.0	0.0	>>>	>>	Dry	0.21	11	
G07	3.1	3	0.0	3.3	20.1	15.7	0.014	0.0	0.0	0.0	1	dry	0.2	14	
G08	4.2	4.1	0.0	0.0		20.2	0.015	0.0	0.0	0.0	1	dry	0.26	14	
G10	0.1	0	0.0	1.5	19.6	18.2	0.012	0.0	0.0	0.0	1	9.24	0.12	18	
G18	0.4	0.3	0.0	0.8	19.7	18.1	0.013	0.0	0.0	0.0	1	dry	0.13	14	
G19	0	0	0.0	1.0	19.8	17.9	0.013	0.0	0.0	0.0	1	7.97	0.2	14	
BH05	0	0	0.0	0.3		19.9	0.015	0.0	0.0	0.0	1	20.07	0.21	29	
Site 2															
LG 02	0.6	0.1	54.4	22.0	18.0	2.0	0.829	0.0	0.0	>>>	>>	8.17	0.18	9	
LG 03	4.3	4.2	65.6	21.5	16.4	-0.2	0.931	0.0	0.0	>>>	>>	~15	0.16	18	water level reading approx due to presence of leachate
LG 04	0	0	21.7	11.8	17.7	10.0	0.490	0.0	0.0	>>>	>>	11.97	0.1	15	
LG 05	7.1	7	65.5	27.5	11.5	-0.3	0.929	0.0	0.0	>>>	>>	13.78	0.1	14	
LG 06	3.4	0	64.0	28.5	18.1	-0.1	0.918	0.0	0.0	>>>	>>	6.62	0.33	6.4	
LG 07	3.3	3.3	63.1	25.1	15.4	-0.1	0.909	0.0	0.0	>>>	>>	~10		17	water level reading approx due to presence of leachate
LG 08	4.9	4.6	57.9	29.3	14.9	-0.2	0.863	0.0	0.0	>>>	>>	~7.8	0.1	8	water level reading approx due to presence of leachate
LG 09	3.4	3	61.6	23.5	15.6	-0.1	0.896	0.0	0.0	>>>	>>	10.98	0.1	17	water level reading approx due to presence of leachate
LG 10	3.9	0	58.7	24.4	18.5	-0.3	0.870	0.0	0.0	>>>	>>	17.5	0.22	18	water level reading approx due to presence of leachate
Offsite															
G01	3.9	3.8	0.0	4.9	17.0	11.8	0.010	0.0	0.0	0.0	1	dry	0.44	17.1	
G02	2.4	1.8	0.0	6.8	18.1	8.7	0.011	0.0	0.0	0.0	1	Dry	ground level	19.5	
G03	4.3	4.2	4.5	10.5		1.1	0.204	0.0	0.0	>>>	3.8		0.15	19.5	
G04	0	0	0.0	1.6	19.1	11.6	0.014	0.0	0.0	0.0	1	9.05	0.35	20	
G05	0.4	0.1	12.7	2.0	17.9	12.2	0.370	0.0	0.0	>>>	>>	16.16	0.1	20	
G13	6.7	6.4	0.0	0.7	20.1	19.1	0.011	0.0	0.0	0.0	1	dry	0.16	20	
G20	3	2.8	0.0	0.8	17.8	15.7	0.013	0.0	0.0	0.0	1	14.41	0.28	20	
G21	3.7	3.4	0.0	1.6	19.5	17.0	0.009	0.0	0.0	0.0	1	dry	0.43	17	
G22	0	0	0.0	0.7	20.2	18.9	0.012	0.0	0.0	0.0	1		0.33	15	gas tap stuck
G23	0.1	0	0.0	0.8	19.9	19.3	0.012	0.0	0.0	0.0	1		0.1	20	gas tap stuck
G24	8.4	8.4	0.0	1.0	18.8	17.0	0.011	0.0	0.0	0.0	1	dry	0.1	20	
G25	1.2	0.9	30.7	7.3	17.0	5.0	0.593	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	1	0.7	0.0	2.2	20.2	14.1	0.012	0.0	0.0	0.0	1	14.14	0.22	21	
BH03	5.8	5	8.6	7.1	16.8	8.0	0.300	0.0	0.0	>>>	7.3	dry	0.1	19.5	
BH04	11.4	10.8	0.0	1.8	12.7	7.2	0.013	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11	7.5	6.7	5.2	12.6	12.9	2.3	0.224	0.0	0.0	>>>	4	dry	0.12	33	
BH13	2.2	1.5	18.0	7.7	16.0	0.0	0.445	0.0	0.0	>>>	>>	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	4.3	4.2	52.9	26.8		-0.2	0.814	0.0	0.0	>>>	>>	7.13	0.2	8	
LG 19	35.1	33.7	70.4	29.7	6.5	-0.2	0.991	0.0	0.0	>>>	>>	~14.27	0.36	15	water level reading approx due to presence of leachate
LG 20	3.1	3	46.7	26.7	19.2	-0.2	0.751	0.0	10.0	>>>	>>	dry	0.49	12	
MW3 (19 dia. Pipe)			69.6	30.5		-0.1	0.984	25.0	0.0	>>>	>>	~9.5	~0.5	11	water level reading approx due to presence of leachate
MW3 (50 dia. Pipe)	0.6	0	13.8	5.7		12.7	0.387	0.0	0.0	>>>	>>	15.96	1.04	18.1	not sampled
MW4	34	31.8	68.3	31.9	7.0	-0.2	0.976	30.0	0.0	>>>	>>	~7.71	1	10	water level reading approx due to presence of leachate
Offsite															
G12	0	0	0.0	0.6	19.5	19.2	0.016	0.0	0.0	0.0	1	10.29	0.2	14	muddy water on dip meter probe
G14	0	0	0.0	0.8	19.9	18.7	0.014	0.0	0.0	0.0	1	7.63	0.38	14	
BH07	1.5	0.6	0.0	1.0	19.6	18.6	0.013	0.0	0.0	0.0	1	13.76	0.26	21	
BH09	0	0	0.0	0.9	20.1	18.9	0.013	0.0	0.0	0.0	1	6.57	0.19	12	
BH10	0	0	0.0	0.6	20.3	19.2	0.015	0.0	0.0	0.0	1	8.5	0.19	14	
Site 3B															
Onsite															
LG 16	3.3	3.2	67.9	31.7	17.3	0.0	0.951	0.0	0.0	>>>	>>	3.33	0.24	3.5	
LG 17	4.6	4.5	67.0	33.2	17+	-0.2	0.960	0.0	0.0	>>>	>>	3.61	0.26	3.9	not sampled
LG 21	0.7	0.4	63.5	36.6	16.7	-0.2	0.922	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	0	0	0.0	2.3	19.5	16.6	0.012	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	0.8	20.0	19.6	0.015	0.0	0.0	0.0	1	4.11	0.34	6	
G17	0	0	0.0	1.5	19.5	16.2	0.013	0.0	0.0	0.0	1	dry	0.37	6	
BH08	0	0	0.0	2.4	19.6	16.4	0.012	0.0	0.0	0.0	1	6.92	0.8	13.5	
Site 3C															
Onsite															
MW2	3.5	1.6	69.5	30.3	17.7	0.0	0.973	25.0	0.0	>>>	>>	5.17	0.75	5	
LG 14	2.2	1.9	74.1	26.1	20.0	-0.2	1.017	40.0	0.0	>>>	>>	9.67	0.37	12	
LG 18	1	0.9	68.1	32.1	17.7	-0.2	0.970	40.0	0.0	>>>	>>	~10	0.38	10	water level reading approx due to presence of leachate
Offsite															
G09	0	0	9.2	7.9	18.6	2.2	0.311	0.0	0.0	>>>	8	12.38	0.42	14	
G11	0	0	0.0	0.9		18.8	0.015	0.0	0.0	0.0	1	9.87	0.27	15	
BH06	0	0	18.1	16.6	17.8	1.1	0.446	0.0	0.0	>>>	>>	5.57	ground level	14	

Day Tuesday & Wednesday
Date 29/30th March 2016
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured on site) Morning (hPa)	Evening (hPa)	
Dublin airport (met eireann)		SW	6	Fine	3	80	0	987	983	Tuesday
Dublin airport (met eireann)		NW	13 gust 30	Rain Shower	6	83	1.2	991	996	Wednesday

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 1															
Onsite															
LG 11	0	0	0.0	0.8		19.3	0.026	0.0	0.0	0.0	1	11.79	0.32	13	
LG 12	0	0	0.0	4.5	20.3	16.2	0.011	0.0	0.0	0.0	1	dry	0.25	12	
LG 13	0	0	1.7	6.2		13.4	0.096	0.0	0.0	39.6	1.8	9.48	0.36	9	
Offsite															
G06	1	0.4	22.2	7.2	19.3	0.6	0.501	0.0	0.0	>>>	>>	dry	0.21	11	
G07	0	0	0.0	0.0		20.4	0.012	0.0	0.0	0.0	1	dry	0.2	14	
G08	0	0	0.0	0.1	20.4	20.2	0.013	0.0	0.0	0.0	1	dry	0.26	14	
G10	0	0	0.0	0.3		20.1	0.012	0.0	0.0	0.0	1	9.27	0.12	18	
G18	0	0	0.0	0.5		19.5	0.012	0.0	0.0	0.0	1	7.97	0.13	14	
G19	0	0	0.0	0.2		20.0	0.014	0.0	0.0	0.0	1	dry	0.2	14	
BH05	0	0	0.0	0.8	20.2	19.4	0.010	0.0	0.0	0.0	1	20.1	0.21	29	
Site 2															
LG 02	0	0	36.4	15.1		7.7	0.654	0.0	0.0	>>>	>>	8.21	0.18	9	
LG 03		-1	26.6	11.7	19.8	11.0	0.554	0.0	0.0	>>>	>>	13.19	0.16	18	fluctuating -1.9 to -0.7
LG 04	0	0	0.0	0.0		20.3	0.016	0.0	0.0	0.0	1	12.13	0.1	15	
LG 05	0	-0.4	45.2	19.9	19.4	5.7	0.740	0.0	0.0	>>>	>>	13.73	0.1	14	
LG 06	0.9	0	31.8	15.2	19.6	9.7	0.609	0.0	0.0	>>>	>>	6.59	0.33	6.4	
LG 07	0	0	67.8	24.1	19.9	0.5	0.956	0.0	0.0	>>>	>>	11		17	
LG 08	-1.3	0	0.0	0.0	20.4	20.3	0.014	0.0	0.0	0.0	1	7.78	0.1	8	
LG 09	0	0	0.0	0.0		20.2	0.017	0.0	0.0	0.0	1	10.83	0.1	17	
LG 10	0	0	17.0	7.4	20.2	14.7	0.437	0.0	0.0	>>>	>>	~13.58	0.22	18	water level reading approx due to presence of leachate
Offsite															
G01		-9	0.0	0.0	20.4	20.2	0.015	0.0	0.0	0.0	0.1	dry	0.44	17.1	
G02	0	-3.3	0.0	0.0		20.1	0.015	0.0	0.0	0.0	1	dry	ground level	19.5	
G03		-4.2	0.0	0.0		20.2	0.013	0.0	0.0	0.0	1	dry	0.15	19.5	
G04	0	0	0.0	1.7	19.5	10.3	0.014	0.0	0.0	0.0	1	9.48	0.35	20	
G05	0	0	0.0	0.0		20.3	0.014	0.0	0.0	0.0	1	16.23	0.1	20	
G13	0	-6.2	0.0	0.0		20.2	0.014	0.0	0.0	0.0	1	dry	0.16	20	
G20	0	-0.9	0.0	0.0		20.1	0.014	0.0	0.0	0.0	1	14.45	0.28	20	
G21		-7.6	0.0	0.2	20.3	20.0	0.015	0.0	0.0	0.0	1	dry	0.43	17	
G22	0	0	0.0	0.1		20.1	0.014	0.0	0.0	0.0	1	gas tap stuck	0.33	15	
G23		-1.3	0.0	0.0	20.4	20.2	0.014	0.0	0.0	0.0	1	gas tap stuck	0.1	20	
G24		-13.7	0.0	0.0		20.2	0.015	0.0	0.0	0.0	1	dry	0.1	20	
G25	0	0	12.4	2.0	19.7	14.3	0.369	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	0.1	-0.4	0.0	0.0		20.2	0.016	0.0	0.0	0.0	1	14.49	0.22	21	
BH03		-9	0.0	0.5	20.3	19.5	0.033	0.0	0.0	0.0	1	dry	0.1	19.5	
BH04		-17.8	0.0	0.0		20.2	0.016	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11		-14.1	0.0	0.0		20.1	0.014	0.0	0.0	0.0	1	dry	0.12	33	
BH13	2.2	1.9	9.9	3.3	19.0	11.6	0.326	0.0	0.0	>>>	8.8	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	0.1	0	47.5	20.1		2.3	0.763	0.0	0.0	>>>	>>	7.06	0.2	8	
LG 19	21	20.1	70.4	29.7	9.0	-0.2	0.988	0.0	0.0	>>>	>>	~14.33	0.36	15	
LG 20	0	-1.3	22.6	12.3	19.7	12.7	0.503	0.0	0.0	>>>	>>	dry	0.49	12	
MW3 (19 dia. Pipe)	no cap		10.4	5.6		17.5	0.334	0.0	0.0	>>>	9.5	10.36	~0.5	11	
MW3 (50 dia. Pipe)	0	0	8.4	3.1	19.1%	12.9	0.297	0.0	0.0	>>>	7.1	16.13	1.04	18.1	not sampled
MW4	27	25.8	69.0	31.1	9.0	-0.2	0.979	40.0	0.0	>>>	>>	7.32	1	10	
Offsite															
G12	0	0	0.0	0.0		20.4	0.014	0.0	0.0	0.0	1	10.44	0.2	14	
G14	1.2	0	0.0	1.3	19.1	18.2	0.012	0.0	0.0	0.0	1	7.75	0.38	14	
BH07	0	0	0.0	0.5	20.1	19.6	0.013	0.0	0.0	0.0	1	13.81	0.26	21	
BH09	0	0	0.0	0.4		19.8	0.014	0.0	0.0	0.0	1	6.75	0.19	12	
BH10	0	0	0.0	1.6	19.8	18.6	0.012	0.0	0.0	0.0	1	8.61	0.19	14	
Site 3B															
Onsite															
LG 16	0	0	42.2	22.3	18.9	5.7	0.707	0.0	0.0	>>>	>>	3.34	0.24	3.5	
LG 17	0	0	67.7	31.6	19.9	0.3	0.954	0.0	0.0	>>>	>>	3.66	0.26	3.9	not sampled
LG 21	0	0	25.8	17.2	18.3	10.9	0.543	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	0.1	0	0.0	0.9	20.1	18.4	0.013	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	1.8	19.4	18.0	0.012	0.0	0.0	0.0	1	4.18	0.34	6	
G17	0	0	0.0	0.5	19.8	19.6	0.015	0.0	0.0	0.0	1	dry	0.37	6	
BH08	0	0	0.0	3.9	18.9	15.2	0.014	0.0	0.0	0.0	1	7.09	0.8	13.5	
Site 3C															
Onsite															
MW2	0	0	63.9	31.2	17.5	1.1	0.921	0.0	0.0	>>>	>>	4.81	0.75	5	
LG 14	0.7	0	72.6	27.5	18.0	-0.2	1.001	40.0	0.0	>>>	>>	9.99	0.37	12	
LG 18	3	0	67.8	32.3	18.9	-0.2	0.969	40.0	0.0	>>>	>>	10.02	0.38	10	
Offsite															
G09	0	0	0.0	0.1		20.3	0.014	0.0	0.0	0.0	1	12.47	0.42	14	
G11	3.4	0	0.0	0.0		20.3	0.011	0.0	0.0	0.0	1	10	0.27	15	
BH06	1.8	0	21.2	17.1	19.6	1.1	0.488	0.0	0.0	>>>	>>	5.65	ground level	14	

Day Tuesday & Wednesday
Date 5/6th April 2016
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured on site) Morning (hPa)	Evening (hPa)	
Dublin Airport		W	13	Fair	11	57	0	999	995	Tuesday
Dublin airport (met eireann)		W	23 Gust 35	Hail Showers	7	76	0.1	990	991	Wednesday

	Flow Peak	Flow Steady	CH4 (%)	CO2(%)	O2(%) Peak	O2(%) Steady	Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
Site 1															
Onsite															
LG 11	0.0	0.0	0.0	0.1		20.3	0.0	0.0	0.0	0.0	1.0	11.7	0.32	13	
LG 12	0.0	0.0	0.0	0.1		20.3	0.0	0.0	0.0	0.0	1.0	dry	0.25	12	
LG 13	0.0	0.0	1.5	6.5	20.2	12.5	0.1	0.0	0.0	34.6	1.7	9.4	0.36	9	
Offsite															
G06	0.6	0.0	21.1	8.1	16.8	-0.3	0.5	0.0	0.0	>>>	>>	dry	0.21	11	
G07	0	0	0.0	0.0		20.3	0.013	0.0	0.0	0.0	1	dry	0.2	14	
G08	0	-2.1	0.0	0.0		20.4	0.013	0.0	0.0	0.0	1	dry	0.26	14	
G10	0	0	0.0	0.3		20.2	0.011	0.0	0.0	0.0	1	9.32	0.12	18	
G18	0	0	0.0	0.1		20.2	0.013	0.0	0.0	0.0	1	dry	0.13	14	
G19	0	0	0.0	0.3		20.1	0.013	0.0	0.0	0.0	1	8.03	0.2	14	
BH05	0	0	0.0	1.3	19.2%	18.8	0.011	0.0	0.0	0.0	1	20.06	0.21	29	
Site 2															
LG 02	0.9	0.1	5.4	2.4	19.6	18.3	0.231	0.0	-10.0	>>>	4.2	8.42	0.18	9	
LG 03	0	0	49.5	20.6		3.6	0.783	0.0	0.0	>>>	>>	16.34	0.16	18	
LG 04	0	-1.2	0.0	0.0		20.5	0.012	0.0	0.0	0.0	1	12.16	0.1	15	
LG 05	0.1	0	0.0	0.0		20.5	0.011	0.0	0.0	0.0	1	13.84	0.1	14	
LG 06	2.8	0.9	30.5	15.7	19.1	9.5	0.593	0.0	0.0	>>>	>>	6.55	0.33	6.4	
LG 07	0	0	59.1	21.7	20.2	2.8	0.877	0.0	0.0	>>>	>>	9.15		17	
LG 08	0	-3.1	0.0	0.1	20.4	20.2	0.018	0.0	0.0	0.0	1	dry	0.1	8	
LG 09	0	-1.6	0.0	0.3	20.3	20.1	0.033	0.0	0.0	0.0	1	~9.44	0.1	17	
LG 10	0	0	9.4	4.7	20.2	17.1	0.310	0.0	0.0	>>>	7.9	~17.14	0.22	18	
Offsite															
G01	0	-9.1	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.44	17.1	
G02	0	-2.5	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	ground level	19.5	
G03	0	-5.3	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.15	19.5	
G04	0	0	0.0	1.5	19.9	12.4	0.013	0.0	0.0	0.0	1	7.75	0.35	20	
G05	0	0	0.0	0.0	20.4	20.3	0.014	0.0	0.0	0.0	1	16.36	0.1	20	
G13	0	-8.2	0.0	0.0		20.2	0.013	0.0	0.0	0.0	1	dry	0.16	20	
G20	0	-0.4	0.0	0.3	20.2	19.8	0.016	0.0	0.0	0.0	1	14.49	0.28	20	
G21	0	-7.3	0.0	1.3	20.1	15.6	0.011	0.0	0.0	0.0	1	dry	0.43	17	
G22	1.5	0	0.0	0.1		20.2	0.013	0.0	0.0	0.0	1		0.33	15	Gas tap stuck - no water level taken
G23	0	-10.3	0.0	0.0		20.3	0.013	0.0	0.0	0.0	1	17	0.1	20	
G24	0	-15.9	0.0	0.0		20.3	0.013	0.0	0.0	0.0	1	dry	0.1	20	
G25	0	0	12.5	2.2		14.2	0.368	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	0	-0.1	0.0	0.0		20.4	0.014	0.0	0.0	0.0	1	14.65	0.22	21	
BH03	0	-9.3	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.1	19.5	
BH04	0	-18.6	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11	0	-12.6	0.0	0.0		20.3	0.012	0.0	0.0	0.0	1	dry	0.12	33	
BH13	0	0	3.4	1.4	19.8	17.2	0.166	0.0	0.0	77.3	3.5	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	0.7	0	53.4	21.8		0.1	0.824	0.0	0.0	>>>	>>	6.64	0.2	8	
LG 19	31.7	29.6	71.7	28.5	6.7	-0.3	1.001	30.0	0.0	>>>	>>	14.44	0.36	15	
LG 20	9.1	Fluctuating ~3.4	63.2	31.8	19.2	-0.2	0.916	0.0	0.0	>>>	>>		0.49	12	wind affecting steady flow reading
MW3 (19 dia. Pipe)	no cap		34.4	14.6	19.8%	6.4 (after falling to almost 0 started to increase)	0.634	0.0	0.0	>>>	>>	10.16	~0.5	11	
MW3 (50 dia. Pipe)	3	0	8.7	2.9		12.5	0.304	0.0	0.0	>>>	7.4	16.2	1.04	18.1	not sampled
MW4	25.1	23.1	68.7	31.5	8.2	-0.3	0.978	30.0	0.0	>>>	>>	7.05	1	10	
Offsite															
G12	0	0	0.0	0.1		20.1	0.014	0.0	0.0	0.0	1	10.55	0.2	14	
G14	4	~0	0.0	1.8		16.9	0.012	0.0	0.0	0.0	1	7.81	0.38	14	
BH07	5.9	fluctuating ~1.9	0.0	0.0		20.3	0.013	0.0	0.0	0.0	1	13.88	0.26	21	wind affecting steady flow reading
BH09	0	0	0.0	0.9	18.9	14.4	0.013	0.0	0.0	0.0	1	6.85	0.19	12	
BH10	4.2	~1.5	0.0	1.1	19.4	18.7	0.012	0.0	0.0	0.0	1	8.63	0.19	14	wind affecting steady flow reading
Site 3B															
Onsite															
LG 16	4.3	0	39.4	19.5	18.7	7.4	0.682	0.0	0.0	>>>	>>	3.32	0.24	3.5	
LG 17	0	0	67.7	32.4	19.8	-0.2	0.967	0.0	0.0	>>>	>>	3.6	0.26	3.9	not sampled
LG 21	3.1	0	59.9	35.7	19.8	0.0	0.886	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	3.1	0	0.0	2.3	19.7	16.4	0.013	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	2.3	20.1	16.7	0.012	0.0	0.0	0.0	1	4.27	0.34	6	
G17	0	0	0.0	1.1	19.3	17.3	0.013	0.0	0.0	0.0	1	dry	0.37	6	
BH08	0.1	0	0.0	3.9	19.8	15.0	0.012	0.0	0.0	0.0	1	7.26	0.8	13.5	
Site 3C															
Onsite															
MW2	1.2	fluctuating 0	48.9	7.3	18.6	7.3	0.770	0.0	0.0	>>>	>>	4.5	0.75	5	wind affecting steady flow reading
LG 14	2.5	fluctuating 1.2	72.0	28.0	19.1	0.0	0.991	50.0	0.0	>>>	>>	10.5	0.37	12	wind affecting steady flow reading
LG 18	3.3	fluctuating ~1	67.7	32.5	16.3	-0.2	0.970	40.0	0.0	>>>	>>	9.88	0.38	10	wind affecting steady flow reading
Offsite															
G09	2.7	0.4	12.5	12.1	18.0	1.7	0.369	0.0	0.0	>>>	>>	12.6	0.42	14	
G11	0.1	0	0.0	0.1	20.0%	20.0	0.014	0.0	0.0	0.0	1	10.05	0.27	15	
BH06	3.4	0.3	22.2	17.0	18.0	1.3	0.500	0.0	0.0	>>>	>>	5.74	ground level	14	

Day Tuesday & Wednesday
Date 12/13th April 2016
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured on site) Morning (hPa)	Evening (hPa)	
Dublin Airport			4.5				0.6	996	991	Tuesday
Dublin airport (met eireann)								993	994	Wednesday

	Flow Peak	Flow Steady	CH4 (%)	CO2(%)	O2(%) Peak	O2(%) Steady	Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
Site 1															
Onsite															
LG 11	0.0	0.0	0.0	3.3	19.8	15.0	0.0	0.0	0.0	2.1	1.0	11.5	0.32	13	
LG 12	0.0	0.0	0.0	7.9	19.6	12.5	0.012	0.0	0.0	0.0	1.0	dry	0.25	12	
LG 13	0.0	0.0	2.2	8.4	17.9	10.0	0.1	0.0	0.0	51.8	2.3	9.07	0.36	9	
Offsite															
G06	2.5	2.2	21.7	7.5		-0.2	0.5	0.0	0.0	>>>	>>	dry	0.21	11	
G07	0	0	0.0	1.2	20.2	18.9	0.010	0.0	0.0	0.0	1	19.99	0.2	14	
G08	1.5	1.2	0.0	0.7	20.0%	19.0	0.011	0.0	0.0	0.0	1	dry	0.26	14	
G10	0	0	0.0	1.4	19.6	18.7	0.010	0.0	0.0	0.0	1	9.23	0.12	18	
G18	0	0	0.0	1.1	19.4	13.9	0.010	0.0	0.0	0.0	1	dry	0.13	14	
G19	0.1	0	0.0	0.8	19.6	18.1	0.011	0.0	0.0	0.0	1	7.93	0.2	14	
BH05	1.3	1	0.0	2.3	19.8%	16.7	0.009	0.0	0.0	0.0	1	dry	0.21	29	
Site 2															
LG 02	3.3	3	67.4	27.4	19.8	0.0	0.950	0.0	0.0	>>>	>>	8.43	0.18	9	
LG 03	4.5	4.3	68.2	22.1	16.4	-0.2	0.958	0.0	0.0	>>>	>>	15.32	0.16	18	strong odour
LG 04	3.3	3.1	48.2	19.4	16.7	-0.2	0.770	0.0	0.0	>>>	>>	12.29	0.1	15	
LG 05	6	5.8	67.8	28.5	11.7	-0.3	0.954	0.0	0.0	>>>	>>	12.62	0.1	14	
LG 06	2.5	2.2	48.3	23.4	18.1	4.0	0.772	0.0	0.0	>>>	>>	6.62	0.33	6.4	
LG 07	3.9	3.9	73.7	24.8	17.9	-0.3	1.003	0.0	0.0	>>>	>>	2.21		17	
LG 08	4.3	4.3	40.1	24.3		-0.3	0.690	0.0	14.0	>>>	>>	7.82	0.1	8	
LG 09	3.9	3.9	60.1	24.0	18.2	0.0	0.888	0.0	0.0	>>>	>>	11.54	0.1	17	
LG 10	4.7	4.5	57.9	24.7	13.0	-0.3	0.866	0.0	0.0	>>>	>>	16.48	0.22	18	strong odour
Offsite															
G01	3.9	3.6	0.0	1.9	18.8	16.6	0.011	0.0	0.0	0.0	1	dry	0.44	17.1	
G02	0	0	0.0	3.8		14.6	0.011	0.0	0.0	0.0	1	dry	ground level	19.5	
G03	2.8	2.5	0.9	9.3	15.2%	1.5	0.062	0.0	0.0	22.5	1.4	dry	0.15	19.5	
G04	0	0	0.0	0.6	18.3	17.9	0.012	0.0	0.0	0.0	1	2.19	0.35	20	
G05	0.6	0.1	37.1	6.2	17.2	0.4	0.659	0.0	0.0	>>>	>>	16.45	0.1	20	
G13	3.4	3.3	0.0	0.6	19.9	17.6	0.012	0.0	0.0	0.0	1	dry	0.16	20	
G20	5.8	5.5	0.0	0.5		20.0	0.012	0.0	0.0	0.0	1	14.53	0.28	20	
G21	3.4	3.3	0.0	1.8	19.4	16.1	0.012	0.0	0.0	0.0	1	dry	0.43	17	
G22	0	-0.6	0.0	0.6		18.5	0.013	0.0	0.0	0.0	1	9.27	0.33	15	
G23	1.9	1.8	0.0	0.9	19.8	18.4	0.012	0.0	0.0	0.0	1	17.05	0.1	20	
G24	5.5	5.4	0.0	1.1	19.3	17.3	0.012	0.0	0.0	0.0	1	dry	0.1	20	
G25	3.8	3.7	52.4	6.2	16.2	-0.1	0.813	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	1	0.7	0.0	2.1	19.6	13.1	0.014	0.0	0.0	0.0	1	14.71	0.22	21	
BH03	1.2	1	1.5	5.0	18.6	12.7	0.085	0.0	0.0	34.2	1.7	dry	0.1	19.5	
BH04	7.2	7.2	0.0	1.5	15.2	9.6	0.011	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11	5	4.8	4.6	13.2	14.1	2.5	0.209	0.0	0.0	>>>	3.8	dry	0.12	33	
BH13	0.6	0	20.7	7.3	14.7	-0.3	0.481	0.0	0.0	>>>	>>	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	0	0	55.0	19.4	20.1%	0.0	0.839	0.0	10.0	>>>	>>	6.63	0.2	8	
LG 19	27.7	27.6	70.1	30.1	10.5	-0.2	0.985	0.0	0.0	>>>	>>	9.3	0.36	15	
LG 20	1	0.4	68.9	33.1	19.5	-0.2	0.937	0.0	0.0	>>>	>>	dry	0.49	12	
MW3 (19 dia. Pipe)	0	0	69.1	31.0	19.8%	-0.2	0.995	25.0	0.0	>>>	>>	10.02	~0.5	11	
MW3 (50 dia. Pipe)	0	0	7.6	2.9	19.6%	11.0	0.283	0.0	0.0	>>>	6.2	16.38	1.04	18.1	not sampled
MW4	30.3	30.1	71.2	28.9	6.6	-0.2	0.990	30.0	0.0	>>>	>>	6.97	1	10	
Offsite															
G12	0	0	0.0	0.1	21.7	20.8	0.013	0.0	0.0	0.0	1	10.64	0.2	14	
G14	0	0	0.0	0.9	20.3	18.6	0.011	0.0	0.0	0.0	1	7.87	0.38	14	
BH07	0	0	0.0	0.9	19.3	18.6	0.012	0.0	0.0	0.0	1	13.97	0.26	21	
BH09	0	0	0.0	0.1	20.4	20.4	0.012	0.0	0.0	0.0	1	6.88	0.19	12	
BH10	0	0	0.0	1.8	20.2	17.0	0.011	0.0	0.0	0.0	1	8.71	0.19	14	
Site 3B															
Onsite															
LG 16	0.6	0	70.4	28.8	19.6	-0.1	0.976	0.0	0.0	>>>	>>	3.33	0.24	3.5	
LG 17	0	0	67.7	32.1	3.4	0.1	0.950	0.0	0.0	>>>	>>	3.6	0.26	3.9	not sampled
LG 21	2.7	2.5	66.2	33.9	18.1	-0.2	0.956	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	0	0	0.0	2.7	19.4	15.5	0.010	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	2.1	20.1	16.5	0.012	0.0	0.0	0.0	1	4.27	0.34	6	
G17	0	0	0.0	1.5	19.4	16.6	0.012	0.0	0.0	0.0	1	4.4	0.37	6	
BH08	0	0	0.0	4.2	20.0	14.7	0.011	0.0	0.0	0.0	1	7.35	0.8	13.5	
Site 3C															
Onsite															
MW2	19.5	11.7	83.5	14.0	9.6	-0.2	1.096	40.0	0.0	>>>	>>	4.18	0.75	5	strong odour
LG 14	1	0.9	72.3	27.5	19.3	-0.2	0.993	25.0	0.0	>>>	>>	9.54	0.37	12	strong odour
LG 18	0.4	0.3	68.1	32.0	18.5	-0.2	0.963	40.0	0.0	>>>	>>	9.99	0.38	10	strong odour
Offsite															
G09	0	0	18.6	13.5	19.5	-0.2	0.456	0.0	0.0	>>>	>>	12.65	0.42	14	
G11	0	0	0.0	0.1	20.8%	20.3	0.012	0.0	10.0	0.0	1	10.13	0.27	15	
BH06	0	0	10.4	8.5	19.0	6.6	0.335	0.0	0.0	>>>	9.5	5.7	ground level	14	

Day Wednesday & Thursday
Date 20/21st April 2016
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured on site) Morning (hPa)	Evening (hPa)	
Dublin Airport			7.4		13.5			1022	1016	Wednesday
Dublin airport (met eireann)		E	14	Fair	13	44	0	1010	1012	Thursday

	Flow Peak	Flow Steady	CH4 (%)	CO2(%)	O2(%) Peak	O2(%) Steady	Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
Site 1															
Onsite															
LG 11	0.0	0.0	0.0	0.9	20.4	18.9	0.0	0.0	0.0	0.0	1.0	10.6	0.32	13	water level reading approx due to presence of leachate
LG 12	0.0	0.0	0.0	2.9	19.4	18.5	0.006	0.0	0.0	0.0	1.0	dry	0.25	12	
LG 13	0.0	0.0	0.0	4.3	20.2	14.3	0.0	0.0	0.0	0.0	1.0	8.84	0.36	9	
Offsite															
G06	0.0	0.0	21.8	7.3	19.5	-0.1	0.5	0.0	0.0	>>>	>>	dry	0.21	11	
G07	0	0	0.0	0.4		20.3	0.008	0.0	0.0	0.0	1	dry	0.2	14	
G08	0	0	0.0	1.7	19.7	16.5	0.007	0.0	0.0	0.0	1	dry	0.26	14	
G10	0	0	0.0	1.9	19.3	18.4	0.008	0.0	0.0	0.0	1	9.24	0.12	18	
G18	0	0	0.0	1.4	19.8	11.7	0.007	0.0	0.0	0.0	1	dry	0.13	14	
G19	0	0	0.0	0.8	20.2	17.5	0.007	0.0	0.0	0.0	1	7.9	0.2	14	
BH05	0	0	0.0	1.3	20.2	18.9	0.004	0.0	0.0	0.0	1	19.95	0.21	29	
Site 2															
LG 02	3.3	3.1	45.1	18.4	17.0	5.1	0.731	0.0	0.0	>>>	>>	8.55	0.18	9	
LG 03	4.3	4.2	67.5	22.5	17.2	0.0	0.943	0.0	0.0	>>>	>>	15.95	0.16	18	water level reading approx due to presence of leachate
LG 04	0.4	0	2.5	6.3	17.7	8.4	0.138	0.0	10.0	59.0	2.7	12.17	0.1	15	
LG 05	4.3	4.1	69.5	28.2	14.5	-0.1	0.959	0.0	0.0	>>>	>>	13.9	0.1	14	
LG 06	3.4	3.3	55.1	25.3	16.7	2.2	0.832	0.0	0.0	>>>	>>	6.58	0.33	6.4	
LG 07	1.5	0.4	71.6	25.2	18.6	-0.1	0.976	0.0	0.0	>>>	>>	10.98		17	water level reading approx due to presence of leachate
LG 08	0	0	34.4	19.4	19.8	5.3	0.624	0.0	0.0	>>>	>>	dry	0.1	8	
LG 09	0	0	3.1	1.6	19.8	19.0	0.158	0.0	0.0	72.6	3.5	9.81	0.1	17	water level reading approx due to presence of leachate
LG 10	3.3	3.1	71.3	23.5	18.6	0.4	0.974	0.0	0.0	>>>	>>	17.47	0.22	18	water level reading approx due to presence of leachate
Offsite															
G01	0	0	0.0	0.1	20.5	20.3	0.009	0.0	0.0	0.0	1	dry	0.44	17.1	
G02	0	0	0.0	0.0	20.7	20.5	0.008	0.0	0.0	0.0	1	dry	ground level	19.5	
G03	0	-0.3	0.0	0.0		20.5	0.007	0.0	0.0	0.0	1	dry	0.15	19.5	
G04	0	0	0.0	1.7	18.6	12.3	0.009	0.0	0.0	0.0	1	6.46	0.35	20	
G05	5.5	5.3	36.4	6.1	12.2	2.5	0.644	0.0	0.0	>>>	>>	16.46	0.1	20	
G13	0	-0.3	0.0	0.7	19.7	15.4	0.012	0.0	0.0	0.0	1	dry	0.16	20	
G20	3.4	3	0.0	0.0		20.7	0.009	0.0	0.0	0.0	1	16.57	0.28	20	
G21	0	0	0.0	2.2	20.1	15.6	0.009	0.0	0.0	0.0	1	dry	0.43	17	
G22	0	0	0.0	0.0		19.9	0.014	0.0	0.0	0.0	1	9.38	0.33	15	
G23	0	0	0.0	0.0		20.0	0.012	0.0	0.0	0.0	1	dry	0.1	20	
G24	0	-1.1	0.0	0.1	20.3	20.0	0.011	0.0	0.0	0.0	1	dry	0.1	20	
G25	7	6.9	53.9	6.7	14.4	-0.3	0.820	0.0	0.0	>>>	>>	dry	0.3	20	
BH01	1.2	0.3	0.0	0.0		20.7	0.010	0.0	0.0	0.0	1	14.86	0.22	21	
BH03	0	-0.3	0.0	0.0		20.5	0.008	0.0	0.0	0.0	1	dry	0.1	19.5	
BH04	0	-3.2	0.0	0.0	20.4	20.4	0.009	0.0	0.0	0.0	1	dry	0.27	25.5	
BH11	0	-0.4	0.0	0.5	20.4	19.9	0.031	0.0	0.0	0.0	1	dry	0.12	33	
BH13	3.1	3	21.7	5.3	17.2	1.3	0.487	0.0	0.0	>>>	>>	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady									
Site 3A															
Onsite															
LG 15	3.6	3.6	51.5	26.1	14.1%	-0.1	0.798	0.0	0.0	>>>	>>	6.72	0.2	8	water level reading approx due to presence of leachate
LG 19	31.1	30	70.4	29.7	8.0	-0.1	0.981	0.0	0.0	>>>	>>	6.47	0.36	15	
LG 20	4.4	4.1	55.6	31.0	17.5	-0.2	0.837	0.0	0.0	>>>	>>	dry	0.49	12	
MW3 (19 dia. Pipe)	no cap		69.7	30.4	20.4	-0.1	0.974	25.0	0.0	>>>	>>	16.46	~0.5	11	
MW3 (50 dia. Pipe)	0	0	9.8	4.0	18.7	9.5	0.320	0.0	0.0	>>>	8.7	7.19	1.04	18.1	not sampled
MW4	25.3	24.3	69.0	31.0	20.3	-0.1	0.969	25.0	0.0	>>>	>>	7.39	1	10	
Offsite															
G12	0	0	0.0	0.0	20.5	20.4	0.009	0.0	0.0	0.0	1	10.73	0.2	14	
G14	0	0	0.0	1.4	19.7	17.7	0.008	0.0	0.0	0.0	1	7.91	0.38	14	
BH07	0	0	0.0	0.2		20.2	0.012	0.0	0.0	0.0	1	14.09	0.26	21	
BH09	0	0	0.0	1.1	20.0	15.3	0.009	0.0	0.0	0.0	1	6.94	0.19	12	
BH10	0	0	0.0	1.9	19.7	17.0	0.008	0.0	0.0	0.0	1	8.7	0.19	14	
Site 3B															
Onsite															
LG 16	1.5	1	67.5	32.7	17.6	-0.2	0.949	0.0	0.0	>>>	>>	3.4	0.24	3.5	
LG 17	0	0	67.5	32.6	19.5	-0.1	0.960	0.0	0.0	>>>	>>	3.51	0.26	3.9	not sampled
LG 21	2.7	1.8	66.1	34.0	17.9	-0.2	0.952	0.0	0.0	>>>	>>	dry	0.28	4	not sampled
Offsite															
G15	0	0	0.0	3.3	18.9	14.2	0.009	0.0	0.0	0.0	1	dry	0.28	6	
G16	0	0	0.0	2.5	19.7	15.6	0.010	0.0	0.0	0.0	1	4.31	0.34	6	
G17	0	0	0.0	1.8	19.6	14.3	0.009	0.0	0.0	0.0	1	dry	0.37	6	
BH08	0	0	0.0	2.9	18.9	15.8	0.009	0.0	0.0	0.0	1	7.47	0.8	13.5	
Site 3C															
Onsite															
MW2	0.3	0	68.8	28.5	18.9	0.6	0.955	50.0	0.0	>>>	>>	4.95	0.75	5	
LG 14	1.3	0.1	72.0	28.2	18.8	-0.2	0.984	30.0	0.0	>>>	>>	10.2	0.37	12	
LG 18	0	0	67.7	32.4	19.2	-0.2	0.961	40.0	0.0	>>>	>>	9.98	0.38	10	
Offsite															
G09	0	0	0.0	0.0		20.6	0.009	0.0	0.0	0.0	1	12.74	0.42	14	
G11	0	0	0.0	2.4	19.9	15.7	0.006	0.0	0.0	0.0	1	10.17	0.27	15	
BH06	0	0	21.3	16.0	19.3	2.0	0.484	0.0	0.0	>>>	>>	5.75	ground level	14	

Day Tuesday & Wednesday
Date 26/27th April 2016
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured on site) Morning (hPa)	Evening (hPa)	
Dublin Airport		NW	23 gust 35	showers (hail)	7.00	57	0.1	1003	1002	Tuesday
Dublin airport (met eireann)		N	14 gust 25	hail shower	5.00	71	0.2	1003	1001	Wednesday

	Flow Peak	Flow Steady	CH4 (%)	CO2(%)	O2(%) Peak	O2(%) Steady	Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Flow Peak	Flow Steady	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
Site 1																	
Onsite																	
LG 11	0.0	0.0	0.6	2.2	19.0	17.0	0.051	0.0	0.0	15.5	1.2	0.0	0.0	11.3	0.32	13	
LG 12	0.0	0.0	0.0	5.5	19.5	13.7	0.023	0.0	0.0	0.0	1.0	0.0	0.0	dry	0.25	12	
LG 13	3.0	0.0	8.0	17.2	19.5	2.4	0.288	0.0	0.0	>>>	6.6	3.0	0.0	9.12	0.36	9	
Offsite																	
G06	6.6	3.5	21.3	7.4	17.8	-0.2	0.486	0.0	0.0	>>>	>>	6.6	3.5	dry (wet sand)	0.21	11	
G07	3.1	1.8	0.0	1.2	19.9	19.0	0.009	0.0	0.0	0.0	1	3.1	1.8	dry	0.2	14	
G08	3.1	1	0.0	1.2	19.9	17.3	0.010	0.0	0.0	0.0	1	3.1	1	dry	0.26	14	
G10	0	0	0.0	1.8	19.5	17.1	0.010	0.0	0.0	0.0	1	0	0	9.26	0.12	18	
G18	0.3	0	0.0	1.7	19.5	12.8	0.010	0.0	0.0	0.0	1	0.3	0	dry	0.13	14	
G19	0.6	0	0.0	0.9	19.4	16.8	0.010	0.0	0.0	0.0	1	0.6	0	7.92	0.2	14	
BH05	0	0	0.0	0.6	19.7	19.6	0.010	0.0	0.0	0.0	1	0	0	20	0.21	29	
Site 2																	
LG 02	5.2	4.7	65.3	27.9	17.5	0.1	0.929	0.0	0.0	>>>	>>	5.2	4.7	8.48	0.18	9	
LG 03	4.6	3.7	58.4	23.7	15.3	0.5	0.869	0.0	0.0	>>>	>>	4.6	3.7	~14.89	0.16	18	
LG 04	0	-0.6	1.9	1.1	19.7	19.4	0.104	0.0	0.0	43.6	1.9	0	-0.6	12.45	0.1	15	
LG 05	6.7	6.4	68.1	28.4	14.6	-0.1	0.953	0.0	0.0	>>>	>>	6.7	6.4	13.74	0.1	14	
LG 06	7.3	3	60.6	27.4	14.0	0.8	0.889	0.0	0.0	>>>	>>	7.3	3	6.56	0.33	6.4	
LG 07	0	0	68.9	25.1	18.9	0.3	0.960	0.0	0.0	>>>	>>	0	0	11.46		17	
LG 08	4.2	3.5	52.7	28.6	17.5	1.0	0.813	0.0	0.0	>>>	>>	4.2	3.5	~7.65	0.1	8	
LG 09	4	~3.5	60.2	21.3	17.6	1.0	0.885	0.0	0.0	>>>	>>	4	~3.5	11.11	0.1	17	
LG 10	5.5	4.8	63.1	24.9	15.1	0.0	0.910	0.0	0.0	>>>	>>	5.5	4.8	~17.46	0.22	18	
Offsite																	
G01	0.1	0	0.0	3.1	20.0	15.3	0.011	0.0	0.0	0.0	1	0.1	0	dry	0.44	17.1	
G02	0	0	0.0	0.0		20.2	0.013	0.0	0.0	0.0	1	0	0	dry	ground level	19.5	
G03	0.6	0	3.5	10.6	19.4	1.6	0.172	0.0	0.0	81.4	3.6	0.6	0	dry	0.15	19.5	
G04	0.3	0	0.0	2.1	17.2	9.1	0.011	0.0	0.0	0.0	1	0.3	0	8.23	0.35	20	
G05	6.5	6.3	42.4	6.7	12.3	1.9	0.706	0.0	0.0	>>>	>>	6.5	6.3	16.46	0.1	20	
G13	1.5	0	0.0	0.8	20.0	18.1	0.010	0.0	0.0	0.0	1	1.5	0	dry	0.16	20	
G20	4.3	3.9	0.0	0.7	19.6	17.1	0.011	0.0	0.0	0.0	1	4.3	3.9	14.57	0.28	20	
G21	3.3	2.1	0.0	1.8	19.7	16.7	0.012	0.0	0.0	0.0	1	3.3	2.1	dry	0.43	17	
G22	0	0	0.0	0.9	20.1	18.5	0.011	0.0	0.0	0.0	1	0	0	9.42	0.33	15	
G23	0	-3	0.0	0.0		20.4	0.011	0.0	0.0	0.0	1	0	-3	17.24	0.1	20	
G24	0	0	0.0	0.6		18.7	0.012	0.0	0.0	0.0	1	0	0	dry	0.1	20	
G25	9.3	9	55.3	6.3		0.0	0.839	0.0	0.0	>>>	>>	9.3	9	dry	0.3	20	
BH01	3.2	1.8	0.0	0.1		20.1	0.013	0.0	0.0	0.0	1	3.2	1.8	14.82	0.22	21	
BH03	0	-3.4	0.0	0.1	20.4	20.0	0.016	0.0	0.0	0.0	1	0	-3.4	dry	0.1	19.5	
BH04	0	0	0.0	0.0		20.2	0.013	0.0	0.0	0.0	1	0	0	dry	0.27	25.5	
BH11	0.1	-3.3	0.0	0.4		19.9	0.014	0.0	0.0	0.0	1	0.1	-3.3	dry	0.12	33	
BH13	5.2	4.7	19.8	7.6	15.5	-0.2	0.469	0.0	0.0	>>>	>>	5.2	4.7	dry	-0.1	19.5	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Flow		Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady						Peak	Steady				
Site 3A																	
Onsite																	
LG 15	4.4	4	50.4	26.1	18.5	-0.1	0.791	0.0	0.0	>>>	>>	4.4	4	6.85	0.2	8	
LG 19	31.4	30.7	71.2	29.0	7.3	-0.3	0.992	30.0	0.0	>>>	>>	31.4	30.7	14.58	0.36	15	
LG 20	4.8	4.6	51.6	29.3	18.5	-0.2	0.803	0.0	0.0	>>>	>>	4.8	4.6	dry	0.49	12	
MW3 (19 dia. Pipe)	no cap	no cap	69.6	30.5		-0.2	0.977	0.0	0.0	>>>	>>	no cap		10.44	~0.5	11	
MW3 (50 dia. Pipe)	3.3	3.2	26.7	8.3	19.5	3.1	0.551	0.0	0.0	>>>	>>	3.3	3.2	16.55	not sampled	18.1	
MW4	30.4	29.8	67.8	32.4	7.6	-0.3	0.968	25.0	0.0	>>>	>>	30.4	29.8	7.72	1	10	
Offsite																	
G12	0	0	0.0	1.1	19.9	17.7	0.009	0.0	0.0	0.0	1	0	0	10.75	0.2	14	
G14	0.6	0	0.0	1.8	19.6	17.0	0.010	0.0	0.0	0.0	1	0.6	0	7.94	0.38	14	
BH07	2.4	1.6	0.0	1.3	18.9	17.3	0.011	0.0	0.0	0.0	1	2.4	1.6	14.13	0.26	21	
BH09	0	0	0.0	2.1	18.5	12.2	0.010	0.0	0.0	0.0	1	0	0	6.96	0.19	12	
BH10	0	0	0.0	1.7	20.0	17.3	0.009	0.0	0.0	0.0	1	0	0	8.73	0.19	14	
Site 3B																	
Onsite																	
LG 16	1.5	1	66.8	33.3	18.2	-0.1	0.944	0.0	0.0	>>>	>>	1.5	1	3.34	0.24	3.5	
LG 17	3	1.3	65.0	35.1	12.2	-0.2	0.944	0.0	0.0	>>>	>>	3	1.3	3.61	not sampled	3.9	
LG 21	0	0	51.6	27.8	20.0	3.2	0.803	0.0	0.0	>>>	>>	0	0	dry	not sampled	4	
Offsite																	
G15	0.9	0	0.0	3.4	18.8	14.6	0.010	0.0	0.0	0.0	1	0.9	0	dry	0.28	6	
G16	0	0	0.0	1.9	19.7	18.3	0.009	0.0	0.0	0.0	1	0	0	4.35	0.34	6	
G17	0	0	0.0	1.9	18.5	14.4	0.009	0.0	0.0	0.0	1	0	0	dry	0.37	6	
BH08	0	-1	0.0	3.5	19.9	15.5	0.012	0.0	0.0	0.0	1	0	-1	7.62	0.8	13.5	
Site 3C																	
Onsite																	
MW2	2.8	0	70.0	30.2	16.3	-0.2	0.980	60.0	0.0	>>>	>>	2.8	0	5.21	0.75	5	
LG 14	2.2	0.6	72.1	28.0	17.8	-0.2	0.988	30.0	0.0	>>>	>>	2.2	0.6	10.21	0.37	12	
LG 18	1.9	0.6	67.8	32.3	18.5	-0.2	0.966	30.0	0.0	>>>	>>	1.9	0.6	9.99	0.38	10	
Offsite																	
G09	0	0	3.1	4.2	19.8	15.0	0.157	0.0	0.0	71.3	3.5	0	0	12.78	0.42	14	
G11	0.6	0	0.0	0.6	19.8	19.4	0.011	0.0	0.0	0.0	1	0.6	0	10.18	0.27	15	
BH06	0	0	19.0	17.0	19.1	0.6	0.459	0.0	0.0	>>>	>>	0	0	5.78	ground level	14	

Day Tuesday & Wednesday
Date 26/27th April 2016
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured on site) Morning (hPa)	Evening (hPa)	
Dublin Airport		NNW	7.4	Sunny	18		0	1012	1009	Tuesday
Dublin airport (met eireann)		NE	9.1	Sunny	16		0	115	1014	Wednesday

	Flow Peak	Flow Steady	CH4 (%)	CO2(%)	O2(%) Peak	O2(%) Steady	Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Flow Peak	Flow Steady	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
Site 1																	
Onsite																	
LG 11	0.0	0.0	0.0	0.9	20.5	19.5	0.000	0.0	0.0	>>>	1.0	0.0	0.0	12.0	0.32	13	
LG 12	0.0	-0.4	-0.1	2.6	20.4	18.9	0.000	0.0	0.0	>>>	0.9	0.0	-0.4	dry	0.25	12	
LG 13	0.0	0.0	0.0	2.0	20.4	17.9	0.010	0.0	0.0	>>>	1.0	0.0	0.0	9.33	0.36	9	
Offsite																	
G06	0.5	0.0	23.9	7.2	17.6	0.0	0.500	0.0	0.0	>>>	>>	0.5	0.0	6.3	0.21	11	Thread on allen nut damaged.
G07	0	-3.2	-0.1	0.0	20.7	20.5	0.000	0.0	0.0	>>>	0.9	0	-3.2	dry	0.2	14	
G08	0	-3.7	-0.1	2.8	20.2	18.0	0.000	0.0	0.0	>>>	0.9	0	-3.7	dry	0.26	14	
G10	0	-0.3	-0.1	1.7	20.2	19.0	0.000	0.0	0.0	>>>	0.9	0	-0.3	9.565	0.12	18	
G18	0	0	-0.1	2.3	19.5	15.9	0.000	0.0	0.0	>>>	0.9	0	0	dry	0.13	14	
G19	0	-0.1	-0.1	1.6	20.2	15.9	0.000	0.0	0.0	>>>	0.9	0	-0.1	8.13	0.2	14	
BH05	0	0	-0.1	2.6	20.4	17.2	0.000	0.0	0.0	>>>	0.9	0	0	20.055	0.21	29	Cover broklen.
Site 2																	
LG 02	0.4	0.1	54.7	22.0	19.6	3.9	0.830	0.0	0.0	>>>	>>	0.4	0.1	8.79	0.18	9	
LG 03	1.5	0.4	61.9	24.7	20.0	0.8	0.890	0.0	0.0	>>>	>>	1.5	0.4	13.685	0.16	18	
LG 04	0	0	0.0	0.7	20.7	20.0	0.034	0.0	0.0	>>>	1	0	0	13.4	0.1	15	
LG 05	4	3.5	58.6	27.3	14.8	2.0	0.869	0.0	0.0	>>>	>>	4	3.5	13.83	0.1	14	
LG 06	3.3	0.6	48.1	25.7	19.5	3.2	0.760	0.0	0.0	>>>	>>	3.3	0.6	6.575	0.33	6.4	
LG 07	3	1	38.7	17.7	19.0	7.1	0.660	0.0	0.0	>>>	>>	3	1	10.75		17	
LG 08	0.3	0	9.3	6.8	20.7	4.9	0.310	0.0	0.0	>>>	8.1	0.3	0	7.8	0.1	8	
LG 09	4.6	3.5	66.7	22.3	18.4	0.9	0.924	0.0	0.0	>>>	>>	4.6	3.5	8.39	0.1	17	
LG 10	2.1	0.8	56.4	19.5	19.7	2.9	0.847	0.0	0.0	>>>	>>	2.1	0.8	13.97	0.22	18	
Offsite																	
G01	0.1	-0.7	-0.2	0.4	21.1	20.7	0.000	0.0	0.0	>>>	0.9	0.1	-0.7	dry	0.44	17.1	
G02	0.1	0	-0.1	0.0	20.7	20.7	0.000	0.0	0.0	>>>	0.9	0.1	0	dry	ground level	19.5	
G03	0.1	0	-0.1	0.0	20.8	20.8	0.000	0.0	0.0	>>>	0.9	0.1	0	dry	0.15	19.5	
G04	0	0	-0.1	0.0	21.2	20.7	0.000	0.0	0.0	>>>	0.9	0	0	10.5	0.35	20	
G05	0	-4.2	19.0	4.2	20.5	10.3	0.440	0.0	0.0	>>>	>>	0	-4.2	16.645	0.1	20	
G13	1	0	-0.1	0.7	20.9	19.7	0.000	0.0	0.0	>>>	0.9	1	0	dry	0.16	20	
G20	0	-10.9	0.0	0.1	20.9	20.7	0.000	0.0	0.0	>>>	1	0	-10.9	14.75	0.28	20	
G21	2.1	1.8	-0.2	0.2	21.0	20.8	0.000	0.0	0.0	>>>	0.9	2.1	1.8	dry	0.43	17	
G22	-1	-1.3	-0.2	2.5	20.9	17.5	0.000	0.0	0.0	>>>	0.9	-1	-1.3	9.86	0.33	15	
G23	-0.1	-0.5	-0.2	0.0	21.1	20.9	0.000	0.0	0.0	>>>	0.9	-0.1	-0.5	dry	0.1	20	
G24	0.8	-3	-0.2	0.0	21.1	21.0	0.000	0.0	0.0	>>>	0.9	0.8	-3	dry	0.1	20	No wooden stake around the BH. The BH is in the direction of the line of the tractor and sprayer.
G25	0.3	0	49.8	10.4	18.9	1.0	0.780	0.0	0.0	>>>	>>	0.3	0	dry	0.3	20	
BH01	0	-4.9	-0.1	0.0	20.7	20.7	0.000	0.0	0.0	>>>	0.9	0	-4.9	15.13	0.22	21	
BH03	0.2	0	-0.1	2.1	20.8	19.3	0.000	0.0	0.0	>>>	0.9	0.2	0	dry	0.1	19.5	
BH04	0.1	-9.4	-0.1	0.0	20.9	20.8	0.000	0.0	0.0	>>>	0.9	0.1	-9.4	dry	0.27	25.5	
BH11	0	-0.1	-0.2	0.0	20.9	20.8	0.000	0.0	0.0	>>>	0.9	0	-0.1	dry	0.12	33	
BH13	0	0	16.3	5.2	19.8	5.0	0.410	0.0	0.0	>>>	>>	0	0	dry	-0.1	19.5	

Site 3A																	
Onsite																	
LG 15	3.8	3.3	47.1	24.8	17.2	0.2	0.755	0.0	0.0	>>>	>>	3.8	3.3	6.91	0.2	8	
LG 19	24.4	24.2	68.9	29.7	11.0	0.1	0.966	0.0	0.0	>>>	>>	24.4	24.2	14.36	0.36	15	
LG 20	2.5	1.9	37.3	22.9	21.3	3.7	0.653	0.0	0.0	>>>	>>	2.5	1.9	11.65	0.49	12	
MW3 (25 dia. Pipe)	1.6	1.5	68.6	29.7	20.6	0.0	0.963	0.0	0.0	>>>	>>			9.99	~0.5	11	
MW3 (50 dia. Pipe)	4.4	4.1	38.4	11.1	12.5	0.0	0.665	0.0	0.0	>>>	>>	4.4	4.1	17.09	not sampled	18.1	
MW4	15.7	15.4	66.0	32.4	9.6	0.0	0.940	0.0	0.0	>>>	>>	15.7	15.4	8.11	1	10	
Offsite																	
G12	1.6	1.4	-0.1	0.1	21.1	21.1	0.000	0.0	0.0	>>>	0.9	1.6	1.4	11.24	0.2	14	
G14	1.8	1.3	-0.2	2.1	20.6	17.7	0.000	0.0	0.0	>>>	0.9	1.8	1.3	8.15	0.38	14	
BH07	0	0	-0.1	0.6	20.1	20.1	0.000	0.0	0.0	0.0	0.9	0	0	14.32	0.26	21	
BH09	1.9	1.6	-0.2	2.3	20.5	16.4	0.000	0.0	0.0	>>>	0.9	1.9	1.6	7.27	0.19	12	
BH10	1.5	1.1	-0.2	2.9	20.2	17.5	0.000	0.0	0.0	>>>	0.9	1.5	1.1	9.06	0.19	14	
Site 3B																	
Onsite																	
LG 16	1.6	0.4	60.2	34.3	17.2	0.1	0.886	0.0	0.0	>>>	>>	1.6	0.4	3.35	0.24	3.5	
LG 17	1	1	62.5	36.3	20.1	0.0	0.907	0.0	10.0	>>>	>>	1	1	3.61	not sampled	3.9	
LG 21	2.6	1.8	60.5	37.4	18.2	2.0	0.888	0.0	0.0	>>>	>>	2.6	1.8	dry	not sampled	4	
Offsite																	
G15	1.5	1.3	-0.2	3.6	20.6	17.6	0.000	0.0	0.0	>>>	0.9	1.5	1.3	dry	0.28	6	
G16	0.3	0.1	-0.2	2.0	20.4	18.1	0.000	0.0	0.0	0.0	0.9	0.3	0.1	4.7	0.34	6	
G17	1.3	1.1	-0.1	2.2	20.7	15.7	0.000	0.0	0.0	>>>	0.9	1.3	1.1	dry	0.37	6	
BH08	1.6	1.4	-0.1	3.1	20.5	16.8	0.000	0.0	0.0	>>>	0.9	1.6	1.4	8.03	0.8	13.5	
Site 3C																	
Onsite																	
MW2	1.8	1.8	65.1	32.0	10.2	0.1	0.931	200.0	0.0	>>>	>>	1.8	1.8	5.57	0.75	5	
LG 14	2.2	1.5	69.0	26.5	19.7	0.1	0.966	0.0	0.0	>>>	>>	2.2	1.5	10.53	0.37	12	
LG 18	1.8	1.2	66.0	31.7	20.2	0.0	0.940	30.0	0.0	>>>	>>	1.8	1.2	10.1	0.38	10	
Offsite																	
G09	0.9	0.6	-0.2	0.2	21.3	21.1	0.000	0.0	0.0	>>>	0.9	0.9	0.6	13.15	0.42	14	
G11	1.3	1.1	-0.2	2.3	20.5	18.0	0.000	0.0	0.0	>>>	0.9	1.3	1.1	10.56	0.27	15	
BH06	1.2	0.9	4.2	6.7	21.0	13.4	0.000	0.0	0.0	97.0	3.7	1.2	0.9	6.08	ground level	14	

Day Thursday & Friday
Date 30th June & 1st July 2016
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured Morning (hPa)	Pressure (measured Evening (hPa)	
Dublin Airport		W	15 gust 29	Fair	14	81	0	997	991	Thursday
Dublin airport (met eireann)		W	18	Recent Shower	13	69	0.3	992	991	Friday

	Flow Peak	Flow Steady	CH4 (%)	CO2(%)	O2(%) Peak	O2(%) Steady	Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	DP (Pa)		Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
Site 1																	
Onsite																	
LG 11	0.0	0.0	0.1	2.1	20.5	17.7	0.053	0.0	0.0	2.8	1.0	0.0		12.1	0.32	13	
LG 12	0.0	0.0	0.0	4.0	20.3	15.7	0.010	0.0	0.0	0.0	1.0	0.0		dry	0.25	12	
LG 13	0.0	0.0	3.5	6.0	20.5	14.9	0.200	0.0	0.0	80.1	3.6	0.0		9.16	0.36	9	
Offsite																	
G06	3.0	1.9	19.8	7.1	19.3	0.2	0.522	0.0	0.0	>>>	>>	8.0		dry	0.21	11	
G07	2.4	0.6	0.0	2.3	20.4	16.4	0.004	0.0	0.0	0.0	1	3		dry	0.2	14	
G08	2.7	2	0.0	0.5	20.4	20.1	0.006	0.0	0.0	0.0	1	9		dry	0.26	14	
G10	0.4	0	0.0	1.1	20.2	19.4	0.006	0.0	0.0	0.0	1	0		11.5	0.12	18	
G18	0	0	0.0	1.6	19.8	18.1	0.007	0.0	0.0	0.0	1	0		dry	0.13	14	
G19	0	0	0.0	2.0	20.4	15.9	0.006	0.0	0.0	0.0	1	0		8.25	0.2	14	
BH05	0	0	0.0	1.7	20.5	18.5	0.005	0.0	0.0	0.0	1	0		20.5	0.21	29	Cover broken.
Site 2																	
LG 02	7.4	7	66.2	28.0	13.5	1.2	1.066	0.0	0.0	>>>	>>	51		8.83	0.18	9	
LG 03	3.8	3.6	64.1	25.4	16.9	0.1	1.043	0.0	0.0	>>>	>>	19		14.18	0.16	18	
LG 04	7.6	7.3	68.9	24.6	13.0	0.2	1.097	0.0	0.0	>>>	>>	55		14.41	0.1	15	
LG 05	4.9	5.1	66.0	28.5	15.1	0.5	1.064	0.0	0.0	>>>	>>	32		13.87	0.1	14	
LG 06	3	2	60.8	30.1	16.6	0.4	1.006	0.0	0.0	>>>	>>	9		6.45	0.33	6.4	
LG 07	1.3	0.1	43.2	19.9	18.8	5.1	0.810	0.0	0.0	>>>	>>	1		10.85		17	
LG 08	0	0	19.3	13.7	20.0	9.6	0.512	0.0	0.0	>>>	>>	0		dry	0.1	8	
LG 09	3.5	3.5	67.3	22.4	19.2	1.2	1.078	0.0	0.0	>>>	>>	18		15.67	0.1	17	
LG 10	2.6	1.3	65.0	25.0	19.3	0.2	1.052	0.0	0.0	>>>	>>	6		17.56	0.22	18	
Offsite																	
G01	0	-1.2	0.0	0.9	21.1	19.9	0.005	0.0	0.0	0.0	1	-6		dry	0.44	17.1	
G02	-1.5	-1.5	0.0	3.6	19.6	16.9	0.003	0.0	0.0	0.0	1	-8		dry	ground level	19.5	
G03	0	-3.1	0.0	0.3	21.0	20.6	0.010	0.0	0.0	0.0	1	-16		dry	0.15	19.5	
G04	0	0	0.0	1.8	19.0	14.2	0.008	0.0	0.0	0.0	1	0		11.01	0.35	20	
G05	2.6	2.4	40.0	7.7	12.3	7.7	0.771	0.0	0.0	>>>	>>	23		16.73	0.1	20	
G13	0	0	0.0	1.4	20.8	19.0	0.005	0.0	0.0	0.0	1	0		dry	0.16	20	
G20	11.7	11.2	0.0	0.7	18.7	18.7	0.000	0.0	0.0	0.0	1	92		14.9	0.28	20	
G21	0	0	0.0	0.3	21.1	20.6	0.007	0.0	0.0	0.0	1	0		dry	0.43	17	
G22	0	0	0.0	2.5	18.6	18.2	0.006	0.0	0.0	0.0	1	0		10.23	0.33	15	
G23	1.3	-0.3	0.0	0.0	20.8	20.8	0.004	0.0	0.0	0.0	1	-2		dry	0.1	20	
G24	0	-6.4	0.0	0.8	20.9	18.8	0.006	0.0	0.0	0.0	1	-34		dry	0.1	20	
G25	6.3	6	52.8	10.8	13.5	0.4	0.921	0.0	0.0	>>>	>>	42		dry	0.3	20	
BH01	3	2.6	0.0	1.0	19.5	18.8	0.008	0.0	0.0	0.0	1	11		15.39	0.22	21	
BH03	0	-3.2	0.0	0.0	21.2	20.9	0.005	0.0	0.0	0.0	1	-17		dry	0.1	19.5	
BH04	0	-5.4	0.0	0.0	21.3	20.9	0.000	0.0	0.0	0.0	1	-4.2		dry	0.27	25.5	
BH11	0	-1.5	0.0	0.1	21.1	20.9	0.006	0.0	0.0	0.0	1	-7		dry	0.12	33	
BH13	2.4	1.8	16.7	5.8	18.0	5.3	0.294	0.0	0.0	>>>	>>	8		dry	-0.1	19.5	

Site 3A																
Onsite																
LG 15	3.4	3	49.3	26.0	16.1	0.2	0.884	0.0	0.0	>>>	>>>	13		6.88	0.2	8	
LG 19	35.7	35.7	67.9	31.9		0.1	1.099	0.0	0.0	>>>	>>>	378		14.35	0.36	15	Missed Peak O2 Flow
LG 20	0	0	50.6	26.9	20.1	0.9	0.899	0.0	0.0	>>>	>>>	0		11.07	0.49	12	
MW3 (25 dia. Pipe)			68.9	30.8	19.0	0.2	1.102	0.0	0.0	>>>	>>>			10.59	~0.5	11	Didn't record Flow
MW3 (50 dia. Pipe)	4.3	4	42.6	11.8	19.2	0.2	0.803	0.0	0.0	>>>	>>>	23		17.37	not sampled	18.1	
MW4	13	11.7	65.1	34.6	13.1	0.1	1.067	0.0	0.0	>>>	>>>	113		8.5	1	10	
Offsite																
G12	0	0	0.0	0.3	20.6	20.6	0.010	0.0	0.0	0.0	1	0		11.28	0.2	14	
G14	0	0	0.0	0.9	19.2	19.2	0.006	0.0	0.0	0.0	1	0		8.37	0.38	14	
BH07	0	0	0.0	0.3	20.6	20.6	0.005	0.0	0.0	0.0	1	0		14.64	0.26	21	
BH09	0	0	0.0	0.5	20.5	20.1	0.007	0.0	0.0	0.0	1	0		7.53	0.19	12	
BH10	0	0	0.0	3.2	20.6	16.9	0.006	0.0	0.0	0.0	1	0		9.09	0.19	14	
Site 3B																
Onsite																
LG 16	0	0	52.3	34.7	19.1	0.3	0.916	0.0	0.0	>>>	>>>	0		3.37	0.24	3.5	
LG 17	1.5	1.5	61.9	37.7	19.0	0.2	1.029	0.0	0.0	>>>	>>>	7		3.59	not sampled	3.9	
LG 21	2.4	0	57.0	36.3	18.0	0.1	0.966	0.0	0.0	>>>	>>>	0		dry	not sampled	4	
Offsite																
G15	0	0	0.0	0.8	20.5	20.0	0.006	0.0	0.0	0.0	1	0		dry	0.28	6	
G16	0	0	0.0	3.0	20.5	16.8	0.005	0.0	0.0	0.0	1	0		5.07	0.34	6	
G17	0	0	0.0	3.2	20.4	16.1	0.009	0.0	0.0	0.0	1	0		dry	0.37	6	
BH08	0	0	0.0	4.2	20.2	15.9	0.006	0.0	0.0	0.0	1	0		dry	0.8	13.5	
Site 3C																
Onsite																
MW2	3.3	1.1	66.0	33.8	18.1	0.1	1.073	210.0	0.0	>>>	>>>	5		5.63	0.75	5	
LG 14	1	-0.1	72.1	27.2	17.9	0.1	1.132	25.0	0.0	>>>	>>>	-1		10.85	0.37	12	
LG 18	1.8	0	67.5	32.1	19.7	0.2	1.089	25.0	0.0	>>>	>>>	0		9.84	0.38	10	
Offsite																
G09	0	0	0.0	2.6	19.3	17.5	0.009	0.0	0.0	0.0	1	0		dry	0.42	14	
G11	0	0	0.0	2.1	20.1	18.0	0.005	0.0	0.0	0.0	1	0		10.87	0.27	15	
BH06	0	0	4.3	8.8	20.0	10.4	0.211	0.0	0.0	98.4	3.7	0		6.28	ground level	14	

Day Thursday & Friday
Date 28th & 29th July 2016
Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured	
								Morning	Evening
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Dublin Airport			11.5	Sunny	20.8		1.5	1001	998
Dublin airport (met eireann)			7.5	Small amt of rain	19.5		3.6	1000	998

Thursday (28/07/16)

Friday (29/07/16)

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	DP (Pa)		Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady											
Site 1																	
Onsite																	
LG 11	0.0	0.0	0.1	2.3	20.5	17.8	0.054	0.0	0.0	3.5	1.0	0.0		12.2			
LG 12	0.0	-0.6	0.0	2.9	20.7	17.9	0.011	0.0	0.0	0.0	1.0	-4.0		Dry			
LG 13	0.0	0.0	4.4	7.8	19.7	13.4	0.212	0.0	0.0	+ +	3.7	0.0		8.89			
Offsite																	
G06	0.0	0.0	15.3	4.8	20.5	5.9	0.287	0.0	0.0	+ +	+ +	0.0					
G07	0.0	-3.1	0.0	0.0	-	20.7	0.005	0.0	0.0	0.0	1.0	-16		Dry			
G08	0.0	-3.6	0.0	0.1	20.9	20.7	0.006	0.0	0.0	0.0	1.0	-22		Dry			
G10	-1.5	-1.5	0.0	0.9	20.7	19.7	0.006	0.0	0.0	0.0	1.0	-7.0		14.05			
G18	0.0	0.0	0.0	0.6	20.8	19.9	0.006	0.0	0.0	0.0	1.0	0.0		Dry			
G19	0.0	0.0	0.0	0.8	20.8	19.7	0.006	0.0	0.0	0.0	1.0	0.0		8.37			
BH05																	No sample taken
Site 2																	
LG 02	0	-2.5	45.1	22.4	19.6	5.4	0.831	0.0	0.0	+ +	+ +	-12.0		8.96			
LG 03	4.2	3.6	56.5	25.0	18.1	0.4	0.959	0.0	0.0	+ +	+ +	19.0		17.53			
LG 04	4.8	4.3	68.8	26.2	19.4	0.5	1.095	0.0	0.0	+ +	+ +	26.0		14.59			
LG 05	6.2	5.7	66.4	28.1	16.6	0.2	1.068	0.0	0.0	+ +	+ +	39		12.67			Approx water leachate
LG 06	0.9	0.4	57.7	30.3	19.1	0.7	0.972	0.0	0.0	+ +	+ +	2.0		6.57			
LG 07	3.8	2.0	60.5	24.5	19.9	0.2	1.001	0.0	0.0	+ +	+ +	9.0		11.02			O2 steady = 0.2
LG 08	0.5	0.4	50.5	29.1	19.3	0.3	0.895	0.0	0.0	+ +	+ +	2.0		Dry			
LG 09	4.5	4.2	69.7	22.1	15.7	0.3	1.105	0.0	0.0	+ +	+ +	25		8.84			approx water
LG 10	5.0	4.7	53.6	23.0	18.2	0.3	0.928	0.0	0.0	+ +	+ +	29		15.43			
Offsite																	
G01	3.0	1.9	0.0	3.0	19.4	15.7	0.006	0.0	0.0	0.0	1.0	8.0		Dry			
G02	1.8	1.5	0.0	6.3	19.3	12.0	0.003	0.0	0.0	0.0	1.0	7.0		Dry			
G03	0.4	0	0.7	10.4	20.2	1.9	0.075	0.0	0.0	17.0	1.3	0		Dry			
G04	0.0	0.0	0.0	2.0	20.0	15.4	0.005	0.0	0.0	0.0	1.0	0.0		11.65			post damaged
G05	1.0	-3.9	0.0	0.0	20.8	20.8	0.010	0.0	0.0	0.0	1.0	-25.0		16.83			post around broken
G13	0.0	-5.1	0.0	0.7	20.4	17.6	0.004	0.0	0.0	0.0	1.0	-39.0		15.05			
G20	1.5	1.0	0.0	1.1	21.3	19.1	0.005	0.0	0.0	0.0	1.0	4.0		Dry			
G21	2.5	1.8	0.0	1.3	20.7	18.3	0.005	0.0	0.0	0.0	1.0	8.0		Dry			
G22	0.0	0.0	0.0	0.0	21.4	21.3	0.005	0.0	0.0	0.0	1.0	0.0		10.51			
G23	3.0	2.0	0.0	1.3	21.1	19.6	0.005	0.0	0.0	0.0	1.0	9.0		Dry			
G24	5.4	5.4	0.0	1.0	21.0	18.8	0.004	0.0	0.0	0.0	1	37		Dry			
G25	1.8	1	53.2	10.5	-	0.4	0.923	0.0	0.0	+ +	+ +	5		Dry			
BH01	3.4	3.1	0.0	3.3	18.7	13.1	0.008	0.0	0.0	0.0	1.0	14.0		15.71			
BH03	4.2	4.0	5.5	10.4	16.5	6.4	0.223	0.0	0.0	+ +	4.3	23.0		Dry			
BH04	0.0	-14.4	0.0	0.0	20.8	20.8	0.006	0.0	0.0	0.0	1.0	-14.3		Dry			
BH11	3.6	3.6	3.3	14.3	17.0	1.3	0.193	0.0	0.0	75.6	3.5	19.0		Dry			
BH13	0.0	0.0	12.0	4.9	19.5	8.4	0.268	0.0	0.0	+ +	+ +	0.0		Dry			

Site 3A																
Onsite																
LG 15	0.9	0	47.3	24.9	19.4	0.3	0.858	0.0	0.0	+ +	+ +	0.0		6.98		
LG 19	27.1	27.0	67.1	32.6	10.3	0.1	1.081	0.0	0.0	+ +	+ +	245.0		14.49		
LG 20	0.0	0.0	49.3	24.1	19.9	0.4	0.881	0.0	0.0	+ +	+ +	0.0		11.11		
MW3 (25 dia. Pipe)	_	_	68.6	30.6	_	0.1	1.092	0.0	0.0	+ +	+ +	_		10.77		
MW3 (50 dia. Pipe)	3.4	3.4	43.2	10.2	19.2	10.7	0.808	0.0	0.0	+ +	+ +	17.0		17.65		
MW4	4.5	4.3	64.6	35.1	12.7	0.2	1.056	0.0	0.0	+ +	+ +	42.0		9.04		
Offsite																
G12	0.0	0.0	0.0	0.0	20.8	20.8	0.008	0.0	0.0	0.0	1.0	0.0		11.62		
G14	0.0	0.0	0.0	0.0	20.8	20.8	0.007	0.0	0.0	0.0	1.0	0.0		8.47		
BH07	0.0	0.0	0.0	0.0	20.9	20.9	0.006	0.0	0.0	0.0	1.0	0.0		14.79		
BH09	0.0	0.0	0.0	0.1	21.0	20.9	0.007	0.0	0.0	0.0	1.0	0.0		7.71		
BH10	0.0	0.0	0.0	0.3	20.7	20.6	0.005	0.0	0.0	0.0	1.0	0.0		9.2		
Site 3B																
Onsite																
LG 16	0.0	0.0	24.5	27.0	20.7	1.0	0.582	0.0	0.0	+ +	+ +	0.0		3.29		
LG 17	3.0	3.0	60.7	38.0	-	0.5	1.003	0.0	0.0	+ +	+ +	13.0		3.65		
LG 21	0.0	0.0	46.8	30.4	20.5	2.2	0.852	0.0	0.0	+ +	+ +	0.0		Dry		
Offsite																
G15	0.0	0.0	0.0	2.2	20.4	19.5	0.004	0.0	0.0	0.0	1.0	0.0		Dry		
G16	0.0	0.0	0.0	2.3	19.8	18.9	0.010	0.0	0.0	0.0	1.0	0.0		5.37		
G17	0.0	0.0	0.0	2.2	20.8	18.5	0.006	0.0	0.0	0.0	1.0	0.0		Dry		
BH08	0.0	0.0	0.0	0.0	20.9	20.0	0.006	0.0	0.0	0.0	1.0	0.0		Dry		
Site 3C																
Onsite																
MW2	0.0	0.0	65.9	33.9	-	0.1	1.066	170.0	0.0	+ +	+ +	0.0		5.68		
LG 14	0.0	0.0	71.2	28.1	20.4	0.2	1.120	0.0	0.0	+ +	+ +	0.0		11.06		
LG 18	0.0	0.0	67.6	32.2	19.7	0.1	1.086	25.0	0.0	+ +	+ +	0.0		9.83		
Offsite																
G09	0.0	0.0	0.0	0.1	20.8	20.8	0.012	0.0	0.0	0.0	1.0	0.0		Dry		
G11	0.0	0.0	0.0	0.3	-	20.6	0.005	0.0	0.0	0.0	1.0	0.0		11.9		
BH06	0.0	0.0	0.0	4.2	20.5	16.2	0.005	0.0	0.0	0.0	1.0	0.0		6.39		

Day Wednesday & Thursday
Date 24/08/16 & 25/08/16

Weather as per Met Eireann:

Location	Fassaroe		Weather		Temp	Humidity	Rain	Pressure (measured on	
								Morning	Evening
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Dublin Airport			6.1	Sunny	20.1		0	1015	1013
Dublin airport (met eireann)			5.4	Sunny, partial cloud cover	19.7		0	1009	1003

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	DP (Pa)		Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady											
Site 1																	
Onsite																	
LG 11	0.0	0.0	1.7	7.0	20.5	10.9	0.125	0.0	0.0	40.0	1.8	0.0		12.12			
LG 12	0.0	0.0	0.0	8.5	18.0	11.4	0.018	0.0	0.0	0.0	1.0	0.0		Dry			
LG 13	0.0	0.0	1.7	5.0	20.0	14.5	0.123	0.0	0.0	39.0	1.8	0.0		8.83			
G06	1.1	0.4	23.5	6.1	7.1	0.1	0.567	0.0	0.0	+ +	+ +	2.0		Dry			
G07	0	0	0.0	0.3	20.9	20.9	0.005	0.0	0.0	0.0	1	0		Dry			
G08	0	0	0.0	0.2	21.0	20.9	0.005	0.0	0.0	0.0	1	0		Dry			
G10	0	0	0.0	0.9	20.4	19.5	0.005	0.0	0.0	0.0	1	0		14.56			
G18	0	0	0.0	0.5	20.6	20.6	0.006	0.0	0.0	0.0	1	0		Dry			
G19	0	0	0.0	0.6	20.4	20.3	0.004	0.0	0.0	0.0	1	0		8.51			
BH05	0	0	0.0	0.6	20.3	20.3	0.005	0.0	0.0	0.0	1	0		20.04			
Site 2																	
LG 02	2.4	2.4	53.6	25.0	2.6	1.0	0.924	0.0	0.0	+ +	+ +	10		9.0			
LG 03	3	2.8	58.6	24.2	19.2	0.8	0.977	0.0	0.0	+ +	+ +	12		16.6			
LG 04	5.2	5.1	70.3	26.1	19.5	0.4	1.107	0.0	0.0	+ +	+ +	37		14.8			
LG 05	3.2	3.2	66.9	27.9	17.1	0.6	1.069	0.0	0.0	+ +	+ +	15		13.85			
LG 06	0	0	50.0	28.8	19.9	1.9	0.885	0.0	0.0	+ +	+ +	0		6.51			
LG 07	0	0	9.4	4.8	20.5	17.2	0.251	0.0	0.0	+ +	8.3	0		11.24			
LG 08	0.4	0.4	18.3	12.9	20.0	10.2	0.475	0.0	0.0	+ +	+ +	2		7.79			
LG 09	3	2.7	61.0	22.2	12.4	0.4	1.002	0.0	0.0	+ +	+ +	12		16.13			
LG 10	0.5	0	43.6	20.3	19.9	2.7	0.810	0.0	0.0	+ +	+ +	0		17.16			
Offsite																	
G01	0	-4.7	0.0	0.6	21.2	20.5	0.004	0.0	0.0	0.0	1	-34		Dry			
G02	0	0	0.0	0.0	21.3	21.1	0.005	0.0	0.0	0.0	1	0		Dry			
G03	0	0	0.0	0.6	21.3	20.3	0.007	0.0	0.0	0.0	1	0		Dry			
G04	0	0	0.0	1.8	19.3	15.7	0.005	0.0	0.0	0.0	1	0		11.85			
G05	0	0	17.3	5.1	15.6	6.3	0.294	0.0	0.0	+ +	+ +	0		16.84			
G13	-0.7	-0.5	0.0	0.0	21.1	21.0	0.005	0.0	0.0	0.0	1	-3		Dry			
G20	0.5	0.4	0.0	0.3	20.3	20.3	0.003	0.0	0.0	0.0	1	2		15.18			
G21	0	-3.1	0.0	0.2	21.4	21.0	0.005	0.0	0.0	0.0	1	-17		Dry			
G22	0	0	0.0	0.0	20.9	20.9	0.002	0.0	0.0	0.0	1	0		10.76			
G23	0	-1.5	0.0	0.0	21.4	21.2	0.005	0.0	0.0	0.0	1	-6		Dry			
G24	-4.2	-4.3	0.0	0.0	21.5	21.2	0.006	0.0	0.0	0.0	1	-31		Dry			
G25	3.4	3	52.0	10.0	8.0	0.2	0.911	0.0	0.0	+ +	+ +	13		Dry			
BH01	0	-0.6	0.0	0.1	21.3	21.3	0.012	0.0	0.0	0.0	1	-3		Dry			
BH03	0	-3	0.0	3.8	21.2	17.2	0.022	0.0	0.0	0.0	1	-15		Dry			
BH04	0	-4.1	0.0	0.1	21.1	21.1	0.009	0.0	0.0	0.0	1	-28		Dry			
BH11	0	-4	0.0	0.0	21.1	21.1	0.004	0.0	0.0	0.0	1	-27		Dry			
BH13	0.5	0	17.6	7.8	18.5	0.2	0.295	0.0	0.0	+ +	+ +	0		Dry			

Site 3A																	
Onsite																	
LG 15	3	2.7	46.3	24.6	18.6	0.3	0.845	0.0	0.0	+ +	+ +	12		6.93			
LG 19	0	0	44.0	21.7	13.2	0.2	0.817	0.0	0.0	+ +	+ +	0		11.8			
LG 20	26.7	26.5	68.3	30.7	13.0	0.2	1.087	0.0	0.0	+ +	+ +	41		12.89			
MW3 (19 dia. Pipe)	0	0	68.0	30.4	20.2	0.1	1.084	0.0	0.0	+ +	+ +	0		-			
MW3 (50 dia. Pipe)	5	4.9	43.9	10.6	19.4	0.1	0.815	0.0	0.0	+ +	+ +	3.2		17.78			
MW4	10.7	10.6	63.8	35.3	15.2	0.3	1.036	0.0	0.0	+ +	+ +	87		6.46			
Offsite																	
G12	0	0	0.0	1.1	20.5	18.6	0.016	0.0	0.0	0.0	1	0		11.9			wooden posts removed
G14	0	0	0.0	1.2	14.5	19.5	0.006	0.0	0.0	0.0	1	0		8.59			
BH07	0	0	0.0	0.6	20.4	20.3	0.007	0.0	0.0	0.0	1	0		14.84			wooden posts removed
BH09	0	0	0.0	1.8	18.5	18.5	0.005	0.0	0.0	0.0	1	0		7.85			
BH10	0.6	0.5	0.0	1.9	18.7	18.7	0.010	0.0	0.0	0.0	1	2		9.29			
Site 3B																	
Onsite																	
LG 16	0	0	22.0	25.0	20.5	0.3	0.548	0.0	0.0	+ +	+ +	0		3.32			
LG 17	3.7	3.6	60.9	38.8	16.8	0.2	1.004	0.0	0.0	+ +	+ +	19		3.66			posts knocked down
LG 21	0.1	0	48.1	32.2	20.2	0.9	0.866	0.0	0.0	+ +	+ +	0		Dry			
Offsite																	
G15	0	0	0.0	2.2	19.4	18.5	0.011	0.0	0.0	0.0	1	0		Dry			
G16	0	0	0.0	2.7	19.9	17.5	0.005	0.0	0.0	0.0	1	0		Dry			
G17	0	0	0.0	2.4	20.5	17.9	0.009	0.0	0.0	0.0	1	0		Dry			
BH08	0.7	0	0.0	3.7	17.8	17.8	0.004	0.0	0.0	0.0	1	0		Dry			posts knocked down
Site 3C																	
Onsite																	
MW2	0.9	0.9	65.5	34.2	20.6	0.1	1.057	120.0	0.0	+ +	+ +	4		5.75			
LG 14	0.7	0.3	71.2	25.1	19.3	0.1	1.118	0.0	0.0	+ +		1		Dry			
LG 18	0	0	66.2	31.8	19.8	0.3	1.003	0.0	0.0	+ +	+ +	0		9.94			
Offsite																	
G09	0	0	0.0	0.5	21.0	20.1	0.005	0.0	0.0	0.0	1	0		Dry			
G11	0	0	0.0	1.9	18.7	18.0	0.003	0.0	0.0	0.0	1	0		11.58			
BH06	0	0	0.0	4.8	18.7	15.0	0.003	0.0	0.0	0.0	1	0		6.42			

Day Thursday & Friday
Date 29.09.2016 & 30.09.2016
Weather as per Met Eireann:

Location	Fassaroe		Weather		Temp	Humidity	Rain	Pressure (measured on	
								Morning	Evening
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Dublin Airport		W	20 gust 34	showers in afternoon	13	66	trace	998	994
Dublin airport (met eireann)							0	994	993

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	DP (Pa)	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady										
Site 1																
Onsite																
LG 11	0.4	0.0	1.4	4.7	19.5	14.0	0.058	0.0	0.0	33.9	1.7	0.0	11.80			
LG 12	2.8	0.7	1.9	15.7	20.0	2.5	0.073	0.0	0.0	43.3	1.9	3.0	dry			
LG 13	4.0	0.0	10.6	14.2	20.0	8.0	0.311	0.0	0.0	>>>	9.8	0.0	8.70			
G06	4.8	0.2	17.1	6.5		0.1	0.377	0.0	0.0	>>>	>>	1.0	dry			
G07	0.9	0	0.0	1.5	19.4	18.1	0.007	0.0	0.0	0.0	1	0	dry			
G08	3.3	0.6	0.0	0.5		20.0	0.007	0.0	0.0	0.0	1	2	dry			
G10	3.4	2.7	0.0	0.7	20.1	19.4	0.007	0.0	0.0	0.0	1	11	14.68			
G18	0.2	0	0.0	0.9	20.2	18.4	0.007	0.0	0.0	0.0	1	0	dry			
G19	1.2	0	0.0	0.8	20.7	18.8	0.007	0.0	0.0	0.0	1	0	dry			
BH05	6.2	4.6	0.0	3.4	19.5	18.3	0.006	0.0	0.0	0.0	1	32	20.02			
Site 2																
LG 02	3.2	0	37.7	20.4	18.0	3.1	0.531	0.0	0.0	>>>	>>	0	8.9			
LG 03	5.4	3	52.0	24.5	16.7	0.7	0.638	0.0	0.0	>>>	>>	14	17.55			
LG 04	10.8	7.6	69.2	26.3	12.6	0.1	0.758	0.0	0.0	>>>	>>	66	15.05			
LG 05	6.1	4.6	66.0	28.6	12.5	0.0	0.734	0.0	0.0	>>>	>>	32	13.62			
LG 06	0.2	0	50.1	29.7	20.1	1.6	0.625	0.0	0.0	>>>	>>	0	6.46			
LG 07	3.3	2.6	57.2	25.2	14.7	0.2	0.671	0.0	0.0	>>>	>>	11	10.31			
LG 08	0.6	0	44.9	28.3	19.8	0.3	0.586	0.0	10.0	>>>	>>	0	7.42			
LG 09	7.8	6	68.4	21.5	18.0	0.0	0.753	0.0	0.0	>>>	>>	48	11.41			
LG 10	3.3	1.2	48.2	21.2	14.9	1.9	0.610	0.0	0.0	>>>	>>	5	12.37			
Offsite																
G01	3.7	2.8	8.0	3.6	19.3	14.7	0.004	0.0	0.0	0.0	1	12	dry			
G02	0.2	5	0.0	6.0	19.4	13.8	0.004	0.0	0.0	0.0	1	0	dry			
G03	2.2	0	0.0	0.0	20.6	20.5	0.006	0.0	0.0	0.0	1	0	dry			
G04	0.3	0	0.0	2.0	19.1	16.4	0.007	0.0	0.0	0.0	1	0	12.32			
G05	3	1.2	25.3	5.6	18.0	5.3	0.442	0.0	0.0	>>>	>>	5	16.97			
G13	4	0	0.0	1.0	20.7	18.6	0.005	0.0	0.0	0.0	1	0	dry			
G20	4.1	1.2	0.0	0.3		19.4	0.010	0.0	0.0	0.0	1	5	15.3			
G21	3.9	0.9	0.0	1.5	20.5	17.8	0.004	0.0	0.0	0.0	1	4	dry			
G22	0	0	0.0	0.0		20.7	0.050	0.0	0.0	0.0	1	0	11.08			
G23	0	-1.7	0.0	0.0		20.6	0.006	0.0	0.0	0.0	1	-9	dry			
G24	3.4	0.5	0.0	1.2	20.4	17.5	0.005	0.0	0.0	0.0	1	2	dry			
G25	8.3	2.4	46.4	10.0	12.8	0.1	0.597	0.0	0.0	>>>	>>	10	dry			
BH01	0	0	0.0	0.2	20.6	20.4	0.008	0.0	0.0	0.0	1	0	16.26			
BH03	2.8	0	6.9	14.1	19.3	2.6	0.195	0.0	0.0	>>>	5.4	0	dry			
BH04	4.5	4.5	0.0	1.6	19.8	9.4	0.005	0.0	0.0	0.0	1	3	dry			
BH11	0	0	3.5	14.3	19.5	1.4	0.122	0.0	0.0	79.9	3.6	0	dry			
BH13	0	0	13.8	8.1	20.0	0.4	0.346	0.0	0.0	>>>	>>	0	dry			

Site 3A																
Onsite																
LG 15	0.6	0	46.0	24.8	19.4	0.0	0.598	0.0	0.0	>>>	>>	0	6.88			
LG 19	26.7	26.3	66.5	32.8	9.6	0.0	0.739	25.0	0.0	>>>	>>	283	14.36			
LG 20	0.2	0	44.8	22.0	18.1	0.2	0.587	0.0	0.0	>>>	>>	0	11			
MW3 (19 dia. Pipe)	-	-	67.3	30.8	-	0.0	0.745	0.0	0.0	>>>	>>	-	8.6			
MW3 (50 dia. Pipe)	4.6	4.6	40.7	10.9	15.8	0.0	0.556	0.0	0.0	>>>	>>	32	16.92			
MW4	9	0.9	63.6	36.2	18.4	0.0	0.717	0.0	0.0	>>>	>>	4	8.44			
Offsite																
G12	0	0	0.0	0.0	-	20.4	0.008	0.0	0.0	0.0	1	0	12.13			
G14	0	0	0.0	0.4	-	19.8	0.007	0.0	0.0	0.0	1	0	8.7			
BH07	0	0	0.0	0.0	-	20.5	0.009	0.0	0.0	0.0	1	0	15.07			
BH09	0	0	0.0	0.3	-	19.8	0.010	0.0	0.0	0.0	1	0	7.99			
BH10	0	0	0.0	0.7	20.2	19.3	0.007	0.0	0.0	0.0	1	0	9.42			
Site 3B																
Onsite																
LG 16	0	0	26.7	24.6	6.2	0.6	0.453	0.0	0.0	>>>	>>	0	3.35			
LG 17	0	0	60.3	38.9	4.6	0.6	0.693	0.0	0.0	>>>	>>	0	3.66			
LG 21	0	0	47.8	32.0		0.3	0.609	0.0	0.0	>>>	>>	0	dry			
Offsite																
G15	0	0	0.0	1.9	-	18.8	0.007	0.0	0.0	0.0	1	0	dry			
G16	0	0	0.0	3.3	19.2	16.8	0.007	0.0	0.0	0.0	1	0	dry			
G17	0	0	0.0	0.1	-	20.6	0.011	0.0	0.0	0.0	1	0	dry			
BH08	0	0	0.0	2.9	20.0	18.0	0.007	0.0	0.0	0.0	1	0	dry			
Site 3C																
Onsite																
MW2	0.1	0	64.6	35.0	19.3	0.1	0.724	190.0	0.0	>>>	>>	0	dry			
LG 14	1.2	0	72.8	25.3	17.3	0.0	0.785	0.0	0.0	>>>	>>	0	dry			
LG 18	0	0	66.5	32.8	19.8	0.0	0.739	40.0	0.0	>>>	>>	0	9.51			
Offsite																
G09	0	0	0.0	0.0	-	20.5	0.010	0.0	0.0	0.0	1	0	dry			
G11	0	0	0.0	0.7	-	19.7	0.007	0.0	0.0	0.0	1	0	11.98			
BH06	0	0	0.0	0.4	-	19.9	0.009	0.0	0.0	0.0	1	0	6.48			

Day Monday & Tuesday
Date 24.10.2016 & 25.10.2016
Weather as per Met Eireann:

Location	Fassaroe		Weather		Temp	Humidity	Rain	Pressure (measured on	
								Morning	Evening
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Dublin Airport								1003	
Dublin airport (met eireann)								1005	

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	DP (Pa)	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady										
Site 1																
Onsite																
LG 11	0.0	0.0	0.0	1.5	19.7	19.5	0.001	0.0	-10.0	0.0	1.0	0.0	12.18			
LG 12	0.0	0.0	-0.1	0.1	20.7	20.7	0.000	0.0	-10.0	<<<<	0.9	0.0	12.69 (Dry)			
LG 13	0.0	0.0	3.5	8.7	19.0	13.7	0.159	0.0	-10.0	80.2	3.6	0.0	9.00			
Offsite																
G06	0.3	0.3	21.2	6.5	19.0	0.9	0.469	0.0	-10.0	>>>>	>>>	1.0	11.14 (Dry)			
G07	0	-0.7	-0.1	0.1	21.0	20.8	0.000	0.0	-10.0	<<<<	0.9	5	14.00 (Dry)			
G08	0.3	0	-0.1	0.2	20.9	20.7	0.000	0.0	-10.0	<<<<	0.9	0	13.91 (Dry)			
G10	0	-0.4	0.0	0.4	20.7	20.6	0.000	0.0	-10.0	<<<<	1	3	15.00			
G18	0	0	0.0	0.6	20.3	20.3	0.000	0.0	-11.0	<<<<	1	0	13.7 (Dry)			
G19	0	0	-0.1	1.0	19.8	19.8	0.000	0.0	-10.0	<<<<	0.9	0	13.86 (Dry)			
BH05	1.6	1.6	-0.1	0.5	20.5	20.5	0.000	0.0	-10.0	<<<<	0.9	-25	20.43			
Site 2																
LG 02	1.8	1.1	51.9	26.5	12.3	1.0	0.808	0.0	-10.0	>>>>	>>>	6	17.74			
LG 03	0.3	0	65.8	29.7	19.1	1.1	0.941	0.0	0.0	>>>>	>>>	0	14.29			
LG 04	0.1	0.1	63.3	27.2	17.9	1.1	0.918	0.0	-10.0	>>>>	>>>	2	15.16			
LG 05	1.9	1.2	65.7	36.1	13.8	0.7	0.940	0.0	-10.0	>>>>	>>>	15	14.44 (Dry)			
LG 06	0	0	21.5	15.9	20.1	10.9	0.473	0.0	-10.0	>>>>	>>>	0	6.75			
LG 07	1.6	1.8	52.9	23.3	20.0	3.5	0.817	0.0	0.0	>>>>	>>>	10	12.11			
LG 08	0.6	0	23.6	17.0	20.1	9.8	0.495	0.0	0.0	>>>>	>>>	-1	8.10 (Dry)			
LG 09	0.6	-0.1	64.1	24.4	20.5	1.3	0.925	0.0	-10.0	>>>>	>>>	-2	17.60			
LG 10	1.3	0.5	53.0	25.4	12.0	1.0	0.817	0.0	-10.0	>>>>	>>>	2	17.74			
Offsite																
G01	2.5	2.5	0.0	0.5	20.9	20.6	0.000	0.0	-11.0	<<<<	0.9	-16	17.34 (Dry)			
G02	0	0	-0.1	0.1	20.7	20.7	0.000	0.0	-10.0	<<<<	0.9	0	20.00 (Dry)			
G03	0	-0.8	0.0	3.0	16.9	16.6	0.006	0.0	-10.0	0.0	1	4	20.25 (Dry)			
G04	0	0	0.0	2.6	19.0	10.5	0.000	0.0	-10.0	<<<<	1	0	12.67			
G05	0	0	22.6	4.9	19.8	7.7	0.484	0.0	-10.0	>>>>	>>>	0	17.30			
G13	0.1	0.1	0.0	0.1	21.2	20.9	0.000	0.0	-10.0	<<<<	0.9	-3	20.00 (Dry)			
G20	0.3	0.1	0.1	0.2	20.5	20.5	0.000	0.0	-10.0	<<<<	0.9	-4	15.73			
G21	2.2	1.1	0.0	0.6	20.9	20.4	0.000	0.0	-10.0	<<<<	0.9	-7	17.12 (Dry)			
G22	0	0	0.0	0.1	21.1	20.9	0.000	0.0	-10.0	<<<<	0.9	0	11.47			
G23	0	0	0.0	0.1	21.1	20.9	0.000	0.0	-10.0	<<<<	0.9	0	18.18 (Dry)			
G24	0	-5.7	0.0	0.1	21.1	20.8	0.000	0.0	-10.0	<<<<	0.9	60	20.38 (Dry)			
G25	2.2	1.2	44.2	11.1	18.8	0.9	0.723	0.0	-10.0	>>>>	>>>	6	21.1 (Dry)			
BH01	0.7	0	0.0	0.2	20.8	20.7	0.005	0.0	-10.0	0	1	-6	16.53			
BH03	0.3	-0.7	3.0	5.1	21.0	13.8	0.144	0.0	-10.0	69.5	3.5	5	20.06 (Dry)			
BH04	0	0	0.0	0.2	20.5	20.5	0.000	0.0	-10.0	0.0	0	1	25.60 (Dry)			
BH11	0	-10	0.0	0.1	21.1	20.8	0.000	0.0	-10.0	<<<<	0.9	9	30.57 (Dry)			
BH13	0	0	10.6	6.4	18.9	6.4	0.323	0.0	-10.0	>>>>	0	9.8	17.45 (Dry)			

Site 3A																
Onsite																
LG 15	0	0	45.4	26.6	20.7	0.6	0.735	0.0	0.0	>>>>	>>>	0	7.24			
LG 19	0.1	0	63.3	35.9	20.6	0.6	0.931	0.0	0.0	>>>>	>>>	-1	14.78			
LG 20	0	0	40.8	22.4	20.7	1.4	0.687	0.0	0.0	>>>>	>>>	0	11.45			
MW3 (19 dia. Pipe)	0	0	66.1	32.9	20.7	0.6	0.942	0.0	0.0	>>>>	>>>	0	12.74			
MW3 (50 dia. Pipe)	0.1	-0.3	34.9	12.0	20.7	0.7	0.625	0.0	-10.0	>>>>	>>>	-0.1	18.10			
MW4	1.7	1.6	62.2	37.0	20.7	0.6	0.919	0.0	0.0	>>>>	>>>	20	9.96			
Offsite																
G12	0	0	0.0	0.2	20.9	20.9	0.000	0.0	-10.0	<<<<	1	0	12.50			
G14	0	0	-0.1	0.8	20.5	20.4	0.000	0.0	-10.0	<<<<	0.9	0	8.90			
BH07	0	0	-0.1	0.1	20.9	20.8	0.000	0.0	-10.0	<<<<	0.9	0	15.39			
BH09	0	0	0.0	0.2	20.9	20.9	0.000	0.0	-10.0	<<<<	1	0	8.27			
BH10	0	0	-0.1	2.3	20.5	20.5	0.000	0.0	-10.0	<<<<	0.9	0	9.63			
Site 3B																
Onsite																
LG 16	0	0	34.6	28.0	20.5	0.9	0.621	0.0	-10.0	>>>>	>>>	0	3.70			
LG 17	2.4	1.9	59.7	39.4	20.3	0.8	0.887	0.0	-10.0	>>>>	>>>	10	3.92			
LG 21	1.5	0.9	53.9	35.5	19.8	0.8	0.825	0.0	-10.0	>>>>	>>>	5	4.40			
Offsite																
G15	0	0	0.0	2.6	20.5	18.4	0.000	0.0	-10.0	<<<<	1	0	5.72 (Dry)			
G16	0	0	-0.1	1.7	20.6	19.2	0.000	0.0	-10.0	<<<<	0.9	0	5.67 (Dry)			
G17	0	0	0.0	2.2	20.6	18.8	0.001	0.0	-10.0	0.0	1	0	5.55 (Dry)			
BH08	0	0	0.0	2.8	20.6	18.9	0.000	0.0	-10.0	<<<<	1	0	8.3 (Dry)			
Site 3C																
Onsite																
MW2	0	0	58.3	34.2	20.7	2.2	0.868	60.0	-10.0	>>>>	>>>	0	5.95			
LG 14	0.9	0.5	72.0	27.2	20.5	0.6	0.998	0.0	-10.0	>>>>	>>>	2	11.79 (Dry)			
LG 18	0	0	63.9	35.1	20.7	0.9	0.922	0.0	-10.0	>>>>	>>>	0	10.35 (Dry)			
Offsite																
G09	0	0	-0.1	0.4	20.7	20.7	0.000	0.0	-10.0	<<<<	0.9	0	13.43 (Dry)			
G11	0	0	-0.1	0.2	20.7	20.7	0.000	0.0	-10.0	<<<<	0.9	0	12.49			
BH06	0	0	0.0	1.4	19.2	19.2	0.092	0.0	-10.0	0.0	1	0	6.81			

Day Tuesday 22/11/2016
Date Wednesday 23/11/2016
Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured on site)	
								Morning	Evening
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Dublin Airport		N	14		7.00		0.8	988	991
Dublin airport (met eireann)		N	11		8.00		0	1005	1003

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Atmospheric pressure	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady										
Site 1																
Onsite																
LG 11	0.0	0.0	0.0	0.6	19.9	19.9	0.000	0.0	-10.0	>>>	1.0	990.0	dry	0.32	13	
LG 12	0.2	-0.8	-0.1	2.5	19.7	19.5	0.000	0.0	-10.0	>>>	0.9	991.0	dry	0.25	12	
LG 13	0.0	0.0	4.1	13.8	20.5	8.8	0.180	0.0	-10.0	94.9	3.7	991.0	dry	0.36	9	
Offsite																
G06	0.0	0.0	11.0	3.2	20.4	11.8	0.331	0.0	-10.0	>>>	10.4	991.0	dry	0.21	11	
G07	0	0	-0.1	0.1	20.7	20.5	0.000	0.0	-10.0	>>>	0.9	991.0	dry	0.2	14	
G08	0	-0.4	-0.1	0.1	20.7	20.4	0.000	0.0	-10.0	>>>	0.9	991.0	dry	0.26	14	
G10	0	0	0.0	0.5	20.6	20.1	0.000	0.0	-10.0	>>>	1	990.0	dry	0.12	18	
G18	0	0	-0.1	0.3	20.2	20.2	0.000	0.0	-20.0	>>>	0.9	991.0	dry	0.13	14	
G19	0	0	-0.1	0.3	20.6	20.3	0.000	0.0	-10.0	>>>	0.9	991.0	dry	0.2	14	
BH05	0	-1.9	0.0	0.1	20.8	20.5	0.000	0.0	-10.0	>>>	1	990.0	20.54	0.21	29	
Site 2																
LG 02	0.3	0.1	0.0	0.3	20.8	20.7	0.004	0.0	-10.0	0.0	1	994	8.76	0.18	9	
LG 03	0	-0.4	53.9	24.8	20.3	1.1	0.830	0.0	-10.0	>>>	>>>	990	dry	0.16	18	
LG 04	0	-5.2	61.9	25.3	19.2	1.6	0.908	50.0	-10.0	>>>	>>>	990	dry	0.1	15	
LG 05	0	-6.2	51.3	25.0	17.4	4.2	0.803	0.0	-10.0	>>>	>>>	990	dry	0.1	14	
LG 06	0.2	0.2	0.0	0.3	20.4	20.3	0.006	0.0	-10.0	0.0	1	990	6.89	0.33	6.4	
LG 07	0.1	-0.3	17.2	10.8	20.1	13.4	0.422	0.0	-10.0	>>>	>>>	991	12.15		17	
LG 08	0	0	0.0	0.3	20.3	20.3	0.005	0.0	-10.0	0.0	1	991	8.06	0.1	8	
LG 09	0	-6.6	1.3	1.8	20.3	19.6	0.014	0.0	-10.0	41.9	1.9	991	17.3	0.1	17	
LG 10	1.2	-1.2	60.8	25.7	19.6	1.2	0.898	0.0	-10.0	>>>	>>>	991	17.94	0.22	18	
Offsite																
G01	0	-15.9	-0.1	0.2	20.5	20.2	0.000	0.0	-10.0	>>>	0.9	988	dry	0.44	17.1	
G02	0.1	-1.9	0.1	0.8	20.4	19.9	0.000	0.0	-10.0	>>>	0.9	990	dry	ground level	19.5	
G03	0	-0.8	0.0	2.6	20.4	16.7	0.009	0.0	-10.0	0.0	1	991	dry	0.15	19.5	
G04	0.1	0.1	0.0	1.1	20.5	17.8	0.005	0.0	-10.0	0.0	1	991	12.15	0.35	20	
G05	0.6	-0.5	-0.1	0.1	20.7	20.6	0.000	0.0	-10.0	>>>	0.9	991	17.39	0.1	20	
G13	-0.3	-0.3	-0.1	0.4	20.5	20.1	0.000	0.0	-10.0	>>>	0.9	988	dry	0.16	20	
G20	0	0	0.0	0.1	20.6	20.5	0.000	0.0	-10.0	>>>	1	991	dry	0.28	20	
G21	0.4	-0.8	-0.1	0.7	20.3	19.6	0.000	0.0	-10.0	>>>	0.9	989	dry	0.43	17	
G22	0.5	-0.1	-0.1	1.7	20.3	18.5	0.000	0.0	-10.0	>>>	0.9	991	dry	0.33	15	
G23	-9	-9	-0.1	0.1	20.5	20.2	0.000	0.0	-10.0	>>>	0.9	989	dry	0.1	20	
G24	1	0.2	-0.1	0.6	20.2	19.6	0.000	0.0	-10.0	>>>	0.9	989	dry	0.1	20	
G25	0	-0.3	26.2	8.6	20.7	5.0	0.330	0.0	-10.0	>>>	>>>	991	dry	0.3	20	
BH01	0.1	0	0.0	0.2	20.3	20.3	6.000	0.0	-10.0	>>>	>>>	981	dry	0.22	21	
BH03	0.9	0.4	0.0	11.2	20.4	11.2	0.030	0.0	-10.0	0.0	1	989	dry	0.1	19.5	
BH04	0.1	-0.4	0.0	0.1	20.2	20.2	0.000	0.0	-10.0	>>>	1	989	dry	0.27	25.5	
BH11	0.1	0.1	0.0	0.1	20.5	20.3	0.000	0.0	-10.0	>>>	1	989	dry	0.12	33	
BH13	0	-0.2	0.0	0.1	20.6	20.5	0.000	0.0	-10.0	>>>	1	990	dry	-0.1	19.5	

Site 3A																
Onsite																
LG 15	0	0	38.8	23.3	20.2	1.1	0.666	0.0	-10.0	>>>	>>>	1004	7.08	0.2	8	
LG 19	12.8	12.1	63.4	35.7	11.7	0.8	0.923	0.0	-10.0	>>>	>>>	1003	14.67	0.36	15	
LG 20	0	0	22.9	14.6	14.4	7.8	0.400	87.0	-10.0	>>>	>>>	1004	dry	0.49	12	
MW3 (19 dia. Pipe)	0	0	1.0	0.9	20.5	20.0	0.059	0.0	-20.0	>>>	1	1003	11.99	~0.5	11	
MW3 (50 dia. Pipe)	0	0	1.0	0.9	20.5	20.0	0.059	0.0	-20.0	23.3	1.5	1003	8	not sampled	18.1	
MW4	4.6	4.6	63.1	35.2	20.3	0.5	0.934	0.0	0.0	>>>	>>>	1003	9.86	1	10	
Offsite																
G12	0	0	-0.1	1.2	20.5	19.6	0.000	0.0	-10.0	>>>	0.9	1004	12.58	0.2	14	
G14	0	0	-0.1	0.1	20.5	20.5	0.000	0.0	-10.0	>>>	0.9	1003	9.15	0.38	14	
BH07	0	0	0.0	1.4	18.6	18.4	0.000	0.0	-10.0	>>>	1	1004	15.4	0.26	21	
BH09	0	0	0.0	1.7	20.1	18.7	0.000	0.0	-10.0	>>>	1	1005	8.36	0.19	12	
BH10	0	0	-0.1	0.1	20.4	20.4	0.000	0.0	-10.0	>>>	0.9	1003	9.77	0.19	14	
Site 3B																
Onsite																
LG 16	0	0	25.5	20.1	20.3	3.5	0.518	0.0	-10.0	>>>	>>>	1005	dry	0.24	3.5	
LG 17	0	0	30.9	19.9	17.7	5.3	0.582	0.0	0.0	>>>	>>>	1005	3.77	not sampled	3.9	
LG 21	0	0	54.6	36.2	20.1	1.4	.8.0	0.0	-10.0	>>>	>>>	1005	4.43	not sampled	4	
Offsite																
G15	0	0	-0.1	2.8	18.1	18.1	0.000	0.0	-10.0	>>>	0.9	1004	dry	0.28	6	
G16	0	0	-0.1	3.0	18.0	17.8	0.000	0.0	-10.0	>>>	0.9	1005	dry	0.34	6	
G17	0	0	0.0	2.9	20.3	17.8	0.000	0.0	-10.0	>>>	1	1005	dry	0.37	6	
BH08	0	0	-0.1	1.5	19.5	19.5	0.000	0.0	-10.0	>>>	0.9	1004	dry	0.8	13.5	
Site 3C																
Onsite																
MW2	0	0	62.0	37.2	20.3	0.6	0.913	0.0	0.0	>>>	>>>	1004	dry	0.75	5	
LG 14	0	0	5.9	4.1	20.3	18.2	0.227	0.0	-10.0	>>>	4.6	1004	dry	0.37	12	
LG 18	0	0	64.3	34.9	19.3	0.7	0.941	0.0	0.0	>>>	>>>	1004	dry	0.38	10	
Offsite																
G09	0	0	0.0	0.4	20.5	20.5	0.015	0.0	-10.0	0.0	1	1005	dry	0.42	14	
G11	0	0	0.1	0.6	20.3	20.1	0.000	0.0	-10.0	>>>	0.9	1004	dry	0.27	15	
BH06	0	0	0.0	0.3	20.5	20.3	0.000	0.0	-10.0	>>>	1	1005	6.94	ground level	14	

Day Monday & Tuesday
Date 12th & 13th Dec 2016
Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured on site)	
								Morning	Evening
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Dublin Airport	Monday							1006	1004
Dublin airport (met eireann)	Tuesday							1001	999

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Dynamic pressure	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady										
Site 1																
Onsite																
LG 11	0.3	-0.1	1.6	8.3	19.7	10.0	0.070	0.0	0.0	37.9	1.8	0.0	12.2			
LG 12	0.0	0.0	0.8	12.5	19.9	6.5	0.043	0.0	0.0	19.2	1.3	0.0	dry			
LG 13	0.0	0.0	13.6	18.7	20.2	4.4	0.309	0.0	0.0	>>>	>>	0.0	9.37			
Offsite																
G06	0.3	0.1	17.0	8.0	19.1	0.1	0.352	0.0	0.0	>>>	>>	1.0	dry			lid not on right - a lot of debris in BH - no screw
G07	0	0	0.0	2.0	20.1	17.9	0.000	0.0	0.0	>>>	1	0.0	dry			
G08	0.4	0.2	0.0	0.8	20.1	19.4	0.000	0.0	0.0	>>>	1	2.0	dry			
G10	0.1	0	0.0	0.8	19.8	19.3	0.000	0.0	0.0	0.0	1	0.0	dry			
G18	0	0	0.0	2.2	20.3	13.9	0.000	0.0	0.0	>>>	1	0.0	dry			
G19	0.1	0.1	0.0	1.3	19.7	17.8	0.000	0.0	0.0	>>>	1	1.0	dry			cows in field - no screw
BH05	0.7	0.7	0.0	5.1	17.2	15.9	0.000	0.0	0.0	>>>	1	4.0	20.27			lid off
Site 2																
LG 02	1.9	1.9	49.6	29.8	16.9	0.0	0.645	0.0	0.0	>>>	>>	21	8.67			
LG 03	0	-0.3	47.8	26.1	18.6	0.1	0.630	0.0	0.0	>>>	>>	-4	17.82			
LG 04	1.3	1.3	70.0	27.3	17.8	0.000	0.807	0.0	0.0	>>>	>>	15	15.16			
LG 05	1.4	1.3	66.1	29.9	15.3	0.0	0.775	0.0	0.0	>>>	>>	17	14.36			
LG 06	1.1	1	50.4	30.1	20.0	1.7	651.000	0.0	0.0	>>>	>>	5	6.83			
LG 07	1	1	47.1	25.5	19.5	0.1	0.625	0.0	0.0	>>>	>>	11	12.02			cap loose when doing test
LG 08	2.2	2.1	47.7	30.7	19.2	0.1	0.629	0.0	0.0	>>>	>>	12	dry			
LG 09	1.4	1.3	63.1	24.4	18.7	0.1	0.749	0.0	0.0	>>>	>>	15	dry			
LG 10	1.3	1.2	54.2	25.2	20.1	0.1	0.670	0.0	0.0	>>>	>>	15	17.68			
Offsite																
G01	0	0	-0.1	2.6	20.0	16.4	0.000	0.0	0.0	>>>	0.9	0.1	dry			
G02	3.7	0.3	-0.1	5.6	20.2	13.6	0.000	0.0	0.0	>>>	0.9	4	dry			
G03	0	-0.1	0.0	9.3	17.8	7.4	0.021	0.0	0.0	0.0	1	-1	dry			
G04	0.1	0	0.0	1.8	18.1	16.6	0.000	0.0		>>>	1	0	13.09			
G05	1.2	1.2	48.4	8.1	17.5	0.2	0.635	0.0	0.0	>>>	>>	13	dry			
G13	0.3	0.3	0.0	1.3	20.6	18.3	0.000	0.0	0.0	>>>	1	2	dry			
G20	0	0	0.0	0.4	19.2	19.1	0.002	0.0	0.0	0.0	1	-1	dry			
G21	0.3	0.3	-0.1	1.7	20.3	17.9	0.000	0.0	0.0	>>>	0.9	3	dry			
G22	0.3	0.1	0.0	0.1	20.6	20.4	0.000	0.0	0.0	>>>	1	1	dry			
G23	0.1	0.1	0.0	1.5	19.1	19.0	0.000	0.0	0.0	>>>	1	0	dry			
G24	0.1	0.1	0.0	1.3	20.6	18.2	0.000	0.0	0.0	>>>	1	2	dry			
G25	1.2	1.2	40.1	11.6	15.8	0.0	0.570	0.0	0.0	>>>	>>	15	dry			
BH01	0	-0.1	-0.1	3.9	19.3	13.8	0.000	0.0	0.0	>>>	0.9	-1	16.89			
BH03	0.1	0	2.4	12.7	18.9	7.8	0.099	0.0	0.0	55.5	2.6	1	dry			
BH04	0.3	0.2	0.0	2.0	15.2	8.0	0.000	0.0	0.0	>>>	1	2	dry			
BH11	0.1	0.1	3.6	16.0	9.9	0.6	0.130	0.0	0.0	82.1	3.6	2	dry			
BH13	0.9	0.9	12.3	9.5	18.6	0.0	0.291	0.0	0.0	>>>	>>	4	dry			

Site 3A																
Onsite																
LG 15	0.9	0.7	42.8	25.1	20.0	0.5	0.596	0.0	0.0	>>>	>>	4	5.36			
LG 19	30.1	29.9	66.0	34.1	18.7	-0.2	0.786	0.0	0.0	>>>	>>	322	3.45			approx dip meter inconsistent as leachate
LG 20	0	0	31.6	19.3	19.1	2.5	0.496	0.0	0.0	>>>	>>	0	11.12			
MW3 (19 dia. Pipe)			67.1	32.4		0.0	0.784	0.0	0.0	>>>	>>		7.14			
MW3 (50 dia. Pipe)	3.5	2.5	27.9	14.4	10.7	-0.2	0.464	0.0		>>>	>>	8	18			
MW4	15.6	15.4	64.3	35.8	20.0	-0.2	0.770	0.0	0.0	>>>	>>	155	10.15			
Offsite																
G12	0	0	0.0	1.9	19.9	16.3	0.000	0.0	0.0	>>>	1	0	12.43			
G14	0	0	0.0	1.8	19.6	18.2	0.000	0.0	0.0	>>>	1	0	8.89			
BH07	0.3	0.3	0.0	1.4	18.4	18.2	0.000	0.0	0.0	>>>	1	2	15.48			
BH09	0	0	0.0	2.1	18.1	15.8	0.000	0.0	0.0	>>>	1	0	7.25			
BH10	0	0	0.0	2.4	20.0	16.1	0.000	0.0	0.0	>>>	1	0	9.57			
Onsite																
LG 16	1.6	0.7	73.1	26.6	19.3	0.3	0.941	0.0	32.0	>>>	>>	4	3.37			
LG 17	6.6	6.2	66.3	29.9	14.1	0.7	0.778	0.0	0.0	>>>	>>	49	4.61			
LG 21	2.5	2.3	60.0	32.9	16.3	0.9	0.726	0.0	0.0	>>>	>>	11	dry			
Offsite																
G15	0	0	0.0	2.2	19.8	18.3	0.000	0.0	0.0	>>>	1	0	dry			
G16	0	-0.5	0.0	2.9	19.5	16.8	0.000	0.0	0.0	>>>	1	-2	dry			
G17	0.4	0.1	0.0	2.9	19.1	16.1	0.000	0.0	0.0	>>>	1	2	dry			
BH08	0	0	0.0	2.5	18.1	18.1	0.000	0.0	0.0	>>>	1	0	dry			
Site 3C																
Onsite																
MW2	0.7	0.6	63.9	36.2	17.9	-0.2	0.766	0.0	0.0	>>>	>>	1	5.61			
LG 14	0.1	0	72.8	27.3	19.0	-0.1	0.830	0.0	0.0	>>>	>>	0	dry			
LG 18	0	0	65.2	34.9	20.4	-0.2	0.779	25.0	0.0	>>>	>>	0	dry			
Offsite																
G09	0.2	0.2	0.0	5.0	18.1	13.8	0.000	0.0	0.0	>>>	1	0	dry			
G11	0	-0.1	0.0	2.7	18.8	17.2	0.000	0.0	0.0	>>>	1	-1	12.73			
BH06	0.3	0	5.3	6.7	19.0	11.2	0.171	0.0	0.0	>>>	4.1	0	6.62			

Day Friday
Date !7th January
Weather as per Met Eireann:

Location			Weather		Temp	Humidity	Rain	Pressure (measured	
								Morning	Evening
		Dir	Speed (Kts)		°C	(%)	(mm)	(hPa)	
Dublin Airport	Friday							1006	1004
Dublin airport (met eireann)	Monday							1001	999

	Flow		CH4 (%)	CO2(%)	O2(%)		Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Dynamic pressure	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
	Peak	Steady			Peak	Steady										
Site 1																
Onsite																
LG 11	0.0	0.0	4.4	11.7	18.2	8.0	0.270	0.0	0.0	>>>	3.7	0.0	dry			
LG 12	0.0	0.0	4.6	18.9	19.3	0.7	0.281	0.0	0.0	>>>	3.8	0.0	dry			
LG 13	0.0	0.0	7.9	18.1	18.8	9.5	0.310	0.0	-10.0	>>>	0.0	0.0	9.10			
Offsite																
G06	0.0	0.0	16.1	7.3	20.0	0.3	0.537	0.0	0.0	>>>	>>>	0.0	dry			
G07	2.2	1.9	0.0	2.9	19.2	16.2	0.011	0.0	0.0	0.0	1	8.0	dry			
G08	3.9	3.9	0.0	0.0	20.1	20.0	0.000	0.0	0.0	0.0	1	22.0	dry			
G10	3.2	3.1	0.0	1.1	19.3	18.0	0.011	0.0	0.0	0.0	1	15.0	12.3			
G18	0	0	0.0	0.0	20.0	20.0	0.025	0.0	0.0	0.0	1	0.0	dry			
G19	0	0	0.0	1.7	19.2	19.2	0.910	0.0	0.0	0.0	1	0.0	dry			
BH05	9	9	0.0	5.9	17.2	19.2	0.010	0.0	0.0	0.0	1	82.0	dry			
Site 2																
LG 02	4	3.4	63.4	28.7	16.1	0.3	1.164	0.0	0.0	>>>>	>>>	18	8.65			
LG 03	0	0	44.3	24.2	19.1	0.3	0.553	0.0	0.0	>>>>	>>>	0	dry			
LG 04	6.8	6.7	72.2	26.6	13.2	0.300	1.271	25.0	0.0	>>>>	>>>	56	dry			
LG 05	1.1	1	58.8	24.9	20.1	1.0	0.698	0.0	0.0	>>>>	>>>	0	dry			
LG 06	0.1	0	0.3	0.8	19.7	19.7	0.063	0.0	0.0	8.9	1.1	0	dry			
LG 07	3.7	3.4	68.8	26.6	18.8	0.4	1.227	0.0	0.0	>>>>	>>>	14	dry			
LG 08	2.8	2.7	54.0	36.6	19.2	0.3	1.044	0.0	0.0	>>>>	>>>	11	dry			
LG 09	5.2	4.8	61.2	22.4	19.1	0.5	1.137	0.0	0.0	>>>>	>>>	34	dry			
LG 10	4.4	4.3	59.1	16.3	18.3	0.3	1.110	0.0	0.0	>>>>	>>>	28	17.13			
Offsite																
G01	3.8	3.3	45.4	25.5	16.0	0.4	0.941	0.0	0.0	>>>>	>>>	16	17.71			
G02	3.7	3.5	0.0	9.5	16.8	8.1	0.024	0.0	0.0	0.0	1	18	dry			
G03	5.4	4.7	4.9	17.2	18.9	0.4	0.294	0.0	0.0	>>>>	3.8	0	dry			
G04	0.4	0	0.0	2.0	14.4	14.4	0.029	0.0	0.0	0.0	1	0	13.15			
G05	4.5	4.2	55.7	6.3	10.4	0.0	1.067	0.0	0.0	>>>>	>>>	26	17.56			
G13	5.4	5.4	0.0	1.3	18.1	17.1	0.015	0.0	0.0	>>>>	>>>	4	dry			
G20	13.8	13.6	0.0	0.8	15.4	15.4	0.014	0.0	0.0	0.0	1	136	dry			
G21	6.5	5.8	0.0	1.9	18.2	16.5	0.012	0.0	0.0	0.0	1	46	dry			
G22	0.4	0.2	0.0	0.1	20.1	20.1	0.000	0.0	0.0	>>>>	1	1	dry			
G23	0	0	0.0	1.0	18.4	18.4	0.018	0.0	0.0	0.0	1	0	dry			
G24	11	10.5	0.0	1.6	15.8	15.1	0.012	0.0	0.0	0.0	1	99	dry			
G25	1.9	1.8	29.1	9.7	16.7	0.4	0.723	0.0	0.0	>>>>	>>>	9	dry			
BH01	3.6	3.4	0.0	4.8	19.3	19.9	0.013	0.0	0.0	0.0	1.0	17	17.39			
BH03	10.2	10.2	3.6	15.4	18.5	0.3	0.235	0.0	0.0	83.3	36	95	dry			
BH04	0	0	0.0	0.0	20.0	20.0	0.013	0.0	0.0	0.0	1	0	dry			
BH11	7.2	7.2	0.0	7.4	15.1	9.4	0.011	0.0	0.0	0.0	1	61	dry			
BH13	0	0	8.2	6.0	12.1	6.7	0.377	0.0	0.0	<<<<	6.9	987	dry			

Site 3A																
Onsite																
LG 15	0.3	0.3	42.1	23.9	19.1	0.6	0.901	0.0	0.0	>>>	>>>	1	2.99			
LG 19	20.8	20.7	68.4	31.1	15.2	0.2	1.222	0.0	0.0	>>>	>>>	220	14.62			
LG 20	0	0	39.1	19.4	18.8	0.6	0.862	0.0	0.0	>>>	>>>	0	11.38			
MW3 (19 dia. Pipe)	0	0	65.7	29.7	15.4	0.1	1.190	0.0	0.0	>>>	>>>	0	11.36			
MW3 (50 dia. Pipe)	1.8	1	21.4	11.9	15.4	5.0	0.612	0.0	0.0	>>>	>>>	4	18.24			
MW4	10.1	10	66.2	33.5	14.4	0.2	1.997	0.0	0.0	>>>	>>>	95	8.65			
Offsite																
G12	0	0	0.0	0.0	20.4	20.4	0.015	0.0	0.0	0.0	1	0	dry			
G14	0	0	0.0	1.6	18.3	18.3	0.013	0.0	0.0	0.0	1	0	9.13			
BH07	0	0	0.0	0.5	20.5	19.7	0.019	0.0	0.0	0.0	1	0	15.81			
BH09	0	0	0.0	1.4	18.2	18.2	0.043	0.0	0.0	0.0	1	0	8.49			
BH10	0	0	0.0	1.7	19.4	17.3	0.013	0.0	0.0	0.0	1	0	dry			
Onsite																
LG 16	0	0	54.1	26.6	20.1	2.0	1.045	0.0	0.0	>>>	>>>	0	dry			
LG 17	3.7	3.7	70.5	26.9	19.4	0.3	1.249	0.0	0.0	>>>	>>>	20	4.61			
LG 21	1.9	1.9	59.7	31.3	19.3	0.7	1.117	0.0	0.0	>>>	>>>	8	dry			
Offsite																
G15	0	0	0.0	2.4	20.1	18.4	0.014	0.0	0.0	0.0	1	0	dry			
G16	0	0	0.0	2.5	20.2	17.9	0.014	0.0	0.0	0.0	1	0	dry			
G17	0	0	0.0	2.5	18.5	18.0	0.030	0.0	0.0	0.0	1	0	dry			
BH08	0	0	0.0	1.7	19.3	18.4	0.002	0.0	0.0	0.0	1	0	dry			
Site 3C																
Onsite																
MW2	0	0	64.7	35.0	18.4	0.1	1.190	80.0	0.0	>>>	>>>	0	dry			
LG 14	0	0	72.3	26.5	19.0	0.3	1.270	0.0	0.0	>>>	>>>	0	dry			
LG 18	0	0	66.7	32.6	18.9	0.6	1.204	0.0	0.0	>>>	>>>	0	dry			
Offsite																
G09	0	0	0.0	0.0	20.4	20.4	0.019	0.0	0.0	0.0	1	0	dry			
G11	0	0	0.0	0.8	21.0	20.6	0.014	-25.0	0.0	0.0	1	0	dry			
BH06	0	0	17.4	18.2	18.2	0.5	0.548	0.0	0.0	>>>	>>>	0	6.84			

Day Tuesday & Thursday
Date 21st & 23rd February
Weather as per Met Eireann:

Location		Dir	Weather Speed (Kts)		Temp °C	Humidity (%)	Rain (mm)	Pressure (measured Morning (hPa)	Evening (hPa)
Dublin Airport	Tuesday	WSW	16.6		11.1		1.9	1000	
Dublin airport (met eireann)	Thursday	W	26		6	82	0	996	

	Flow Peak	Flow Steady	CH4 (%)	CO2(%)	O2(%) Peak	O2(%) Steady	Hex(%)	H_2S (ppm)	CO(ppm)	LEL	PID	Dynamic pressure	Water level (m below top of standpipe)	Height of standpipe above gl (cm)	Total depth of BH (mbgl)	Notes
Site 1																
Onsite																
LG 11	0.3	-0.3	1.7	7.7	20.4	10.6	0.067	0.0	0.0	40.4	1.8	-2.0	dry			
LG 12	0.0	0.0	0.7	12.1	20.2	7.9	0.037	0.0	0.0	18.0	1.3	0.0	dry			
LG 13	0.3	-2.1	2.5	8.7	20.1	13.3	0.100	0.0	0.0	58.8	2.7	-12.0	8.66			
Offsite																
G06	1.0	0.0	13.9	8.1	16.7	0.2	0.321	0.0	0.0	>	>	0.0	dry			
G07	1.4	1.4	-0.1	3.2	18.8	16.5	0.000	0.0	0.0	<	0.9	16.0	dry			
G08	0.7	0.3	-0.1	1.3	20.3	18.9	0.000	0.0	0.0	<	0.9	4.0	dry			
G10	1.5	0.3	-0.1	1.3	20.1	18.8	0.000	0.0	0.0	<	0.9	3.0	9.78			
G18	0.0	-3.2	-0.1	2.5	18.2	12.7	0.000	0.0	0.0	<	0.9	-16.0	dry			
G19	0.7	0.6	-0.1	1.7	19.8	16.9	0.000	0.0	0.0	<	0.9	7.0	dry			
BH05	0.0	0.0	-0.1	5.0	18.1	14.7	0.000	0.0	0.0	<	0.9	1.0	20.68			
Site 2																
LG 02	1.1	1.1	0.0	0.2	20.4	20.4	0.000	0.0	0.0	<	1.0	6	8.61			
LG 03	0.0	-0.5	47.9	19.0	17.9	0.7	0.656	0.0	0.0	>	>	-6	17.77			
LG 04	0.4	-0.4	70.3	27.7	17.7	0.100	0.852	25.0	0.0	>	>	-4	15.14			
LG 05	0.3	0.0	63.9	30.8	17.9	0.0	0.797	0.0	0.0	>	>	-1	13.93			
LG 06	2.4	1.2	51.8	28.8	20.1	2.1	0.688	0.0	0.0	>	>	6	6.64			
LG 07	0.0	-0.1	69.1	25.2	16.0	0.7	0.842	0.0	0.0	>	>	-2	12.03			
LG 08	1.7	1.3	46.1	29.8	18.0	0.2	0.641	0.0	0.0	>	>	15	dry			
LG 09	0.3	-0.4	71.5	23.5	17.8	0.1	0.861	0.0	0.0	>	>	-5	17.15			
LG 10	1.5	1.5	60.8	27.9	15.6	0.0	0.770	0.0	0.0	>	>	18	17.71			
Offsite																
G01	0.6	0.6	-0.1	4.0	19.1	15.1	0.000	0.0	0.0	<	0.9	7	dry			
G02	1.6	0.9	-0.1	8.9	19.0	10.1	0.000	0.0	0.0	<	0.9	10	dry			
G03	0.1	0.1	2.6	14.3	16.7	0.3	0.100	0.0	0.0	59.3	2.9	2	dry			
G04	0.0	-0.3	0.0	1.7	20.4	15.4	0.000	0.0	0.0	<	1.0	-2	dry			
G05	0.3	-0.1	53.6	6.8	15.4	0.2	0.703	0.0	0.0	>	>	-2	17.67			
G13	0.3	0.3	-0.1	1.3	19.6	18.5	0.000	0.0	0.0	<	0.9	5	dry			
G20	0.4	-0.3	0.0	0.8	18.2	16.4	0.000	0.0	0.0	<	1.0	-2	dry			
G21	0.0	0.0	-0.1	1.7	20.1	18.0	0.000	0.0	0.0	<	0.9	-1	dry			
G22	0.0	-2.7	-0.1	1.9	20.3	17.9	0.000	0.0	0.0	<	0.9	-16	dry			
G23	1.2	0.7	-0.1	1.3	20.3	19.3	0.000	0.0	0.0	<	0.9	8	dry			
G24	0.3	0.1	-0.1	1.5	19.4	16.8	0.000	0.0	0.0	<	0.9	3	dry			
G25	0.4	0.0	30.3	11.2	18.5	0.3	0.496	0.0	0.0	>	>	1	dry			
BH01	0.3	-0.3	0.0	0.1	20.7	20.7	0.000	0.0	0.0	<	1.0	-2	17.53			
BH03	3.4	-1	6.1	15.0	19.8	3.1	0.183	0.0	0.0	>	4.7	-11	dry			
BH04	0.3	0.3	0.0	0.2	20.2	20.2	0.002	0.0	0.0	0.0	1.0	2	dry			
BH11	0.6	0.1	3.0	16.5	18.1	0.2	0.113	0.0	0.0	69.9	3.5	2	dry			
BH13	0.7	0.2	11.0	9.5	20.0	0.4	0.276	0.0	0.0	>	10.4	3	dry			
Site 3A																
Onsite																

LG 15	0.6	0.6	34.5	21.4	19.8	3.7	0.538	0.0	0.0	>	>	6	6.59			
LG 19	2.6	1.5	66.1	33.1	19.5	0.3	0.820	0.0	0.0	>	>	19	dry			
LG 20	0.0	0.0	2.8	4.3	20.1	16.3	0.100	0.0	0.0	65.1	3.2	0	11.25			
MW3 (19 dia. Pipe)	0.0	0.0	-0.1	0.0	20.6	20.5	0.000	0.0	0.0	<	0.9	0	dry			
MW3 (50 dia. Pipe)	4.6	0.7	0.0	0.1	20.6	20.5	0.000	0.0	0.0	<	1.0	8	dry			
MW4	2.9	-0.8	65.1	34.1	18.8	0.3	0.811	0.0	0.0	>	>	-10	7.22			
Offsite																
G12	1.9	0.0	-0.1	0.0	20.6	20.5	0.000	0.0	0.0	<	0.9	0	dry			
G14	3.9	1.3	-0.1	0.2	20.6	20.3	0.000	0.0	0.0	<	0.9	11	9.12			
BH07	3.1	0.0	-0.1	0.0	20.5	20.5	0.000	0.0	0.0	<	0.9	0	15.9			
BH09	2.2	-0.2	-0.1	0.9	19.4	18.5	0.000	0.0	0.0	<	0.9	-3	8.48			
BH10	0.9	-0.3	-0.1	2.2	20.5	15.9	0.000	0.0	0.0	<	0.9	-3	9.81			
Onsite																
LG 16	0.8	0.3	0.0	0.1	20.6	20.5	0.000	0.0	0.0	<	1.0	3	dry			
LG 17	0.0	-0.1	58.5	32.4	20.4	1.9	0.751	0.0	0.0	>	>	0	dry			
LG 21	2.5	0.7	48.2	30.0	20.4	3.9	0.662	0.0	0.0	>	>	4	dry			
Offsite																
G15	0.0	0.0	-0.1	2.7	20.2	17.8	0.000	0.0	0.0	<	0.9	1	dry			
G16	0.3	0.0	-0.1	3.2	19.7	17.0	0.000	0.0	0.0	<	0.9	0	dry			
G17	2.2	2.2	-0.1	0.6	20.5	19.7	0.000	0.0	0.0	<	0.9	11	dry			
BH08	3.7	0.7	-0.1	0.3	20.5	20.2	0.000	0.0	0.0	<	0.9	3	dry			
Site 3C																
Onsite																
MW2	0.0	-2.2	36.6	24.3	20.3	6.0	0.558	0.0	0.0	>	>	-11	5.14			
LG 14	0.0	0.0	7.2	4.4	20.1	17.8	0.201	0.0	0.0	>	5.7	0	11.5			
LG 18	3.7	0.0	64.2	35.3	19.5	0.4	0.811	0.0	0.0	>	>	0	9.95			
Offsite																
G09	4.0	3.1	-0.1	14.8	15.6	0.7	0.000	0.0	0.0	<	0.9	15	dry			
G11	2.2	1.2	0.0	0.3	20.6	20.4	0.000	0.0	0.0	<	1	13	13.12			
BH06	0.0	0.0	18.9	19.6	19.9	1.0	0.385	0.0	0.0	>	>	0	6.62			

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 21.6.20 8:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: dry, cloudy
ATMOSPHERIC PRESSURE: 999
ATMOSPHERIC TEMP: 15°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar STATIC READINGS

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUSTMENT %	DIP LEVEL	BASE LEVEL
ARRIVAL												
FLARE												
LG05	n/a	0	0	21.1	0	0	0.18		x	x		
LG07	n/a	34.5	23.1	1.4	2	0	0.35		x	x		
LG09	n/a	55.1	19.7	2.2	2	0	0.4		x	x		
LG10	n/a	57.8	30	1.1	7	0	0.27		x	x		
LG12	n/a	37.1	22.2	0.5	7	0	0		x	x		
LG13	n/a	36.4	21.9	0.8	6	0	0		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUSTMENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0	0	21.1	0	0	0	0.4	x	x		
LG02	n/a	0	0	20.8	0	0	0	0.14	x	x		
LG03	n/a	51.8	23.9	1.2	0	0	0	0.23	x	x		
LG04	n/a	0	0	20.9	0	0	0	0.3	x	x		
LG11	n/a	1.1	4.8	16	1	0	0	0	x	x		
LG08	n/a	42.6	26.4	1.3	4	0	0	0.33	x	x		
BH01	n/a	0	0.9	0	0	0	0	0.34	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0	20.5	0	0	0	0.15	x	x		
G01												
G02												
G03												
G04	n/a	0	1.3	17.2	0	0	0	-0.08	x	x		
G05	n/a	18	6.1	2.2	0	0	0	0.14	x	x		
G06												
G07	n/a	0	0	21.1	1	0	0	0	x	x		
G08	n/a	0	0.2	21	0	0	0	0.13	x	x		
G10												
G13												
G18	n/a	9.2	4.7	1	0	0	0	0.95	x	x		
G19	n/a	0	1.4	18.7	0	0	0	0.34	x	x		
G20												
G21												
G25	n/a	14.6	4.9	5	0	0	0	0	x	x		
DEPART												
HOURS RUN												
TOTAL FLOW												
FLARE												
GENERATOR HRS RUN												
FUEL LEVEL												

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 22.6.20 09:00am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy,drizzle
ATMOSPHERIC PRESSURE: 1006
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar Blower- 85%

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	170	20.6	19.4	3	4	2	-130		100%	x		
LG05	5.35	59.7	27.4	0.2	2	0	-9		100%	x		
LG07	4.8	42.5	25.9	1	2	1	-11		100%	x		
LG09	3.86	61	23.2	0.4	1	4	-9.5		100%	x		
LG10	3.93	52.4	24.3	0	1	3	-9		100%	x		
LG12	2.71	4.9	17.5	2.9	5	0	-11		30%	x		
LG13	8.24	8.4	19.8	1.5	6	3	-11		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	1	2.5	16.9	0	0	0	0.24	x	x		
LG02	n/a	0.4	0.5	20.8	0	0	0	0.23	x	x		
LG03	n/a	0	0	21.3	0	0	0	0.08	x	x		
LG04	n/a	0	0	21.1	1	0	0	0.24	x	x		
LG11	n/a	0	0	20.8	0	0	0	0.22	x	x		
LG08	n/a	9.2	7.2	14.1	1	0	0	0.2	x	x		
BH01	n/a	0	1	20.6	0	0	0	0.22	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0	20.8	0	0	0	0.22	x	x		
G01												
G02												
G03												
G04	n/a	0	1.4	17.1	0	0	0	0.2	x	x		
G05	n/a	5.6	1.9	15.9	0	0	0	0.18	x	x		
G06												
G07	n/a	0	0	21.2	0	0	0	0.1	x	x		
G08	n/a	0	0	21.3	0	0	0	0.12	x	x		
G10												
G13												
G18	n/a	6	3.1	8.5	0	0	0	3.5	x	x		
G19	n/a	0	1	19.6	0	0	0	0.24	x	x		
G20												
G21												
G25	n/a	15.4	5.7	4.4	0	0	0	0.3	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	120	27.3	19.6	3.7	3	1	-154	x	100%	x		
GENERATOR HRS RUN	12561.8											
FUEL LEVEL	FULL											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 22.6.20 11:45am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy drizzle
ATMOSPHERIC PRESSURE: 1008
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	122	27	19.3	4	3	1	-153		100%	x		
LG05	4.89	58.8	27.1	0.4	3	1	-8		100%	x		
LG07	4.68	41.9	25.7	1	2	3	-10		100%	x		
LG09	3.62	60	23.2	0.3	2	6	-9		100%	x		
LG10	3.4	51.4	24	0.1	1	6	-8		100%	x		
LG12	2.82	4.6	17.2	3.3	6	0	-11		30%	x		
LG13	7.36	8.3	19.7	1.1	8	3	-11		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0	0	21	0	0	0	0.26	x	x		
LG02	n/a	0.4	0.7	20.4	0	0	0	0.26	x	x		
LG03	n/a	0	0	21.1	0	0	0	0	x	x		
LG04	n/a	0	0	21	0	0	0	0.22	x	x		
LG11	n/a	0	0.5	20.4	0	0	0	0.16	x	x		
LG08	n/a	7.2	5.9	14.9	1	0	0	0.42	x	x		
BH01	n/a	0	1.6	20.1	0	0	0	0.28	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0.4	20.5	0	0	0	0.13	x	x		
G01												
G02												
G03												
G04	n/a	0	1.4	17	0	0	0	0.23	x	x		
G05	n/a	0.5	0.3	20.2	0	0	0	-0.2	x	x		
G06												
G07	n/a	0	0	21	0	0	0	0	x	x		
G08	n/a	0	0	21	0	0	0	0	x	x		
G10												
G13												
G18	n/a	2.4	1.5	15.5	0	0	0	0.27	x	x		
G19	n/a	0	1.1	19.3	0	0	0	0.2	x	x		
G20												
G21												
G25	n/a	14.3	5.5	5.1	0	0	0	-0.2	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	115	28.2	19.6	3.6	4	2	-154	x	100%	x		
GENERATOR HRS RUN	12564.5											
FUEL LEVEL	FULL											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 22.6.20 14:00
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1007
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	115	28	19.5	3.8	4	2	-154		100%	x		
LG05	4.27	58.5	26.9	0.2	3	0	-8		100%	x		
LG07	3.86	41.7	25.5	1	3	1	-10		100%	x		
LG09	3.21	59	23.1	0.4	2	3	-9		100%	x		
LG10	3.1	51	23.9	0	2	4	-8		100%	x		
LG12	2.26	4.5	17	3.3	6	1	-11		30%	x		
LG13	6.61	7.7	19.5	1.1	8	5	-11		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0.7	1.5	18.6	0	0	0	0.38	x	x		
LG02	n/a	0.6	1.1	19.8	0	0	0	0.25	x	x		
LG03	n/a	37.8	18.8	4.5	2	0	0	0.31	x	x		
LG04	n/a	0	0.2	20.6	0	0	0	0.26	x	x		
LG11	n/a	0	0.6	20.4	0	0	0	0.3	x	x		
LG08	n/a	5.8	5	16.1	1	0	0	0.35	x	x		
BH01	n/a	0	0.8	20.4	0	0	0	0.36	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0.4	20.4	0	0	0	0.45	x	x		
G01												
G02												
G03												
G04	n/a	0	1.4	16.6	0	0	0	0.34	x	x		
G05	n/a	6.8	3.8	11.2	0	0	0	0.5	x	x		
G06												
G07	n/a	0	0	20	0	0	0	0	x	x		
G08	n/a	0	0	21.1	0	0	0	0.13	x	x		
G10												
G13												
G18	n/a	3.7	2.1	12.5	0	0	0	0.43	x	x		
G19	n/a	0	1	19.6	0	0	0	0.34	x	x		
G20												
G21												
G25	n/a	13.8	5.4	5.2	0	0	0	0.42	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	115	27.7	19.5	3.7	4	2	-153	x	100%	x		
GENERATOR HRS RUN	12566.4											
FUEL LEVEL	FULL											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 23.6.20 8:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy drizzle
ATMOSPHERIC PRESSURE: 1009
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	115	26.3	19.2	3.9	4	2	-157		100%	x		
LG05	7.65	54	26.7	0.3	2	1	-8		100%	x		
LG07	5.31	40.6	25.8	1	2	3	-10		100%	x		
LG09	4.82	55.9	23.5	0.5	1	6	-9		100%	x		
LG10	3.1	46.5	24.2	0	1	1	-8		100%	x		
LG12	9.62	4.1	16.5	3.8	8	1	-11		30%	x		
LG13	8.82	5.4	18.6	1.5	10	5	-11		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0	0	21.1	0	0	0	0.4	x	x		
LG02	n/a	2.8	4.2	16.4	0	0	0	0	x	x		
LG03	n/a	49.7	22.7	1.8	1	0	0	0.2	x	x		
LG04	n/a	0.3	0.6	20.6	0	0	0	0.34	x	x		
LG11	n/a	0	0.7	20.4	0	0	0	0.36	x	x		
LG08	n/a	0	0	21.1	0	0	0	0.35	x	x		
BH01	n/a	0	0.7	20.7	0	0	0	0.42	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0.3	20.9	0	0	0	0.25	x	x		
G01												
G02												
G03												
G04	n/a	0	1.4	17.1	0	0	0	0.42	x	x		
G05	n/a	0	0	21	0	0	0	0.12	x	x		
G06												
G07	n/a	0	0	21.1	0	0	0	0.12	x	x		
G08	n/a	0	0	21.1	0	0	0	0	x	x		
G10												
G13												
G18	n/a	0	0	21.2	0	0	0	0.36	x	x		
G19	n/a	0	1	20.1	0	0	0	0.35	x	x		
G20												
G21												
G25	n/a	13.1	5.4	5.8	0	0	0	0.07	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	115	26.3	19.4	3.7	5	2	-157	x	100%	x		
GENERATOR HRS RUN	12585.3											
FUEL LEVEL	FULL											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 23.6.20 11:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy,drizzle
ATMOSPHERIC PRESSURE: 1009
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar Blower- 85%

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	115	26	19.2	4	5	2	-157		100%	x		
LG05	6.64	53.2	26.5	0.2	3	1	-8		100%	x		
LG07	5.1	40.1	25.6	1	2	3	-10		100%	x		
LG09	4.88	55.1	23.5	0.5	2	6	-9		100%	x		
LG10	2.98	45.4	24	0.1	2	0	-8		100%	x		
LG12	7.78	4	16.4	3.9	8	1	-11		30%	x		
LG13	8.69	5.1	18.6	1.6	11	4	-11		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0	0	20.8	0	0	0	0.4	x	x		
LG02	n/a	3.5	5	15.1	0	0	0	0.2	x	x		
LG03	n/a	49.5	22.9	1.5	1	0	0	0.3	x	x		
LG04	n/a	0.2	0.4	20.5	0	0	0	0.38	x	x		
LG11	n/a	0	0.7	20.4	0	0	0	0.35	x	x		
LG08	n/a	1.3	1.5	19.4	1	0	0	0.41	x	x		
BH01	n/a	0	0.7	20.5	0	0	0	0.42	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0.6	20.3	0	0	0	0.33	x	x		
G01												
G02												
G03												
G04	n/a	0	1.4	16.8	0	0	0	0.4	x	x		
G05	n/a	0	0	21	0	0	0	0.16	x	x		
G06												
G07	n/a	0	0	21	0	0	0	0	x	x		
G08	n/a	0	0	21.1	0	0	0	0	x	x		
G10												
G13												
G18	n/a	0	0	21.1	0	0	0	0.4	x	x		
G19	n/a	0	0.8	20.4	0	0	0	0.36	x	x		
G20												
G21												
G25	n/a	13.5	5.5	5.4	0	0	0	0.35	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	115	26	19.2	3.8	5	2	-155	x	100%	x		
GENERATOR HRS RUN	12588											
FUEL LEVEL	FULL											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 23.6.20 14:00pm
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy drizzle
ATMOSPHERIC PRESSURE: 1009
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	115	26.1	19.4	3.9	5	2	-156		100%	x		
LG05	6.74	52.7	26.6	0.3	2	1	-8		100%	x		
LG07	5.17	40.2	25.4	1	1	2	-10		100%	x		
LG09	4.92	55	23.6	0.4	1	5	-9		100%	x		
LG10	3.24	46.4	24.5	0.1	1	1	-8		100%	x		
LG12	8.22	4.1	16.3	3.9	9	3	-11		30%	x		
LG13	9.18	5	18.4	1.5	10	5	-11		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0	0	20.9	0	0	0	0.35	x	x		
LG02	n/a	2.6	4.1	16.8	0	0	0	0.24	x	x		
LG03	n/a	49.1	22.5	1.5	0	0	0	0.34	x	x		
LG04	n/a	0	0.3	20.8	0	0	0	0.36	x	x		
LG11	n/a	0	0.6	19.9	0	0	0	0.22	x	x		
LG08	n/a	1	1.3	20.8	0	0	0	0.38	x	x		
BH01	n/a	0	0.6	21.1	0	0	0	0.4	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0.6	20.8	0	0	0	0.3	x	x		
G01												
G02												
G03												
G04	n/a	0	0	20.1	0	0	0	0.22	x	x		
G05	n/a	0	0	21.2	0	0	0	0	x	x		
G06												
G07	n/a	0	0	21.3	0	0	0	0	x	x		
G08	n/a	0	0	21	0	0	0	0	x	x		
G10												
G13												
G18	n/a	0	0	21.2	0	0	0	0.3	x	x		
G19	n/a	0	0.8	20.1	0	0	0	0.25	x	x		
G20												
G21												
G25	n/a	12.8	5.2	5.5	0	0	0	0.17	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	115	26	19.3	3.8	5	2	-157	x	100%	x		
GENERATOR HRS RUN	12589.7											
FUEL LEVEL	3 .5											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 24.6.20 8:00am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: dry,sunny
ATMOSPHERIC PRESSURE: 1012
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	115	24.7	19.1	3.9	4	2	-155		100%	x		
LG05	6.65	49.3	26.1	0.4	2	0	-8		100%	x		
LG07	5.59	38.3	25.5	0.9	2	2	-9.5		100%	x		
LG09	4.21	52.3	23.7	0.4	2	5	-8		100%	x		
LG10	2.76	42.4	24.2	0.2	1	0	-8		100%	x		
LG12	8.1	3.6	16.2	4.1	8	0	-11		x	x		
LG13	8.62	3.9	17.9	1.8	10	3	-11		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0	0	20.2	0	0	0	0.34	x	x		
LG02	n/a	8.2	10.1	9.2	0	0	0	0.34	x	x		
LG03	n/a	19.8	9.9	13.3	0	0	0	0.23	x	x		
LG04	n/a	0.2	0.7	19.9	0	0	0	0.3	x	x		
LG11	n/a	0	0.9	19.4	0	0	0	0.29	x	x		
LG08	n/a	0.8	1.6	19.1	1	0	0	0.4	x	x		
BH01	n/a	0	0.7	20.1	0	0	0	0.43	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0	20.3	0	0	0	0.27	x	x		
G01												
G02												
G03												
G04	n/a	0	1.5	16.6	0	0	0	0.35	x	x		
G05	n/a	0	0	20.2	0	0	0	0.05	x	x		
G06												
G07	n/a	0	0	20.8	0	0	0	0.17	x	x		
G08	n/a	0	0	21	0	0	0	0.12	x	x		
G10												
G13												
G18	n/a	4.7	2.6	10.5	0	0	0	0.3	x	x		
G19	n/a	0	1.1	19.4	0	0	0	0.25	x	x		
G20												
G21												
G25	n/a	11.6	5.4	6.5	0	0	0	0.12	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	70	36.2	20.2	4.4	2	2	-158	x	100%	x		
GENERATOR HRS RUN	12608.7											
FUEL LEVEL	3.5											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 21.6.20 14:00
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1003
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	65	19.7	17.8	4.7	1	2	-28		100%	x		
LG05	3.25	54.8	26.3	0.7	4	0	-3.5		100%	x		
LG07	2.66	42.2	24.9	1.2	3	0	-3.8		100%	x		
LG09	1.71	63.7	21.5	0.9	2	0	-3.5		100%	x		
LG10	2.55	56.4	24.1	0.1	2	3	-3		100%	x		
LG12	3.12	4.5	18.9	1.9	1	1	-15		100%	x		
LG13	7.61	10.9	21.5	0.4	1	6	-16		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0	0	20.8	0	0	0	0.38	x	x		
LG02	n/a	0	0	20.8	0	0	0	0.42	x	x		
LG03	n/a	47.3	22	2.7	1	0	0	0.2	x	x		
LG04	n/a	0	0	21	1	0	0	0.35	x	x		
LG11	n/a	0.3	2.4	18.4	0	0	0	0.28	x	x		
LG08	n/a	24.4	16.3	9.1	3	0	0	0.33	x	x		
BH01	n/a	0	0.8	20.2	0	0	0	0.36	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0.2	20.5	0	0	0	0.15	x	x		
G01												
G02												
G03												
G04	n/a	0	1.3	16.8	0	0	0	0.36	x	x		
G05	n/a	0	0	20.7	0	0	0	-0.5	x	x		
G06												
G07	n/a	0	0	20.7	0	0	0	-0.05	x	x		
G08	n/a	0	0	20.8	0	0	0	-0.12	x	x		
G10												
G13												
G18	n/a	0	0	20.8	0	0	0	2.02	x	x		
G19	n/a	0	0.7	19.8	0	0	0	0.05	x	x		
G20												
G21												
G25	n/a	18.5	6	2.1	0	0	0	0	x	x		
HOURS RUN	210											
TOTAL FLOW	n/a											
FLARE	65	22.1	18.9	3.5	2	2	-28	x	100%	x		
GENERATOR HRS RUN	12542.8											
FUEL LEVEL	FULL											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 21.6.20 11:45am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy, light rain
ATMOSPHERIC PRESSURE: 1002
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	65	19.5	18	4.3	1	1	-28		100%	x		
LG05	3.19	49.3	24.5	1.7	4	0	-3		100%	x		
LG07	2.85	42.7	25	1.1	2	0	-4		100%	x		
LG09	1.62	64.9	21.7	0.8	2	0	-3.5		100%	x		
LG10	2.51	57.7	24.4	0	2	6	-3		100%	x		
LG12	3.6	4	19	1.6	0	1	-15		100%	x		
LG13	7.66	11.9	21.8	0.3	1	5	-16		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	0	0	21.1	0	0	0	0.35	x	x		
LG02	n/a	0	0	21.2	0	0	0	-0.25	x	x		
LG03	n/a	50.5	23.2	1.9	0	0	0	0.3	x	x		
LG04	n/a	0	0	21.2	1	0	0	0.3	x	x		
LG11	n/a	0.4	3	17.6	0	0	0	0.3	x	x		
LG08	n/a	32.6	21.8	5.2	3	0	0	0.39	x	x		
BH01	n/a	0	0.6	20.9	0	0	0	0.36	x	x		
BH03												
BH04												
BH11												
BH13	n/a	0	0	20.8	0	0	0	0.17	x	x		
G01												
G02												
G03												
G04	n/a	0	1.3	17.2	0	0	0	0.35	x	x		
G05	n/a	0	0	21.1	0	0	0	-0.38	x	x		
G06												
G07	n/a	0	0	20.8	0	0	0	-0.14	x	x		
G08	n/a	0	0	20.9	0	0	0	-0.18	x	x		
G10												
G13												
G18	n/a	0	0	21.1	0	0	0	1.5	x	x		
G19	n/a	0	0.9	19.7	0	0	0	0.3	x	x		
G20												
G21												
G25	n/a	15.6	5.2	5.3	0	0	0	0	x	x		
HOURS RUN	210											
TOTAL FLOW	n/a											
FLARE	65	19.5	17.9	4.4	2	2	-28	x	100%	x		
GENERATOR HRS RUN	12540.7											
FUEL LEVEL	FULL											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 27.6.20 12:00pm
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy, rain
ATMOSPHERIC PRESSURE: 986
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar Blower- 95%

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	85	30.5	18	6.5	1	1	-160		100%	x		
LG05	6.35	43	25.8	0.4	2	0	-7		100%	x		
LG07	7.58	34.5	25.6	1	2	0	-9.5		100%	x		
LG09	5.21	54.6	24.4	0.2	2	1	-8		100%	x		
LG10	3.27	43.8	25.4	0	2	2	-7		100%	x		
LG12	0	1.1	8.5	12.2	2	1	0.28		x	x		
LG13	0	2.2	11.2	8.8	3	0	0.33		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	11.7	14.6	1.9	8	0	0	0.34	x	x		
LG02	n/a	13.3	11.6	9.8	0	0	0	0.32	x	x		
LG03	n/a	58	25.9	0	1	0	0	0.47	x	x		
LG04	n/a	34.8	21.9	0.3	8	0	0	0.38	x	x		
LG11	n/a	3.2	11.3	6.8	1	0	0	0.44	x	x		
LG08	n/a	38.1	26.2	0.5	3	0	0	0.36	x	x		
BH01	n/a	0	1.5	19.8	0	0	0	0.34	x	x		
BH03												
BH04												
BH11												
BH13	n/a	2.6	4.5	8.7	0	0	0	0.33	x	x		
G01												
G02												
G03												
G04	n/a	0	1.5	17.1	0	0	0	0.33	x	x		
G05	n/a	35.6	6.5	0.1	1	0	0	0.48	x	x		
G06												
G07	n/a	0	0.9	19.1	0	0	0	0.44	x	x		
G08	n/a	0	0.7	19.6	0	0	0	0.56	x	x		
G10												
G13												
G18	n/a	7.9	5.1	0	1	0	0	0.33	x	x		
G19	n/a	0	2.8	15.4	0	0	0	0.28	x	x		
G20												
G21												
G25	n/a	22.1	6.3	0	2	1	0	0.34	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	80	32.1	19.2	5.5	1	1	-160	x	100%	x		
GENERATOR HRS RUN	12683.8											
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 25.6.20 8:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: dry,sunny
ATMOSPHERIC PRESSURE: 1008
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	70	33.8	19.4	5.1	1	2	-160		100%	x		
LG05	5.79	46.5	25.8	0.2	3	0	-6		100%	x		
LG07	5.13	36.5	25.1	1	2	0	-8.5		100%	x		
LG09	3.62	51.8	23.5	0.3	2	3	-7		100%	x		
LG10	2.38	42.3	24.2	0	2	3	-6.5		100%	x		
LG12	0	0.7	3.5	17	2	0	0.33		x	x		
LG13	0	1.9	11.2	8.4	5	0	0.32		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	10.2	15.2	0.7	0	0	0	0.44	x	x		
LG02	n/a	13	15	4.4	0	0	0	0.55	x	x		
LG03	n/a	52.8	24.7	0.9	1	0	0	0.62	x	x		
LG04	n/a	7.2	8.5	8.6	3	0	0	0.52	x	x		
LG11	n/a	0.6	4	13.4	0	0	0	0.33	x	x		
LG08	n/a	1.4	2.3	16.9	1	0	0	0.58	x	x		
BH01	n/a	0.2	0.7	20	0	0	0	0.46	x	x		
BH03												
BH04												
BH11												
BH13	n/a	5.4	6.8	0	0	2	0	0.47	x	x		
G01												
G02												
G03												
G04	n/a	0	1.4	16.3	0	0	0	0.44	x	x		
G05	n/a	21	7.9	0	1	0	0	0.61	x	x		
G06												
G07	n/a	0	0	19.8	0	0	0	0.12	x	x		
G08	n/a	0	0	20.3	0	0	0	0.14	x	x		
G10												
G13												
G18	n/a	9.1	4.9	0	0	0	0	0.47	x	x		
G19	n/a	0	1.5	17.3	0	0	0	0.4	x	x		
G20												
G21												
G25	n/a	13.6	5.9	4.1	0	0	0	0.63	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	70	34.1	19.5	4.9	2	2	-158	x	100%	x		
GENERATOR HRS RUN	12633											
FUEL LEVEL	3 quarters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 25.6.20 11:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: dry,sunny
ATMOSPHERIC PRESSURE: 1004
ATMOSPHERIC TEMP: 19°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar Blower- 85%

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	70	34.3	19.3	5	2	1	-158		100%	x		
LG05	6.64	53.2	26.5	0.2	3	1	-6		100%	x	13.3	14.2
LG07	5.1	40.1	25.6	1	2	3	-8.5		100%	x	8.6	16.1
LG09	4.88	55.1	23.5	0.5	2	6	-7		100%	x	14	18.4
LG10	2.98	45.4	24	0.1	2	0	-6.5		100%	x	17.6	19.2
LG12	0	4	16.4	3.9	8	1	0.38		x	x	dry	12.4
LG13	0	5.1	18.6	1.6	11	4	0.36		x	x	9	9.7
GAS MONITORING WELLS	FLOW M/SEC	CH4	CO2	O2	CO	H2S	SUCTION MBAR	WELL PRESS	VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
LG01	n/a	10	14.5	0.9	0	0	0	0.4	x	x	dry	9.4
LG02	n/a	12.9	15.1	4.5	0	0	0	0.52	x	x	8.2	9.2
LG03	n/a	50.6	24.5	0.8	2	0	0	0.58	x	x	dry	17.7
LG04	n/a	7.2	8.8	8.6	0	0	0	0.5	x	x	dry	12.8
LG11	n/a	0.4	4.1	15.5	0	0	0	0.44	x	x	12	13
LG08	n/a	1.1	1.7	17.6	1	0	0	0.38	x	x	6.4	7.6
BH01	n/a	0	0.6	19.9	0	0	0	0.36	x	x	dry	6.8
BH03												
BH04												
BH11												
BH13	n/a	3.2	0.8	1.1	0	0	0	0.44	x	x	dry	17.3
G01												
G02												
G03												
G04	n/a	0	1.4	16.5	0	0	0	0.34	x	x	11.2	18.3
G05	n/a	19.8	8	0.4	0	0	0	0.38	x	x	16.7	18.4
G06												
G07	n/a	0	0	20.8	0	0	0	0	x	x	dry	14
G08	n/a	0	0	20.5	0	0	0	0	x	x	dry	14
G10												
G13												
G18	n/a	8.8	5.5	0.6	0	0	0	0.44	x	x	dry	10.7
G19	n/a	0	1	18.3	0	0	0	0.4	x	x	dry	13.6
G20												
G21												
G25	n/a	13.1	5.9	4.6	0	0	0	0.61	x	x	dry	20
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	70	34.1	19.2	5.2	2	3	-158	x	100%	x		
GENERATOR HRS RUN	12636.3											
FUEL LEVEL	3 quarters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 26.6.20 8:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: dry,cloudy
ATMOSPHERIC PRESSURE: 997
ATMOSPHERIC TEMP: 18°c
EQUIPMENT USED: GA 2000 blower-85%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	70	34.3	19.7	5	1	3	-160		100%	x		
LG05	5.89	44.7	25.5	0.4	3	0	-6		100%	x		
LG07	5.23	36.1	25.3	1.1	2	0	-8.5		100%	x		
LG09	3.6	54.8	24	0.2	2	2	-7		100%	x		
LG10	2.48	44	24.8	0	2	4	-6.5		100%	x		
LG12	0	1.2	7.2	12.5	1	0	0.4		x	x		
LG13	0	2	10.3	9	4	0	0.39		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	11.3	14.7	1.6	5	0	0	0.53	x	x		
LG02	n/a	7	6.8	14.2	0	0	0	0.5	x	x		
LG03	n/a	47.8	24.1	0.6	1	0	0	0.6	x	x		
LG04	n/a	26.2	20.1	0.5	10	0	0	0.56	x	x		
LG11	n/a	1.8	8.7	9.1	0	0	0	0.38	x	x		
LG08	n/a	33.9	25.3	0	8	0	0	0.58	x	x		
BH01	n/a	0.2	1.3	19.9	0	0	0	0.52	x	x		
BH03												
BH04												
BH11												
BH13	n/a	5.2	6.7	0.2	0	0	0	0.46	x	x		
G01												
G02												
G03												
G04	n/a	0	1.1	17.4	0	0	0	0.42	x	x		
G05	n/a	30.7	7.2	0	4	0	0	0.62	x	x		
G06												
G07	n/a	0	2.2	18.5	0	0	0	0.62	x	x		
G08	n/a	0	0.5	19.6	0	0	0	0.61	x	x		
G10												
G13												
G18	n/a	8.1	5	0.2	1	0	0	0.5	x	x		
G19	n/a	0	2.1	15	0	0	0	0.47	x	x		
G20												
G21												
G25	n/a	22	6	0	0	0	0	0.63	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	70	33.9	19.6	4.8	2	2	-158	x	100%	x		
GENERATOR HRS RUN	12657.2											
FUEL LEVEL	3 quarters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 25.6.20 14:00pm
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: dry, sunny
ATMOSPHERIC PRESSURE: 1004
ATMOSPHERIC TEMP: 20°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	70	34.2	19.2	5.3	3	2	-158		100%	x		
LG05	6.51	52.5	26.5	0.4	2	0	-6		100%	x		
LG07	5.19	40.1	25.7	0.9	1	2	-8.5		100%	x		
LG09	4.76	55.5	23.8	0.3	2	6	-7		100%	x		
LG10	2.88	46.1	24.1	0	2	1	-6.5		100%	x		
LG12	0	4	16.2	4.5	8	2	0.22		x	x		
LG13	0	4.9	18.6	1.6	9	3	0.26		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	10.1	14.3	1.2	0	0	0	0.4	x	x		
LG02	n/a	12.8	15.4	4.8	0	0	0	0.51	x	x		
LG03	n/a	49.8	23.6	1	1	0	0	0.58	x	x		
LG04	n/a	7	9.2	10.1	0	0	0	0.48	x	x		
LG11	n/a	0.1	0.6	19.9	0	0	0	0.36	x	x		
LG08	n/a	1	4	17.6	0	0	0	0.4	x	x		
BH01	n/a	0	0.5	20.2	0	0	0	0.41	x	x		
BH03												
BH04												
BH11												
BH13	n/a	3.1	1	1.5	0	0	0	0.5	x	x		
G01												
G02												
G03												
G04	n/a	0	1.1	18.2	0	0	0	0.12	x	x		
G05	n/a	18.9	8.6	0.2	0	0	0	0.16	x	x		
G06												
G07	n/a	0	0	19.8	0	0	0	0	x	x		
G08	n/a	0	0	20.9	0	0	0	0	x	x		
G10												
G13												
G18	n/a	8.6	5.4	1.1	0	0	0	0.55	x	x		
G19	n/a	0	0.5	20.2	0	0	0	0.62	x	x		
G20												
G21												
G25	n/a	13	5.5	5.1	0	0	0	0.35	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	70	34.3	19.4	5.1	3	2	-157	x	100%	x		
GENERATOR HRS RUN	12639.5											
FUEL LEVEL	3 .5											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 26.6.20 11:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: dry,sunny
ATMOSPHERIC PRESSURE: 994
ATMOSPHERIC TEMP: 20°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar Blower- 95% at 10am

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	34.7	19.8	4.8	2	3	D53		100%	x		
LG05	5.4	43.3	24.5	1	4	0	-6.65		100%	x		
LG07	7.5	36.6	25.1	1	3	0	-10		100%	x		
LG09	7.09	54.5	23.6	0.2	3	0	-8		100%	x		
LG10	3.51	44.3	24.6	0	3	4	-7		100%	x		
LG12	0	1.3	7.5	11.8	2	0	0.45		x	x		
LG13	0	2.1	10.3	8.6	5	0	0.46		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	12.3	15.5	0.5	9	0	0	0.56	x	x		
LG02	n/a	9.6	9.5	10.5	1	0	0	0.7	x	x		
LG03	n/a	47.8	24	0.2	2	0	0	0.7	x	x		
LG04	n/a	26.1	19.5	0.2	13	0	0	0.65	x	x		
LG11	n/a	2.7	10.4	6.8	0	0	0	0.44	x	x		
LG08	n/a	36.4	25.5	0	11	0	0	0.61	x	x		
BH01	n/a	0	0.5	20.6	0	0	0	0.55	x	x		
BH03												
BH04												
BH11												
BH13	n/a	5.3	6.6	0	1	0	0	0.6	x	x		
G01												
G02												
G03												
G04	n/a	0	1.1	17.3	0	0	0	0.58	x	x		
G05	n/a	31.5	6.9	0.5	5		0	0.74	x	x		
G06												
G07	n/a	0	1.8	18.8	0	0	0	0.6	x	x		
G08	n/a	0	0.4	20.1	0	0	0	0.58	x	x		
G10												
G13												
G18	n/a	8	4.9	0	2	0	0	0.56	x	x		
G19	n/a	0	2.1	14.7	0	0	0	0.57	x	x		
G20												
G21												
G25	n/a	22.1	5.9	0	5	0	0	0.72	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	75	34.1	19.4	5	3	3	-160	x	100%	x		
GENERATOR HRS RUN	12660.1											
FUEL LEVEL	3 quarters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 26.6.20 14:00pm
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: dry, sunny
ATMOSPHERIC PRESSURE: 993
ATMOSPHERIC TEMP: 21°c
EQUIPMENT USED: GA 2000 blower- 95%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	80	33.8	19	5.4	3	3	-160		100%	x		
LG05	5.94	43.7	25.1	0.6	4	0	-6.62		100%	x		
LG07	7.44	35.6	25.2	1	3	0	-9.5		100%	x		
LG09	6.91	54.6	23.8	0.2	3	1	-8		100%	x		
LG10	3.65	43.8	24.6	0	3	0	-7		100%	x		
LG12	0	1.4	7.6	11.6	2	0	0.5		x	x		
LG13	0	2.2	10.5	8.6	5	0	0.45		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	10.3	12.7	3.2	12	0	0	0.56	x	x		
LG02	n/a	5.8	5.3	15.3	1	0	0	0.6	x	x		
LG03	n/a	47.5	24	0.4	2	0	0	0.62	x	x		
LG04	n/a	30.8	21.6	0.2	15	0	0	0.56	x	x		
LG11	n/a	3.6	12.2	5	2	0	0	0.5	x	x		
LG08	n/a	34.8	25	0.4	9	0	0	0.57	x	x		
BH01	n/a	0	0.5	20.7	0	0	0	0.5	x	x		
BH03												
BH04												
BH11												
BH13	n/a	4.8	6.4	0.8	1	0	0	0.6	x	x		
G01												
G02												
G03												
G04	n/a	0	1.1	17.5	0	0	0	0.6	x	x		
G05	n/a	32	6.8	0	6	0	0	0.75	x	x		
G06												
G07	n/a	0	1.7	19.2	0	0	0	0.68	x	x		
G08	n/a	0	0.7	20.1	0	0	0	0.62	x	x		
G10												
G13												
G18	n/a	6.7	4.1	2.6	2	0	0	0.59	x	x		
G19	n/a	0	2.1	14.8	0	0	0	0.4	x	x		
G20												
G21												
G25	n/a	22.1	5.8	0	6	0	0	0.81	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	80	33	18.9	5.2	3	1	-160	x	100%	x		
GENERATOR HRS RUN	12662.3											
FUEL LEVEL	3 .5											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 27.6.20 8:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy,drizzle
ATMOSPHERIC PRESSURE: 989
ATMOSPHERIC TEMP: 15°c
EQUIPMENT USED: GA 2000 blower-95%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	85	30.6	18	6.5	1	2	-160		100%	x		
LG05	6.25	43	25.6	0.4	2	0	-7		100%	x		
LG07	7.41	34.8	25.6	1	1	0	-6.5		100%	x		
LG09	4.58	54.6	24.3	0	2	1	-8		100%	x		
LG10	3.11	43.8	25.2	0	2	2	-7		100%	x		
LG12	0	1.6	10.2	9.1	0	0	0.26		x	x		
LG13	0	2.5	12.1	7.4	3	0	0.24		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	12	15.3	1.3	8	0	0	0.35	x	x		
LG02	n/a	12.8	12.4	9.5	0	0	0	0.32	x	x		
LG03	n/a	54.6	24.9	0.2	1	0	0	0.55	x	x		
LG04	n/a	33	21.5	0.2	6	0	0	0.38	x	x		
LG11	n/a	4.6	14.5	4.1	1	0	0	0.26	x	x		
LG08	n/a	36.8	25.8	0.6	3	0	0	0.45	x	x		
BH01	n/a	0	3.6	18.4	0	0	0	0.36	x	x		
BH03												
BH04												
BH11												
BH13	n/a	3.6	7.6	0.6	0	0	0	0.35	x	x		
G01												
G02												
G03												
G04	n/a	0	1.5	17.4	0	0	0	0.34	x	x		
G05	n/a	35.2	6.9	0	1	0	0	0.48	x	x		
G06												
G07	n/a	0	2.2	18.5	0	0	0	0.62	x	x		
G08	n/a	0	0.5	19.6	0	0	0	0.61	x	x		
G10												
G13												
G18	n/a	7.6	5.3	0.3	0	0	0	0.35	x	x		
G19	n/a	0	2.5	14.1	0	0	0	0.28	x	x		
G20												
G21												
G25	n/a	22.3	6.3	0	3	0	0	0.42	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	80	31.9	18.9	5.5	1	1	-160	x	100%	x		
GENERATOR HRS RUN	12680.9											
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 27.6.20 14:00pm
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy,rain
ATMOSPHERIC PRESSURE: 986
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000 blower- 95%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	85	31	19.4	6.2	1	2	-160		100%	x		
LG05	6.57	43.1	25.5	0.5	2	0	-7		100%	x		
LG07	7.21	34.4	25.1	1	1	1	-9.5		100%	x		
LG09	5.93	54.5	24.6	0.3	2	2	-8		100%	x		
LG10	3.75	43.8	25.4	0.2	1	0	-7		100%	x		
LG12	0	1.3	8.2	11.8	1	0	0.3		x	x		
LG13	0	2	12.5	9.1	3	1	0.35		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	11.2	13.9	1.6	9	2	0	0.36	x	x		
LG02	n/a	12.8	5	15.8	0	0	0	0.4	x	x		
LG03	n/a	57.7	25.2	0	1	0	0	0.54	x	x		
LG04	n/a	32.7	21	0	12	1	0	0.51	x	x		
LG11	n/a	3.5	11.8	7.8	0	0	0	0.4	x	x		
LG08	n/a	33.1	25.6	0.5	3	0	0	0.36	x	x		
BH01	n/a	0	1.1	20	0	0	0	0.35	x	x		
BH03												
BH04												
BH11												
BH13	n/a	3.2	6.6	10.2	0	0	0	0.28	x	x		
G01												
G02												
G03												
G04	n/a	0	1.5	17.8	1	0	0	0.38	x	x		
G05	n/a	35.5	6.4	0	6	0	0	0.58	x	x		
G06												
G07	n/a	0	1.4	20.5	0	0	0	0.44	x	x		
G08	n/a	0	0.5	19.8	0	0	0	0.47	x	x		
G10												
G13												
G18	n/a	7.9	5.2	0	1	0	0	0.42	x	x		
G19	n/a	0	2.7	15.6	0	0	0	0.32	x	x		
G20												
G21												
G25	n/a	22	7.2	0	3	2	0	0.45	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	85	31.2	19.1	6.4	2	2	-160	x	100%	x		
GENERATOR HRS RUN	12686.2											
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 28.6.20 8:30am
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy,windy
ATMOSPHERIC PRESSURE: 994
ATMOSPHERIC TEMP: 13°c
EQUIPMENT USED: GA 2000 blower-95%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	80	29	18.5	5.8	1	1	-160		100%	x		
LG05	6.25	42.6	25.1	0.3	1	0	-7		100%	x		
LG07	6.94	34.4	25.8	1	2	1	-6.5		100%	x		
LG09	4.41	55	25.2	0.2	3	0	-8		100%	x		
LG10	3.18	43.2	24.6	0	2	1	-7		100%	x		
LG12	0	1.4	9.4	11.4	0	0	0.32		x	x		
LG13	0	3.2	15.1	9.1	3	0	0.28		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	11.2	16.1	1.8	5	0	0	0.42	x	x		
LG02	n/a	12.4	9.4	10.6	0	0	0	0.38	x	x		
LG03	n/a	51.8	26	0.3	1	0	0	0.46	x	x		
LG04	n/a	30.1	22.7	0.3	5	1	0	0.38	x	x		
LG11	n/a	3.8	15.4	5.6	1	0	0	0.28	x	x		
LG08	n/a	32.5	26.2	1	2	0	0	0.46	x	x		
BH01	n/a	0	4.9	19.1	0	0	0	0.28	x	x		
BH03												
BH04												
BH11												
BH13	n/a	4.4	8.6	0	0	0	0	0.52	x	x		
G01												
G02												
G03												
G04	n/a	0	1.7	17.9	0	0	0	0.39	x	x		
G05	n/a	33	7.4	0.5	0	0	0	0.4	x	x		
G06												
G07	n/a	0	0.2	20.1	0	0	0	0.55	x	x		
G08	n/a	0	0	21.6	0	0	0	0.45	x	x		
G10												
G13												
G18	n/a	6.8	5.5	0.9	0	0	0	0.34	x	x		
G19	n/a	0	2.2	14.9	0	0	0	0.28	x	x		
G20												
G21												
G25	n/a	20.9	7.6	0.2	1	0	0	0.4	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	80	30.2	18.6	5.7	1	1	-160	x	100%	x		
GENERATOR HRS RUN	12704.3											
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 28.6.20 14:00pm
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy,windy
ATMOSPHERIC PRESSURE: 995
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000 blower- 95%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	80	29.9	18.3	6	1	1	-160		100%	x		
LG05	6.57	43.1	25.5	0.4	2	0	-7		100%	x		
LG07	7.28	33.8	26.2	1.1	2	0	-7		100%	x		
LG09	5.65	54.1	24	0.3	2	1	-8		100%	x		
LG10	3.75	43.8	25.4	0.4	1	0	-7		100%	x		
LG12	0	1.3	8.3	13.8	0	0	0.38		x	x		
LG13	0	2.6	14	11.5	2	1	0.35		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	10.1	14.5	2.5	4	1	0	0.36	x	x		
LG02	n/a	12.8	12.1	16.1	0	0	0	0.4	x	x		
LG03	n/a	50.9	26.3	1	1	0	0	0.54	x	x		
LG04	n/a	32.4	21	0	5	1	0	0.48	x	x		
LG11	n/a	2.5	10.8	9.8	0	0	0	0.42	x	x		
LG08	n/a	33.1	25.6	0.5	3	0	0	0.33	x	x		
BH01	n/a	0	6.7	19.8	0	0	0	0.35	x	x		
BH03												
BH04												
BH11												
BH13	n/a	5.5	8.9	2.8	0	0	0	0.33	x	x		
G01												
G02												
G03												
G04	n/a	0	1.5	17.8	1	0	0	0.38	x	x		
G05	n/a	34.1	6.9	1.1	4	1	0	0.62	x	x		
G06												
G07	n/a	0	0.2	20.1	0	0	0	0.4	x	x		
G08	n/a	0	0.5	20.8	0	0	0	0.47	x	x		
G10												
G13												
G18	n/a	6.5	6.8	1.9	0	0	0	0.42	x	x		
G19	n/a	0	3.5	17.9	0	0	0	0.33	x	x		
G20												
G21												
G25	n/a	21.8	8	0.7	1	1	0	0.51	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	80	30	18.4	6.2	1	1	-160	x	100%	x		
GENERATOR HRS RUN	12709.9											
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 28.6.20 12:00pm
SITE: FASSAROE SITE 1 & 2
WEATHER CONDITIONS: cloudy, rain
ATMOSPHERIC PRESSURE: 995
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar Blower- 95%

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	80	30.1	18.2	5.8	1	1	-160		100%	x		
LG05	6.45	42.4	25.5	0.4	1	0	-7		100%	x		
LG07	7.15	33.8	26.5	1.2	2	0	-7		100%	x		
LG09	5.21	54.6	24.4	0.2	2	0	-8		100%	x		
LG10	3.11	43	24.7	0	1	1	-7		100%	x		
LG12	0	1.2	9.6	13	0	0	0.28		x	x		
LG13	0	2.8	14.8	10.2	2	1	0.33		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
LG01	n/a	11	16	1.8	5	0	0	0.36	x	x		
LG02	n/a	12.7	10.4	10.1	0	0	0	0.32	x	x		
LG03	n/a	49.9	25.8	0	2	0	0	0.4	x	x		
LG04	n/a	30.2	23.2	0.2	5	1	0	0.36	x	x		
LG11	n/a	4	12.5	6.7	0	0	0	0.4	x	x		
LG08	n/a	32.1	26.6	0.9	3	0	0	0.38	x	x		
BH01	n/a	0	5.5	19.6	0	0	0	0.33	x	x		
BH03												
BH04												
BH11												
BH13	n/a	4.2	8.3	1.3	0	0	0	0.22	x	x		
G01												
G02												
G03												
G04	n/a	0	1.5	17.1	0	0	0	0.4	x	x		
G05	n/a	33.1	6.8	0.7	0	0	0	0.44	x	x		
G06												
G07	n/a	0	0.2	20	0	0	0	0.38	x	x		
G08	n/a	0	0.4	21.1	0	0	0	0.51	x	x		
G10												
G13												
G18	n/a	7.1	5.9	1.3	2	0	0	0.34	x	x		
G19	n/a	0	2.5	17.3	1	0	0	0.3	x	x		
G20												
G21												
G25	n/a	20.6	8.6	0.5	1	0	0	0.33	x	x		
HOURS RUN	n/a											
TOTAL FLOW	n/a											
FLARE	80	30.1	18.8	5.9	1	0	-160	x	100%	x		
GENERATOR HRS RUN	12707.1											
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 14.7.20 14:30pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: rain
ATMOSPHERIC PRESSURE: 1010
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000 STATIC READING
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	0	0	0	0	0	0	0		x	x		
LG14	0	77.2	25.3	0.2	1	3	0		x	x		
LG18	0	59.2	28.3	2.7	2	0	0		x	x		
LG19	0	71.5	29.3	0.2	3	12	0		x	x		
LG20	0	25.3	13.4	11	3	0	0		x	x		
LG15	0	46.1	25.2	0.3	6	1	0		x	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.4	32.4	0.2	1	120	0	0	x	x		
MW03	x	44.3	10.8	0	3	3		0	x	x		
MW04	x	67.4	33.1	0	3	10		0	x	x		
G09	x	0.9	2.2	19.1	1	2		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	0	0	0	0	0	0	0		x	x		
FUEL LEVEL	full											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 17.7.20 08:30am
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1011
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	17.2	13.5	5.2	8	4	-170		100%	x		
LG14	7.23	8.4	3.4	18.1	1	0	-2.8		5%	x		
LG18	7.87	3.7	2.5	19.2	1	1	-1.7		5%	x		
LG19	5.46	32	22.8	1.7	4	8	-28		100%	x		
LG20	2.51	20.8	9.4	12.9	2	1	-3.5		20%	x		
LG15	4.46	17.8	15	2.1	11	4	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.8	32.8.	0.1	1	138		0	x	x		
MW03	x	20.7	9.1	14.5	2	3		0	x	x		
MW04	x	55.5	29.1	3.7	3	1		0	x	x		
G09	x	1	2.5	18.2	0	4		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	75	17.1	13.5	5.1	8	4	-170		100%	x		
FUEL LEVEL	full											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 17.7.20 12:30pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1009
ATMOSPHERIC TEMP: 20°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	17.2	13.4	5.2	8	3	-170		100%	x	x	x
LG14	7.18	8.9	3.4	18.3	1	0	-2.7		5%	x	dry	11.7
LG18	8.25	8.1	4.1	18	2	1	-1.4		5%	x	dry	10.1
LG19	5.89	31.5	22.5	1.6	4	6	-28		100%	x	dry	14.1
LG20	3.36	19.2	8.5	13.4	2	0	-3.8		20%	x	11.2	12.1
LG15	5.67	17.5	14.7	2.1	11	3	-11		100%	x	7	7.6
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.7	32.6	0.2	1	145		0	x	x	5.7	6.3
MW03	x	7.6	3.1	18.5	1	1		0	x	x	18	18.8
MW04	x	31.8	23.1	1.9	2	0		0	x	x	9	11.1
G09	x	1.1	2.6	18	0	3		0	x	x	cant dip	cant dip
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	75	17.2	13.5	4.9	9	3	-170		100%	x	x	x
FUEL LEVEL	full											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 17.7.20 15:00pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1009
ATMOSPHERIC TEMP: 20°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	17.1	13.4	5	9	3	-170		100%	x		
LG14	7.24	8.8	3.5	18.4	1	0	-2.7		5%	x		
LG18	7.91	8	4.2	18.2	2	0	-1.5		5%	x		
LG19	6.12	31.1	22.8	1.9	5	7	-28		100%	x		
LG20	2.81	19.2	8.1	13.6	2	0	-3.8		20%	x		
LG15	6.74	17.4	15.2	2.5	10	4	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.8	32.4	0.1	1	144		0	x	x		
MW03	x	7.6	3	18.8	1	1		0	x	x		
MW04	x	30.1	23	2.4	2	1		0	x	x		
G09	x	1	2.8	18.2	1	3		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	75	17.2	13.3	5.1	8	3	-170		100%	x		
FUEL LEVEL	full											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 18.7.20 08:30am
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: rain
ATMOSPHERIC PRESSURE: 1008
ATMOSPHERIC TEMP: 13°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	16.4	13.5	5.1	7	3	-170		100%	x		
LG14	6.38	8.2	3.3	18.5	0	0	-3		5%	x		
LG18	x	2.5	1.9	20	1	1	-1.7		x	x		
LG19	4.88	29.4	22.7	1.4	3	8	-30		100%	x		
LG20	3.28	13.3	6.2	16	1	0	-2		20%	x		
LG15	5.61	16.7	14.7	2.4	9	3	-12		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.7	33	0.3	1	105		0	x	x		
MW03	x	9	4	18.5	1	0		0	x	x		
MW04	x	44.2	24.6	6.2	2	0		0	x	x		
G09	x	0.8	1.3	19.6	0	2		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	70	17.3	14.6	3.7	7	4	-170		100%	x		
FUEL LEVEL	3 quarters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 18.7.20 15:00pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1009
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	16.9	13.4	5	9	3	-170		100%	x		
LG14	7.15	10.9	4.3	17.9	1	0	-2		5%	x		
LG18	7.88	15.1	9.4	14.4	1	1	-1		5%	x		
LG19	5.22	28.6	22.1	1.4	5	8	-30		100%	x		
LG20	2.64	16.5	7.8	15.5	2	0	-2		20%	x		
LG15	5.72	15.8	15	2.6	9	3	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	67.5	32.2	0.2	1	131		0	x	x		
MW03	x	14.8	8.4	15.1	1	1		0	x	x		
MW04	x	37	22.8	6.2	2	0		0	x	x		
G09	x	0.8	2.3	19.6	0	2		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	75	17.1	13.6	4.9	9	3	-170		100%	x		
FUEL LEVEL	3 quarters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 18.7.20 12:30pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1009
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	70	17.2	14.4	3.8	8	4	-170		100%	x		
LG14	6.37	11.1	4.5	17.6	0	0	-2		5%	x		
LG18	7.82	24.6	13	11.5	2	1	-1		x	5%		
LG19	5.51	28.8	22.3	1.4	4	7	-30		100%	x		
LG20	3.1	16.6	7.6	14.8	1	0	-2		20%	x		
LG15	6.21	16.6	14.5	2.3	10	3	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	66.4	32	0.5	1	123		0	x	x		
MW03	x	20.5	8.9	14.5	2	2		0	x	x		
MW04	x	37.6	23.6	5.8	2	1		0	x	x		
G09	x	1	2.1	18.4	1	3		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	75	16.6	13.8	4.4	8	3	-170		100%	x		
FUEL LEVEL	3 quaters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 19.7.20 08:30am
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1012
ATMOSPHERIC TEMP: 13°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	15.8	13.5	4.9	7	2	-170		100%	x		
LG14	7.15	10.2	3.9	18.4	1	0	-2		5%	x		
LG18	x	2.8	1.9	20.2	1	2	0		x	x		
LG19	4.62	25.5	21.4	1.8	3	7	-31		100%	x		
LG20	3.22	14.3	6.4	15.9	1	0	-2		20%	x		
LG15	4.4	15.9	14.3	2.5	9	3	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.6	33	0.2	1	115		0	x	x		
MW03	x	10.9	4.7	18	1	1		0	x	x		
MW04	x	42.4	22.9	8.1	2	0		0	x	x		
G09	x	0.6	1.5	19.8	0	2		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	75	16.1	13.9	4.2	7	3	-170		100%	x		
FUEL LEVEL	3 quarters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 19.7.20 12:30pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1012
ATMOSPHERIC TEMP: 15°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	16.1	13.8	4.2	8	4	-170		100%	x		
LG14	6.9	9	3.4	18.1	1	0	-2		5%	x		
LG18	x	8.3	4.3	17.7	2	1	0		x	x		
LG19	5.73	25.7	21.5	1.5	4	5	-29		100%	x		
LG20	2.88	13.8	6.1	15.6	1	0	-2		20%	x		
LG15	6.17	15.8	14.2	2.4	10	1	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.6	32.9	0.2	1	125		0	x	x		
MW03	x	8.5	3.6	18.4	2	0		0	x	x		
MW04	x	42.5	22.4	8.2	3	2		0	x	x		
G09	x	0.7	2.3	18.2	0	2		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	75	16.3	13.9	3.9	8	2	-170		100%	x		
FUEL LEVEL	3 quaters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 19.7.20 15:00pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1011
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	75	16.3	13.8	4	8	3	-170		100%	x		
LG14	7.41	8.8	3.1	18.4	1	0	-2		5%	x		
LG18	x	8.1	4.3	18	1	0	0		x	x		
LG19	5.39	25.5	21.1	1.5	3	5	-29		100%	x		
LG20	2.63	13.7	5.9	15.1	1	0	-2		20%	x		
LG15	6.38	15.8	14.1	2.5	10	2	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.7	32.1	0.3	1	131		0	x	x		
MW03	x	7.4	2.8	18.9	2	1		0	x	x		
MW04	x	40.1	21.8	8.4	3	1		0	x	x		
G09	x	0.8	2.3	18.8	0	1		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	75	16.4	13.8	3.9	8	3	-170		100%	x		
FUEL LEVEL	3 quarters											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 15:45pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: rain
ATMOSPHERIC PRESSURE: 1010
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	160	20	10	13	1	2	-117		100%	x		
LG14	7.36	0.7	0.4	20.9	0	0	-12		20%	x		
LG18	O/S	0.3	0.6	20.9	0	0	-14		10%	x		
LG19	3.1	46.8	20.6	6.4	2	7	-28		100%	x		
LG20	3.34	23.4	11.1	12.1	3	1	-20		100%	x		
LG15	O/S	40.2	23.6	0.3	4	5	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	64.4	31.1	1.2	1	116		0	x	x		
MW03	x	44.4	10.8	0	2	2		0	x	x		
MW04	x	52.5	29.9	3.3	3	9		0	x	x		
G09	x	0	1.4	20.2	0	0		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	90	27.7	15.4	7.8	3	3	-170		100%	x		
FUEL LEVEL	full											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 15.7.20 08:30am
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1013
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	78	18.2	14.1	5.1	8	4	-170		100%	x		
LG14	7.11	6.8	2.8	18.6	1	0	-2.5		5%	x		
LG18	8.62	2.5	1.9	19.5	1	1	-2		5%	x		
LG19	5.24	35.6	23.4	1.9	4	9	-29		100%	x		
LG20	2.2	17	7.6	14.2	1	0	-4		20%	x		
LG15	7.51	18.9	16	1.8	11	4	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.6	32.8.	0.4	1	122		0	x	x		
MW03	x	3.1	1.5	19.7	1	0		0	x	x		
MW04	x	33.7	17.5	19.5	2	1		0	x	x		
G09	x	0.5	1.1	19.7	0	3		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	78	18.2	14.2	4.9	8	4	-170		100%	x		
FUEL LEVEL	full											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 16.7.20 12:30pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1013
ATMOSPHERIC TEMP: 21°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	78	18.1	13.9	5.9	9	1	-170		100%	x		
LG14	7.41	6.9	2.7	18.6	0	0	-2.5		5%	x		
LG18	9.14	2.4	1.8	19.4	1	1	-1.5		5%	x		
LG19	5.64	35.1	23.2	1.6	5	8	-28		100%	x		
LG20	2.35	18.5	8.1	13.6	2	0	-3.5		20%	x		
LG15	7.1	18.6	15.5	1.7	12	3	-10		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.8	32.7	0.1	1	133		0	x	x		
MW03	x	6.3	2.7	18.7	2	1		0	x	x		
MW04	x	46.8	25.1	5.2	3	1		0	x	x		
G09	x	0.3	0.4	20.3	1	4		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	78	18.1	13.8	5	9	4	-170		100%	x		
FUEL LEVEL	full											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 16.7.20 15:00pm
SITE: FASSAROE SITE 3a&3c
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1013
ATMOSPHERIC TEMP: 20°c
EQUIPMENT USED: GA 2000 BLOWER-90%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	78	18.2	13.8	5	9	4	-170		100%	x		
LG14	7.29	6.9	2.9	18.5	1	0	.-2.5		5%	x		
LG18	8.69	2.6	1.9	19.1	3	2	-1.5		5%	x		
LG19	5.21	34.8	23	1.7	4	8	-28		100%	x		
LG20	2.71	18.5	8.1	13.8	2	0	-3.5		20%	x		
LG15	7.5	18.3	18.4	1.9	12	3	-10		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
MW02	x	68.7	32.6	0	1	131		0	x	x		
MW03	x	6.6	2.9	19.5	1	1		0	x	x		
MW04	x	44	26.1	5.9	2	1		0	x	x		
G09	x	0.3	0.5	20.8	1	3		0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	78	18	13.5	5.2	9	3	-170		100%	x		
FUEL LEVEL	full											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 4.7.20 9:00am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy,drizzle
ATMOSPHERIC PRESSURE: 995
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000
TECHNICIAN: J. Brown/R. Clachar STATIC READINGS

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE												
LG16	x	0	0	21.2	0	0	0		100%	x		
LG17	x	0	0	21.2	0	0	0		100%	x		
LG21	x	0	0	21.3	0	0	0		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0	16.8	0	0	0	0	x	x		
BH08	x	0	0	19	0	0	0	0	x	x		
BH09	x	0	0	20.1	0	0	0	0	x	x		
G16	x	0	0	17.8	0	0	0	0	x	x		
G17	x	0	0	19.8	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	x											
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 4.7.20 11:00am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy,drizzle
ATMOSPHERIC PRESSURE: 998
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	29.8	26.4	3.2	9	2	-25		100%	x		
LG16	3.57	9.2	20.6	3.2	9	1	-13		100%	x		
LG17	2.65	57.5	34.4	1	22	9	-11		100%	x		
LG21	5.59	34.1	28.8	2.8	5	1	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.4	19.5	0	0	0	0	x	x		
BH08	x	0	3.2	18	1	0	0	0	x	x		
BH09	x	0	0	21	0	0	0	0	x	x		
G16	x	0	3.3	16.4	5	0	0	0	x	x		
G17	x	0	2	18.6	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	40	29.1	26.1	3.4	10	1	-25	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 4.7.20 13:00pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: suunny spells
ATMOSPHERIC PRESSURE: 995
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	27.9	25	3.6	12	3	-25		100%	x		
LG16	3.41	8.6	18.6	3.9	13	0	-13		100%	50%		
LG17	2.66	56.1	34	1.1	23	8	-11		100%	x		
LG21	5.78	30.7	27.3	3	7	1	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.5	20.1	0	0	0	0	x	x		
BH08	x	0	3.5	17.6	1	0	0	0	x	x		
BH09	x	0	1.6	17.1	0	0	0	0	x	x		
G16	x	0	3.1	16.4	2	0	0	0	x	x		
G17	x	0	2.5	17.6	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	40	29.1	25.5	3.5	15	3	-25	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 4.7.20 15:00pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy,windy
ATMOSPHERIC PRESSURE: 994
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	28.1	25.2	3.5	14	3	-25		100%	x		
LG16	3.1	8.3	18	4	14	0	-9		50%	x		
LG17	2.35	54.5	34	1.1	24	9	-11		100%	x		
LG21	5..61	28.9	26.7	3.2	9	1	-11		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.4	18.6	0	0	0	0	x	x		
BH08	x	0	4.3	17.2	0	0	0	0	x	x		
BH09	x	0	1.6	17.4	1	0	0	0	x	x		
G16	x	0	3	16.4	4	0	0	0	x	x		
G17	x	0	2.9	17.5	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	40	28	25.1	3.7	15	2	-25	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 5.7.20 8:00am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 999
ATMOSPHERIC TEMP: 15°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	22.9	22.8	4.3	13	0	-24		100%	x		
LG16	3.52	7.8	15.8	5.6	13	0	-10		50%	30%		
LG17	3.21	49.3	33.3	1.1	15	0	-13		100%	x		
LG21	6.24	21.7	24.1	3.8	10	0	-13		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.6	18.6	0	0	0	0	x	x		
BH08	x	0	0.6	20.1	0	0	0	0	x	x		
BH09	x	0	0.8	20.3	0	0	0	0	x	x		
G16	x	0	0.2	20.2	4	0	0	0	x	x		
G17	x	0	3.8	17	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	40	26.1	24.3	4.3	12	0	-24	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 5.7.20 11:30am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: suunny,showers
ATMOSPHERIC PRESSURE: 997
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	24.5	23.9	4.4	13	0	-25		100%	x		
LG16	2.68	7.3	16	4.6	14	0	-4		30%	x		
LG17	4.28	46.6	33.1	1.4	16	0	-13		100%	x		
LG21	6.34	19.2	22.6	4.7	11	0	-13		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.5	18.7	0	0	0	0	x	x		
BH08	x	0	5.1	16.5	0	0	0	0	x	x		
BH09	x	0	0.3	20.5	0	0	0	0	x	x		
G16	x	0	3.4	15.8	1	0	0	0	x	x		
G17	x	0	3.3	17.6	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	40	24.2	23.6	4.5	13	0	-25	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 5.7.20 14:30pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: sunny,windy
ATMOSPHERIC PRESSURE: 997
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	23.9	23.4	4.6	14	0	-25		100%	x		
LG16	2.54	7.3	15.9	4.6	13	0	-3		50%	x		
LG17	4.81	45.7	32.8	1.5	17	0	-13		100%	x		
LG21	5.72	18.1	22.1	4.9	13	0	-13		100%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.2	19.1	0	0	0	0	x	x		
BH08	x	0	5.2	16.5	0	0	0	0	x	x		
BH09	x	0	1.7	17.5	0	0	0	0	x	x		
G16	x	0	3.2	16.9	3	0	0	0	x	x		
G17	x	0	3.6	17.3	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	40	23.8	23.4	4.6	15	0	-25	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 6.7.20 8:00am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1010
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	20.6	21.9	4.7	20	0	-25		100%	x		
LG16	2.89	4.8	14.9	5.4	8	0	-4		30%	10%		
LG17	4.72	39.2	30.9	1.4	18	0	-14		100%	x		
LG21	5.64	13.7	19.4	5.6	21	0	-13		100%	50%		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.7	18.5	0	0	0	0	x	x		
BH08	x	0	4.7	17.1	1	0	0	0	x	x		
BH09	x	0	0.5	20.6	0	0	0	0	x	x		
G16	x	0	3.4	18.2	2	0	0	0	x	x		
G17	x	0	3.7	16.8	4	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	38	21.6	22	5.1	20	0	-25	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 6.7.20 12:00pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1013
ATMOSPHERIC TEMP: 16°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	20.9	21.6	5.6	20	0	-26		100%	x		
LG16	0	3.6	8.6	11.4	9	0	0		x	x		
LG17	4.86	38.4	33.3	1.7	21	0	-15		100%	x		
LG21	4.21	13.1	18.4	6.1	17	0	-10		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.5	18.6	0	0	0	0	x	x		
BH08	x	0	4.3	16.7	0	0	0	0	x	x		
BH09	x	0	0.4	21	2	0	0	0	x	x		
G16	x	0	3.6	17.4	0	0	0	0	x	x		
G17	x	0	3.8	18.2	3	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	40	21	21.7	5.9	20	0	-26	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 6.7.20 14:45pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: sunny
ATMOSPHERIC PRESSURE: 1013
ATMOSPHERIC TEMP: 17°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	20.6	20.9	5.9	22	0	-26		100%	x		
LG16	0	2.4	7.9	12.3	5	0	0		x	x		
LG17	5.49	37.3	30	2	25	0	-17		100%	x		
LG21	4.35	11.4	17.6	6.6	22	0	-10		50%	30%		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.4	19	0	0	0	0	x	x		
BH08	x	0	4.3	16.8	1	0	0	0	x	x		
BH09	x	0	0	20.1	1	0	0	0	x	x		
G16	x	0	3.4	16.4	1	0	0	0	x	x		
G17	x	0	3.7	16.8	4	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	35	23.4	22.1	5.8	22	0	-26	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 7.7.20 8:30am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: rain
ATMOSPHERIC PRESSURE: 1012
ATMOSPHERIC TEMP: 11°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	40	24.8	23.4	4.3	21	0	-26		100%	x		
LG16	0	5.3	17.8	1.8	2	2	0		x	x		
LG17	5.38	35.8	29.2	1.7	19	0	-17		100%	x		
LG21	3.18	11.3	18.2	5.5	24	0	-6		30%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.4	18.9	0	0	0	0	x	x		
BH08	x	0	4.6	17	2	0	0	0	x	x		
BH09	x	0	2	16.7	1	0	0	0	x	x		
G16	x	0	3.8	17.6	1	0	0	0	x	x		
G17	x	0	3.5	16.9	2	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	40	23.1	22.5	4.9	21	0	-26	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 7.7.20 12:30pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: rain
ATMOSPHERIC PRESSURE: 1008
ATMOSPHERIC TEMP: 12°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	35	21.8	21.8	5.4	22	0	-26		100%	x		
LG16	0	5.3	17.3	2.4	2	0	0		x	x		
LG17	5.1	34	28.5	2.4	29	0	-17		100%	x		
LG21	3.24	10.5	17.7	6	18	0	-6		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.6	18.8	0	0	0	0	x	x		
BH08	x	0	5	16.7	0	0	0	0	x	x		
BH09	x	0	1.8	17.5	1	0	0	0	x	x		
G16	x	0	3.6	18	1	0	0	0	x	x		
G17	x	0	3.5	17.7	1	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	35	21.8	21.9	5.2	26	0	-26	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 7.7.20 15:15pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: rain
ATMOSPHERIC PRESSURE: 1007
ATMOSPHERIC TEMP: 13°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	35	21.5	20.8	5.5	22	0	-26		100%	x		
LG16	0	5.1	17.5	3.1	3	0	0		x	x		
LG17	5.22	33.8	28.1	2.7	29	0	-17		100%	x		
LG21	3.31	10.4	17.6	6.1	19	0	-6		50%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.7	18.6	0	0	0	0	x	x		
BH08	x	0	5.6	17.3	2	0	0	0	x	x		
BH09	x	0	1.5	18.3	1	0	0	0	x	x		
G16	x	0	3.6	17	0	0	0	0	x	x		
G17	x	0	3.9	17.2	3	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	35	21.5	21	5.7	22	0	-26	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 8.7.20 8:30am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: rain
ATMOSPHERIC PRESSURE: 1008
ATMOSPHERIC TEMP: 12°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	35	18.5	20.2	6.1	25	0	-26		100%	x		
LG16	0	6.7	17.1	3.2	3	0	0		x	x		
LG17	4.23	30.2	27.1	2.6	33	0	-19		100%	x		
LG21	3.4	7.8	16.4	6.8	18	0	-6		30%	10%		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.7	19.5	0	0	0	0	x	x		
BH08	x	0	3.9	17.4	1	0	0	0	x	x		
BH09	x	0	2.6	17.9	0	0	0	0	x	x		
G16	x	0	3.4	18	2	0	0	0	x	x		
G17	x	0	3	17.7	1	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	20.6	21.3	5.7	27	0	-26	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 8.7.20 11:45am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1007
ATMOSPHERIC TEMP: 13°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	30	20.2	20.7	5.9	27	0	-26		100%	x		
LG16	0	6	15.3	5.1	2	0	0		x	x		
LG17	4.95	29.5	26.8	2.7	35	0	-19		100%	x		
LG21	2.62	7.4	16.3	6.8	21	0	-3		10%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.5	18.1	0	0	0	0	x	x		
BH08	x	0	5.5	17.6	0	0	0	0	x	x		
BH09	x	0	2.1	18.1	1	0	0	0	x	x		
G16	x	0	3.7	18.6	0	0	0	0	x	x		
G17	x	0	3.5	17.8	2	1	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	20.2	20.8	5.9	29	0	-26	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 8.7.20 14:45pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: rain
ATMOSPHERIC PRESSURE: 1007
ATMOSPHERIC TEMP: 13°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	30	20.4	21.1	5.9	29	0	-26		100%	x		
LG16	0	5.2	16.8	5.4	3	0	0		x	x		
LG17	5.16	29.2	26	2.9	35	0	-19		100%	x		
LG21	2.81	7.4	16.9	6.7	21	0	-6		10%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.7	18.5	0	0	0	0	x	x		
BH08	x	0	5.1	16.8	0	0	0	0	x	x		
BH09	x	0	2.6	18.9	2	0	0	0	x	x		
G16	x	0	3.4	19.1	0	0	0	0	x	x		
G17	x	0	3.7	17.2	2	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	20.1	21.2	6	29	0	-26	0	100%	x		
FUEL LEVEL	half											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 9.7.20 8:30am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1006
ATMOSPHERIC TEMP: 12°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	30	20.9	21.7	4.7	25	0	-24		100%	x		
LG16	0	2.4	6.3	14	2	0	0		x	x		
LG17	5.46	30.3	28	1.3	32	0	-19		100%	x		
LG21	2.24	8.1	17.3	5.2	36	0	-3		10%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	1.1	19.3	0	0	0	0	x	x		
BH08	x	0	5.2	16.4	2	0	0	0	x	x		
BH09	x	0	2.5	18.1	1	0	0	0	x	x		
G16	x	0	3.7	17.5	0	0	0	0	x	x		
G17	x	0	3.4	17.9	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	20.6	21.4	4.8	30	0	-24	0	100%	x		
FUEL LEVEL	quarter											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 9.7.20 12:00pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1006
ATMOSPHERIC TEMP: 13°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	30	19.6	20.4	5.8	27	0	-24		100%	x		
LG16	0	1.6	4.7	15.7	2	0	0		x	x		
LG17	4.86	29.3	27.1	2.1	38	0	-19		100%	x		
LG21	2.45	7.4	16.6	5.8	18	0	-3		10%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.4	17.8	0	0	0	0	x	x		
BH08	x	0	5.2	17.5	0	0	0	0	x	x		
BH09	x	0	2	18	2	0	0	0	x	x		
G16	x	0	3.6	18.9	1	0	0	0	x	x		
G17	x	0	3.5	17.7	1	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	20.1	20.7	5.6	28	0	-24	0	100%	x		
FUEL LEVEL	quarter											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 9.7.20 15:00pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1005
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	30	19.8	20.3	5.8	26	0	-24		100%	x		
LG16	0	6.3	19.6	0.7	4	0	0		x	x		
LG17	4.86	28.9	26.9	2.4	34	0	-19		100%	x		
LG21	2.18	7.1	16.3	5.9	18	0	-3		10%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.7	18.5	0	0	0	0	x	x		
BH08	x	0	5.1	16.8	0	0	0	0	x	x		
BH09	x	0	2.6	18.9	2	0	0	0	x	x		
G16	x	0	3.4	19.1	0	0	0	0	x	x		
G17	x	0	3.7	17.2	2	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	19.8	20.5	5.8	27	0	-24	0	100%	x		
FUEL LEVEL	quarter											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 10.7.20 8:30am
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: sunny,windy
ATMOSPHERIC PRESSURE: 1013
ATMOSPHERIC TEMP: 12°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	35	15.7	16.6	9	17	0	-25		100%	x		
LG16	0	6.4	18.7	2.1	1	0	0		x	x		
LG17	4.89	27.2	25.8	3.1	27	0	-19		100%	x		
LG21	2.41	6.5	16.3	6.2	12	0	-3		10%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	4.6	19.3	0	0	0	0	x	x		
BH08	x	0	1.8	18.1	1	0	0	0	x	x		
BH09	x	0	1.1	18.5	1	0	0	0	x	x		
G16	x	0	3.1	18.9	0	0	0	0	x	x		
G17	x	0	3	18.4	0	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	19.5	20.9	5.6	21	0	-25	0	100%	x		
FUEL LEVEL	quarter											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 10.7.20 12:00pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1013
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	30	19	20.3	5.9	23	0	-25		100%	x		
LG16	0	5.9	17.1	3.5	2	0	0		x	x		
LG17	4.72	26.7	25.4	3.3	29	0	-19		100%	x		
LG21	2.16	6.3	15.9	6.4	13	0	-3		10%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.5	18.2	0	0	0	0	x	x		
BH08	x	0	4.6	17.8	0	0	0	0	x	x		
BH09	x	0	2.2	18.6	1	0	0	0	x	x		
G16	x	0	3.4	19.1	0	0	0	0	x	x		
G17	x	0	3.3	20	2	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	19.2	20.7	5.6	23	0	-25	0	100%	x		
FUEL LEVEL	quarter											

AUTOMATIC FLARE SYSTEMS

FIELD BALANCING & MONITORING SHEET

DATE: 10.7.20 15:00pm
SITE: FASSAROE SITE 3b
WEATHER CONDITIONS: cloudy
ATMOSPHERIC PRESSURE: 1013
ATMOSPHERIC TEMP: 14°c
EQUIPMENT USED: GA 2000 BLOWER- 30%
TECHNICIAN: J. Brown/R. Clachar

GAS EXTRACTION WELLS	FLOW	CH4	CO2	O2	CO	H2S	SUCTION MBAR		VALVE POS %	ADJUST MENT %	DIP LEVEL	BASE LEVEL
FLARE	30	20.1	20.8	5.9	22	0	-25		100%	x		
LG16	0	3.6	2.8	1.8	2	0	0		x	x		
LG17	4.77	26.4	25.5	3.6	27	0	-19		100%	x		
LG21	2.31	5.9	16.3	6	11	0	-3		10%	x		
GAS MONITORING WELLS	**FLOW M/SEC**	**CH4**	**CO2**	**O2**	**CO**	**H2S**	**SUCTION MBAR**	**WELL PRESS**	**VALVE POS %**	**ADJUST MENT %**	**DIP LEVEL**	**BASE LEVEL**
BH07	x	0	0.7	18.7	0	0	0	0	x	x		
BH08	x	0	5	16.8	1	0	0	0	x	x		
BH09	x	0	2	17.5	1	0	0	0	x	x		
G16	x	0	3.6	19.9	0	0	0	0	x	x		
G17	x	0	3.1	16.8	1	0	0	0	x	x		
HOURS RUN	x											
TOTAL FLOW	x											
FLARE	30	20	20.7	5.9	23	0	-25	0	100%	x		
FUEL LEVEL	quarter											

Appendix C

AFS Report, 2020

REPORT ON THE GAS ABSTRACTION PUMPING TRIAL

SITE: Fassaroe Closed Landfill Sites

CLIENT: ***Wicklow County Council***

BY:

AUTOMATIC FLARE SYSTEMS LIMITED
UNIT 8 ENSIGN BUSINESS PARK
WESTWOOD BUSINESS PARK
COVENTRY
CV4 8JA
TEL: 0044 2476 474877
FAX: 0044 2476474834

DATE: 28 July 2020

Revision	**Final**	**Replaces revision**		
	Name	**Position**	**Signature**	**Date**
Prepared By:	J. Brown	Engineer		02.08.20
Approved By:	S. Willacy	Director		02.08.20

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1. INTRODUCTION

2. METHOD STATEMENTS

3. PUMPING TRIAL RESULTS

4. DISCUSSIONS

5. CONCLUSIONS

Appendix

A. SITE DRAWINGS
- a) Site plan showing pumping trial area
- b) Proposed gas extraction system

B. COLLATED GAS MONITORING RECORDS

C. LEACHATE DIP LEVELS

1. Introduction

1.1 General

AFS Ltd were awarded a contract by Wicklow County Council to carry out a landfill gas pumping trial at the Fassaroe Closed Landfill sites in Fassaroe near to Bray.

Five historical landfill sites known as Site 1, Site 2, 3A, 3B, and 3C are located in Fassaroe, Bray, Co. Wicklow immediately to the south of the Dublin/Wicklow county boundary. The sites are located to the west of the M11 motorway and are accessed from Berryfield Lane. Under the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008, Historic Landfill Certificates of Authorisation (CoA) have been issued by the Environmental Protection Agency (EPA) to Wicklow County Council (the CoA Holder) for Sites 2, 3A, 3B, and 3C. While Site 1 does not have a CoA, it does contain historical waste and has therefore been included by Wicklow County Council in this scope of works. In accordance with the requirements of the CoAs and Site 1, for each site a landfill gas pumping trial is to be undertaken to determine the quantity and characteristics of the landfill gas.

The landfill sites are situated between Berryfield Lane and the County Brook River (Fassaroe Stream). The valley which is known as Ballyman Glen is designated a Special Area of Conservation (SAC) (Site Code: 000713) designated on the basis of the following habitats and/or species listed on Annex I/II of the EU Habitats Directive: petrifying springs with tufa formation; and alkaline fens.
Berryfield Lane is characterised by one-off housing developments in a predominantly agricultural setting. A sports ground and associated facilities are located in lands immediately to the east of Site 3B. An integrated waste management facility (EPA Ref. W0053-03) is located immediately to the east of Site 2.
A sand and gravel quarry is located to the south of Berryfield Lane which is operated by Roadstone Limited.

It is understood that Sites 1, 3A and 3C were previously operated as sand and gravel pits. Wicklow County Council's report entitled 'Tier 2-3 Environmental Risk Assessment Landfills No. 3A and 3C - Wicklow County Council', December 2012 (amended April 2013) states:
Between the early-1970s and the mid-1990s, Wicklow County Council operated a number of municipal landfills in the Fassaroe area, to the west of Bray, in north County Wicklow. Four landfills were sited on the northern side of Berryfield Lane with a fifth small landfill located to the south of the road.

Site 1 covers an area of approximately 0.59 Ha. The cross-section shows the profile of the landfill to be relatively flat (1V:35H) with a maximum height of 96mOD and a gradual increase in slope towards the northern section of the site at the top of the river valley. The site is currently vegetated.

Site 2 covers an area of approximately 4.72 Ha. The western and central portions of the site are currently grassed. The cross-section shows the profile of Site 2 to be relatively flat in the western portion of the site with a maximum height of 85mOD. From the centre of the site however, the slope increases in an eastward direction to approximately 1V:8H. The eastern portion of the site, which is densely vegetated with mature trees and bushes, extends down a very steep section of the valley for approximately 50m at a slope of between 1V:2.5H to 1V:3H, dropping from 63mOD to 43mOD. At two locations on this section of the valley, slope failure has occurred, which has exposed waste material.

Site 3A covers an area of approximately 1.9 Ha. The cross-section shows that the profile of Site 3A is relatively level along the centre with the site falling 5m from 106mOD in the west to 101mOD in the east. The northeast tip of Site 3A has a steeper slope at approximately 1V:2.5H falling from 102mOD to 90mOD in a south to north direction. Similarly, the northwest tip has a 1V:6H slope, dropping from 105mOD to 100mOD over 30m in a south to north direction. A shallow slope is located at the southeast corner, with an approximate slope of 1V:10H.

Site 3B covers an area of approximately 0.49 Ha. The cross-section shows the profile of the landfill to be relatively flat with a gradual slope of 1V:30H occurring in a south to north direction from 101mOD to 99mOD.

Site 3C covers an area of approximately 0.9 Ha. The cross section shows that the site slopes downwards from south to north, dropping 11 metres from 95mOD to 84mOD. The northern portion of the site has a steeper slope of 1V:2H.

All pumping trials shall be carried out on the basis of 24-hours per day over seven consecutive days. The contractor shall design and execute the Gas Pumping Trial at the five Fassaroe Sites to meet the following objectives:

- To determine the optimum conditions of landfill gas flow rate and its composition under static and dynamic conditions;
- To measure vacuum (pressure) and flow relationships while actively extracting landfill gas from the landfill.
- To measure sustainable Methane levels in the extracted landfill gas during the test pumping.
- To measure vacuum (pressure) in probes to estimate the lateral vacuum influence of the active test pumping.
- To measure Oxygen levels of the extracted landfill gas during the test pumping to check for air infiltration through the soil during test pumping.
- Utilise the results of the pump test to refine the projections of landfill gas generation on each site.
- To comply with the requirements of Section 2 of this specification
- To provide recommendations for the future management of landfill gas at each site (eg. Active flaring, passive venting etc)

Records for the following parameters shall be recorded at regular intervals throughout the seven consecutive days pumping trial period for each site

- CH4 (%v/v)
- C02(%v/v)
- O2(%v/v)
- H2S (ppm)
- CO (ppm)
- Average flow (m3/hr)
- Negative pressure/suction applied (mbar)
- Barometric Pressure (mBar)

1.2 Landfill Gas Management

The trial was designed to follow the basic principles detailed within the Environment Agency Operational Instruction 566-05: *Using Pumping Trials to Determine Whether a landfill site needs a flaring system (Environment Agency,2009).*

The landfill gas pumping trial was conducted using the following:
1 No. 250m3/hr Lo-Cal high temperature flare unit
1 No. 30Kva Generator and 2,750ltr capacity fuel bowser
Connection to existing gas monitoring wells
Gas control wellheads complete with control valve, gas monitoring port
150mm diameter single wall flexible gas pipe
63mm diameter single wall flexible gas pipe
Gas tight flexible fittings and 160mm - 63mm spigot tee's

The landfill monitoring equipment used during the trial was as follows:
Gas readings were taken using QED Ltd ATEX approved GA5000 gas analyser and a manometer for measuring gas pressure and a Testo anemometer for measuring flow in m/s.

The existing gas monitoring wells were fitted with 63mm elbows each complete with a DN50 Safi ball valve, monitoring point and leachate dipping point. The gas wells were connected to a 160mm gas main using 63mm flexi pipe and flexiseal couplers. All pipelines were laid to falls for condensate removal. AFS delivered and installed a 250 m^3/hour Lo-Cal gas flare, powered by a portable diesel generator. Both were situated in a temporary compound marked on the site map. A staggered knockout pot was installed by the flare for condensate removal.

2. Method Statements

2.1 Pumping Trial

2.1.1 Purpose and Scope of the Pumping Trial

The objective of a landfill gas pumping trial is to determine the volumes and qualities of landfill gas that can be sustainably extracted from a landfill. The information generated from the trial gives assurance that the correct management approach is selected e.g. passive management or active extraction. Where active extraction can be shown to be sustainable, the trial will provide information on the required design parameters of a permanently installed extraction system to ensure the system is adequate in scale so that all the can be controlled correctly.

Gas pumping trials must be conducted in accordance with the Environment Agency Operational Instruction 566_05 titled 'Using pumping trials to determine whether a landfill site needs a flaring system', issued 02/12/2009.

The following documents must also be complied with when conducting a trial.
AFS Risk Assessments,
Working on closed landfill sites (site-specific to be produced in the field),
Delivery of flare unit, generator and fuel bowser,
Commissioning the temporary flare unit,
Installing a temporary gas collection system (pumping trial),
Monitoring of landfill gas,
Monitoring of landfill leachate (if requested),
Flare operation.
Landfill Gas Monitoring method statement.

2.1.2 Pumping Trial Methodology

The following procedures need to be performed to carry out a pumping trial. Firstly, the site has to be examined and assessed on the basis of the age of the waste, since gas well performance and the availability of the gas will vary depending on this factor. The gas wells will have a number of tests to be performed on them. These tests can be broken down into two basic categories:

- Static tests
- Dynamic gas abstraction tests

After completion of these, an assessment of the sustainable gas generation rate can be determined.

2.1.3 Static Tests

Static tests consist of a number of measurements taken from the test gas wells prior to any dynamic tests being carried out and after the gas column in the well has reached equilibrium.

2.1.4 Dynamic Tests

Dynamic tests are conducted to quantify the abstraction characteristics and the effects on gas quality as the pumping trial progresses.

2.1.4.1 Pumping Trials

Two distinct approaches can be adopted at the site to assess the generation rate of landfill gas, these being:

- Collect gas from all of the available vents/wells on the site;
- Collect gas from representative parts of the site.

2.1.4.2 The Pumping Test

Field Set-up

The wells to be monitored are connected to a temporary mobile flaring unit rated a 250m3/hr which is used to carry out the tests and is connected to the temporary gas collection system on which the trial is to be conducted. The measurement of flow, suction pressure and sampling of gases are made at the flare and each gas extraction well.

Rates of Flow

The maximum sustainable rate of pumping for a long term pumping trial without air entrapment is essentially the same as the gas generation rate. Where the pumping trial is a temporary set-up it may be necessary to adjust the results in order to correct for air drawn into the system as a result of the limitations of the temporary nature of the system and site conditions.

It is also feasible to measure the influence of the pumping trial on nearby wells to indicate the extent of the zone of influence. This may only occur if the existing wells are in close proximity to each other and/or within the zone of influence.

Results

Measured gas concentrations and flow rates obtained during the pumping trials require a number of corrections in order to properly represent actual landfill gas availability from the site under the normal extraction conditions.
A possible source of potential error is leakage of air through the waste around the pumping trial wells, though this should be kept to a minimum by regular inspection and maintenance during the trial.

Extrapolation

Where a pumping trial has been carried out on only a proportion of the waste mass, the available gas production required to be corrected to represent the total waste mass from which extraction is proposed. Additional corrections may be required for any areas of non-typical waste composition for the site, or wastes which may be below water within the site due to the proximity of the sea or an area of high water table and consequently not accessible for landfill gas extraction. Also the age and types of wastes within the site will have to be taken into account to fully assess the potential gas yield.

Gas collection efficiencies are also variable between sites, for example due to the depth of waste placed, and corrections have also been included to compensate for this where required.

3. Pumping Trial Results

The purpose of analysing the data is to establish whether there is enough gas present to sustainably run a flare and if so to determine the flow rate that provides constant Methane concentrations at the flare. This constant or steady state flow rate is equivalent to the landfill gas generation rate of the waste.

3.1 Static Test Results

Static monitoring data was collected before the trial commenced. This data is available from the site monitoring information collected outside of the trial period by RPS. AFS collected one set of data from each gas well before the trial commenced.

3.1.1 Interpretation of the Static Results

Static monitoring is normally carried out to determine the typical zone of influence around an extraction well and to indicate the sustainable sphere of influence.

3.2 Dynamic Test Results

The results of the dynamic tests are presented in Appendix B, which shows the gas composition, suction and flow at the flare. The collated monitoring and field balancing records are also located in Appendix B.

3.2.1 Interpretation of the Dynamic Results

Site 1 & 2

The following are the requirements for undertaking the gas pumping trial on Site 1 & 2.
a) Prepare and implement a programme of 24-hours per day pumping trials for seven consecutive days, at a minimum of 3 gas yielding monitoring locations (12% v/v or above) to determine the quantity and characteristics of the landfill gas. We connected 6 gas wells in total, 4 in site 2 and 2 in site 1.
b) In the event that Methane values consistently exceed 12%v/v, install measures for extracting and treating landfill gas by flaring or another suitable technique that is satisfactory to the Agency.

Site 3B

The following are the requirements of Certificate of Authorisation Number H0476-01 (Site 3B) in relation to the landfill gas pumping trial:
a) Prepare and implement a programme of 24-hour pumping trials for seven days, at a minimum of one gas yielding monitoring location (12% v/v or above) to determine the quantity and characteristics of the landfill gas. We connected 3 gas wells in total.
b) In the event that Methane values consistently exceed 12%v/v, install measures for extracting and treating landfill gas by flaring or another suitable technique that is satisfactory to the Agency.

Site 3A & 3C

The following are the requirements of Certificate of Authorisation Number H0477-02 (Site 3A) in relation to the landfill gas pumping trial:
a) Prepare and implement a programme of 24-hour pumping trials for seven days, at a minimum of 2 gas yielding monitoring locations (12% v/v or above) to determine the quantity and characteristics of the landfill gas. We connected 5 gas wells in total, 3 in site 3A and 2 in site 3C.
b) In the event that Methane values consistently exceed 12%v/v, install measures for extracting and treating landfill gas by flaring or another suitable technique that is satisfactory to the Agency.

Site 1 & 2

On initial start-up of the flare each wellhead valve was set to 100%, the flare booster was started. During the first few hours of operation the gas quality at the flare slowly increased in Methane from 20 to 28%, the Oxygen remained constant at 3.5 with a flow rate starting at 170m3/hr but quickly dropping to down to 115m3/hr. On the second day the flow rate remained at 115m3/hr, although the Methane quality dropped slightly to 26%. The gas wells were dipped during the trial to record the leachate levels in the gas wells (see appendix C for the leachate dips).

On day 3 the flow rate was reduced to 70m3/hr after balancing, the Methane content increased to 34% and the Oxygen increased to 5%. Gas wells LG12 & 13 from site 1 were turned off due to the very low quality of Methane and high Oxygen. These wells remained off during the rest of the 7 day trial.
On day 4 the flow was increased again to 80m3/hr and the Methane remained at 34%.
On day 5 the flow was increased again to 85m3/hr which began to draw harder on the connected wells, which in turn started to reduce the Methane down to 30%, the Oxygen at the flare remained around 5-6%.
On day 7 the trial finished with the flare operating at 80m3/hr with 30% Methane and 6.2% Oxygen.

The gas monitoring boreholes around sites 1 & 2 fluctuated in their gas quality during the trial, at the beginning of the trial only 6 of the monitoring boreholes showed signs of Methane, the highest being G25 which had 15.5%. 8 of the boreholes recorded 0% Methane. At the end of the trial 10 of the boreholes recorded Methane and 5 remained at 0%. However, 7 of the monitoring boreholes recorded Methane in double figures.

Site 3B

On initial start-up of the flare each wellhead valve was set to 100%, the flare booster was started. During the first few hours of operation the gas quality at the flare slowly decreased in Methane from 30 to 28%, the Oxygen remained constant at 3.5 with a flow rate starting at 40m3/hr. On the second day the flow rate remained at 40m3/hr, although the Methane quality dropped slightly to 23%. The gas wells were dipped during the trial to record the leachate levels in the gas wells (see appendix C for the leachate dips).

On day 3 the flow rate remained at 40m3/hr after balancing, the Methane content increased to 25% and the Oxygen increased to 5%. Gas wells LG16 was turned off due to the very low quality of Methane. This wells remained off during the rest of the 7 day trial.
On day 4 the flow was decreased to 35m3/hr and the Methane dropped to 20%.
On day 5 the flow was decreased again to 30m3/hr which stabilised the Methane at 20% and the Oxygen at the flare remained around 5-6%.
On day 7 the trial finished with the flare operating at 30m3/hr with 19% Methane and 5.6% Oxygen.

The gas monitoring boreholes around site 3B remained constant during the trial, all of the monitoring boreholes recorded 0% Methane.

Site 3A & 3C

On initial start-up of the flare each wellhead valve was set to 100%, the flare booster was started. During the first few hours of operation the gas quality at the flare slowly increased in Methane from 20 to 28%, the Oxygen reduced from 13% down to 8% with a flow rate starting at 176m3/hr but quickly dropping to down to 90m3/hr. On the second day the flow rate increased slightly to 95m3/hr, although the Methane quality dropped to 17%. The gas wells were dipped during the trial to record the leachate levels in the gas wells (see appendix C for the leachate dips).

On day 3 the flow rate was reduced to 78m3/hr after balancing, the Methane content decreased to 18% and the Oxygen decreased to 5%. Gas wells LG14 & 18 from site 3C were turned down to 5% due to the very low quality of Methane and high Oxygen. LG14 remained at 5% for the rest of the trial and gas well LG18 was turned off on day 5 for the rest of the 7 day trial.
On day 4 the flow was reduced to 75m3/hr and the Methane continued to slowly reduce to 17%.
On day 5 the flow remained at 75m3/hr and the Methane continued to reduce down to 16%, the Oxygen at the flare remained around 4-5%.
On day 7 the trial finished with the flare operating at 70m3/hr with 15% Methane and 4% Oxygen.

The 4 gas monitoring boreholes around sites 3A & 3C fluctuated in their gas quality during the trial, at the beginning of the trial 3 of the monitoring boreholes showed signs of Methane, the highest being MW02 which had 68%. None of the boreholes recorded 0% Methane. At the end of the trial MW02 remained stable with 68% methane and 0.2% Oxygen throughout. MW03 started at 44% Methane and ended the trial at 11%. MW04 started at 67% methane and ended the trial with 32% Methane. G09 remained stable with 1% Methane throughout the trial.

The flare continued to run for a total of 504 hours, during the 3 separate trials. During this time the flare did not stop operating, except for maintenance and dewatering of the system.

The total amount of gas extracted during the trial was:
Site 1 & 2: 15,210m3 @ 90m3/hr, at an average of 15m3/hr per well
Site 3B: 5,880m3 @ 35m3/hr, at an average of 11.6m3/hr per well
Site 3A & 3C: 12,752 @ 76m3/hr at an average of 12.6m3/hr per well

Total tonnage of CH4 destroyed was approximately:

33,8224m3 landfill gas @ 25% average CH4
= 8,455 x 0.667 kg/m3
= 5639.818 / 1000
= 5.63 tonnes of CH4.

4. Discussion

4.1 Comparison of Results

Based on the results gained from the pumping trial on a representative area of the. The sphere of influence prediction is based upon information gathered on the sustainable suction and flow rates that can be applied to the extraction wells of a known depth and leachate levels within the site. This combined with the predicted gas yield from the waste mass and previous experience of sustainable well spacing enables us to predict an effective well spacing of 30m.

5.0 Conclusions

5.1 Sustainable Gas Control Capacity at the Site

The estimated landfill gas output predicts sustainable flaring capacity at the site for the duration of the gas producing life span of the site, which is estimated to be around 2035 at 15-40% Methane. However, landfill gas will continue to be produced at a lower quantity and quality for the following 20-40 years possibly for another 50 years.

The pumping trial was carried out on a small number of gas wells per site. All gas wells were kept under suction until the reservoir of gas within the site was depleted.

Site 1 & 2

Averaged out at 15m3/hr per well
When this data is analysed and extrapolated for the whole site it is envisaged that a flow rate of 240m3/hr of landfill gas could be produced. However, there may be areas of the site that are filled with more inert types of wastes, which may not produce gas of any quality or quantity. Therefore, we will assume that a maximum of 50% of the site will produce gas of a suitable quantity and quality giving a revised possible flow of 120m3/hr.

Site 3B

Averaged out at 11m3/hr per well
When this data is analysed and extrapolated for the whole site it is envisaged that a flow rate of 33m3/hr of landfill gas could be produced. However, there may be areas of the site that are filled with more inert types of wastes, which may not produce gas of any quality or quantity. Therefore, we will assume that a maximum of 50% of the site will produce gas of a suitable quantity and quality giving a revised possible flow of 16m3/hr.

Site 3A & 3C

Averaged out at 12m3/hr per well
When this data is analysed and extrapolated for the whole site it is envisaged that a flow rate of 120m3/hr of landfill gas could be produced. However, there may be areas of the site that are filled with more inert types of wastes, which may not produce gas of any quality or quantity. Therefore, we will assume that a maximum of 50% of the site will produce gas of a suitable quantity and quality giving a revised possible flow of 60m3/hr.

Options:
Due to the low flow rates and methane quality we believe that there is only 1 option for future gas control at sites 2 & 3A.

Option 1:
We can install new gas wells at 30m centres across the sites down to just above the water table, these can then be connected into a common gas main and lead to a small 100m3/hr Lo-Cal flare.

Option 1: for sites 1, 3B & 3C
Install a series of vent pipes and rotating cowls across the site to provide a negative suction within the waste mass. We can also include for a series of vent trenches across and around the perimeter of the site.

5.2 Budget Costs for a Future Gas Control System at the Site.

Option 1: Sites 2 & 3A
We have proposed the installation of 26 gas wells, with 63mm collection pipes leading to a 180mm gas main with several KO pots. We recommend 4 pumped dewatering KO pots and 1 pumped sump located next to the flare. All pipework would be buried within the capping layers to a depth of no more than 750mm. A flare compound would be required to include a concrete base and security fencing 2.4m high. A 100m3 Lo-Cal flare system and a mains electricity supply.

Our budget for this would be £ 250 to 275k.

Option 1:Sites 1, 3B & 3C
Install a series of 30 vent pipes and rotating cowls across the 3 sites to provide a negative suction within the waste mass. These will require drilling down to just above the water table or leachate levels, the installation of slotted pipes, gravel pack, bentonite seal and 7m posts with rotating cowls.

Our budget for this would be £ 60 to 70k.

Appendix A:

Site Drawings

a) Dwg: Site plan showing gas collection system & pumping trial area

B) Proposed gas extraction system

Appendix B:

COLLATED MONITORING RECORDS

First background readings before starting the flare

Start of the Trial

Appendix C:

LEACHATE DIP LEVELS

Appendix D

Revised Risk Site Wide Model (Baseline Conditions – No Development and with Development)

Table 5.1 – Revised Risk Site Wide Model (Baseline Conditions – No Development)

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
S1	Leachate	P1	Vertical to groundwater then horizontally through possible surface water drainage channels into the river	R1	WFD Surface Water Body	None	Medium	No Risk	A formal Surface Water drainage system that directly connects the 5 landfill sites to the SAC and/or County Brook River has not been identified, pollutant linkage does not exist. Groundwater does emerges at the down-gradient springs which then form as riparian drains leading to the river and this is considered as part of pathway P2.
				R2	Surface Water Protected Area	None	Medium	No Risk	
		P2	Vertical & Horizontal via Groundwater	R3	Private Wells	None	Medium	No Risk	There are no known private wells along the leachate plumes (water main connection in the area)
				R4	Groundwater Dependent Terrestrial Ecosystem (GWDTE)	Highly Likely	Severe	High Risk	GWDTE present, location of alkaline fens and tufa sites identified by ecologists within the Ballyman Glen SAC. Sites are down-gradient of landfill Sites 1, 3A and 3C. Water quality at a number of the springs appears to have been affected by leachate migration from some of the landfill sites. Although not proven these effects may have had a direct effect on the tufa forming potential within these riparian streams.
				R5	Aquifer	Highly Likely	Medium	Moderate Risk	The underlying bedrock and gravel aquifers are at risk by direct connection
				R6	Public Supply Well	None	Mild	No Risk	There are no public water supply wells in the area.
				R1	Surface Water Body	Likely	Medium	Moderate Risk	The County Brook River (Fassaroe Stream) is at risk
		P3	Surface Water Drainage	R1	Surface Water Body	None	Medium	No Risk	There are no surface water drainage channels in the area, however at Site 2 there is seepage from exposed waste at collapsed river bank observed at one down-gradient location
				R2	Surface Water Protected Area	None	Medium	No Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
S2	Waste	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	Sites 1, 3A and 3C are currently not in use. Currently minimal clay cap in place.
				R8	Construction Workers	Unlikely/Low Likelihood	Minor	Very Low Risk	Sites 1, 3A and 3C are currently not in use. Currently minimal clay cap in place.
S3	ACM	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Current and Future Site Users	Unlikely	Severe	Low/ Moderate Risk	Shallow soil sampling recorded a single detection of ACM in Site 1 – no detections were recorded at the remaining sites.
				R8	Construction Workers	Unlikely	Severe	Low/Moderate Risk	Shallow soil sampling recorded a single detection of ACM in Site 1 – no detections were recorded at the remaining sites.
S4	Landfill Gas	P5	Lateral Migration Subsoil	R7	Current and Future Site Users	Low Likelihood	Mild	Low Risk	Monitoring indicates that all sites are actively gassing. Offsite gas monitoring completed. The age, extent, volume and composition of waste is known. Potential for ingress to existing buildings and structures. Potentially, landfill gas migration could occur into existing adjacent buildings through cracks within the floor slab construction and/or around service/utility routes. Risks associated with gas migration into existing buildings should be considered further by the Local Authority.
				R8	Construction Workers	Likely	Severe	High Risk	
				R9	Adjacent Buildings and Structures	Low Likelihood/Likely	Severe	Moderate/ High Risk	
				R10	Non Designated Land	Low Likelihood/Likely	Minor	Very Low/Low Risk	
S4	Landfill Gas	P6	Lateral Migration Groundwater	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	Landfill gas known to be present onsite. Offsite gas monitoring completed.
				R8	Construction	Unlikely/Low	Severe	Low/Modera	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
					Workers	Likelihood		te Risk	Age, extent, volume and composition of waste.
				R9	Adjacent Buildings and Structures	Unlikely/Low Likelihood	Severe	Low / Moderate Risk	Groundwater and leachate levels established
S4	Landfill Gas	P7	Vertical Migration Subsoil	R7	Current and Future Site Users	Low Likelihood	Mild	Low Risk	Existing clay cap c.1-2m . The lack of an engineered cap will enable vertical migration of gas and atmospheric dispersion and dilution at surface.
				R8	Construction Workers	Likely	Severe	High Risk	Landfill gas known to be present onsite however no credible dataset available. No offsite monitoring completed. Age, extent, volume and composition of waste known.
				R9	Adjacent Buildings and Structures	Low Likelihood/Likely	Severe	Moderate/High Risk	Water level and effect on gassing regime known. Potential for ingress to existing buildings and structures.
				R10	Non Designated Land	Likely	Minor	Very Low /Low Risk	Vegetation die back noted.
S4	Landfill Gas	P8	Existing & Proposed Services Routes	R9	Adjacent Buildings and Structures	Low Likelihood/Likely	Severe	Low/Moderate Risk	Offsite gas monitoring known to have been completed.

Table 5.2 – Revised Risk Site Wide Model (Baseline Conditions with Development)

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
S1	Leachate	P1	Vertical to groundwater then horizontally through possible surface water drainage channels into the river	R1	Surface Water Body	None	Medium	No Risk	No change to this SPR linkage as a result of the proposed development.
				R2	Surface Water Protected Area	None	Medium	No risk	
		P2	Vertical & Horizontal via Groundwater	R3	Private Wells	Unlikely	Medium	Low Risk	There are no known private wells along the leachate plumes (water main connection in the area). No change following development.
				R4	GWDTE	Highly Likely	Severe	High Risk	No change to SPR linkage with proposed development. Tufa springs still impacted by leachate.
				R5	Aquifer	Likely	Medium	Moderate Risk	The underlying bedrock and gravel aquifers are at risk by direct connection.
				R6	Public Supply Well	None	Mild	No Risk	There are no public water supply wells in the area.
				R1	Surface Water Body	Likely	Medium	Moderate Risk	The County Brook River (Fassaroe Stream) is at risk
		P3	Surface Water Drainage	R1	Surface Water Body	Unlikely	Medium	Low Risk	There are no surface water drainage channels in the area, however at Site 2 there is seepage from exposed waste at collapsed river bank observed at one down-gradient location. The proposed development will route normal rainfall events from the housing and roads areas to soakaways as such there will be no substantial change in runoff. Excess inflow from storm events greater than 1 in 5year event will be discharge directly to surface
				R2	Surface Water Protected Area	Unlikely	Medium	Low Risk	

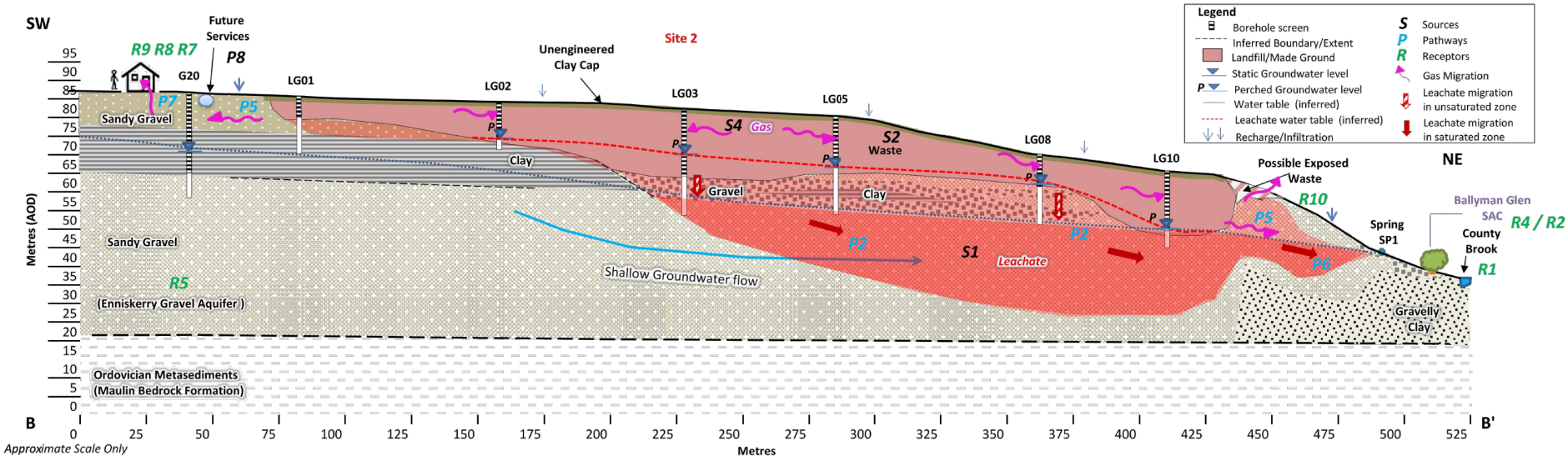
Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
									water via attenuation ponds with not potential for contamination from the waste body. As such there are no material change to these SPR linkages as a result of the proposed development.
S2	Waste	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	No change to SPR linkage with proposed development Sites 1, 3A and 3C are currently not in use. Currently minimal clay cap in place.
				R8	Construction Workers	Low Likelihood	Minor	Very Low Risk	Risk to construction workers during excavations should be mitigated by the use of appropriate PPE
S3	ACM	P4	Direct dermal contact Ingestion dust and soil Inhalation of dust	R7	Current and Future Site Users	Unlikely	Severe	Low/Moderate Risk	No change to SPR linkage with proposed development. Shallow soil sampling recorded a single detection of ACM in Site 1 – no detections were recorded at the remaining sites.
				R8	Construction Workers	Unlikely	Severe	Low/Moderate Risk	No change to SPR linkage with proposed development. Shallow soil sampling recorded a single detection of ACM in Site 1 – not detections were recorded at the remaining sites. Risk to construction workers during excavations should be mitigated by the use of appropriate PPE
S4	Landfill Gas	P5	Lateral Migration Subsoil	R7	Current and Future Site Users	Likely	Mild	Moderate Risk	Monitoring indicates that all sites are actively gassing. Offsite gas monitoring completed. Age, extent, volume and composition of waste known.
				R8	Construction Workers	Likely	Severe	High Risk	
				R9	Adjacent Buildings	Likely	Severe	High Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
					and Structures				Potential for exposure to construction workers during excavations. The installation of hardstand as part of the proposed development may promote off site lateral gas migration. Potential for ingress to existing and proposed buildings and structures. Potentially, landfill gas migration could occur into existing adjacent buildings through cracks within the floor slab construction and/or around service/utility routes. If the proposed development does not proceed risks associated with gas migration into existing buildings should be considered further by the Local Authority.
				R10	Non-designated Land	Low Likelihood/Likely	Minor	Very Low/Low Risk	
S4	Landfill Gas	P6	Lateral Migration Groundwater	R7	Current and Future Site Users	Unlikely	Mild	Very Low Risk	Landfill gas known to be present onsite. Offsite gas monitoring completed. Age, extent, volume and composition of waste. Groundwater and leachate levels established
				R8	Construction Workers	Unlikely/Low Likelihood	Severe	Low/ Moderate Risk	
				R9	Adjacent Buildings and Structures	Low Likelihood	Severe	Moderate Risk	
S4	Landfill Gas	P7	Vertical Migration Subsoil	R7	Current and Future Site Users	Low Likelihood	Mild	Low Risk	Existing clay cap c.1-2m . The lack of an engineered cap will enable vertical migration of gas and atmospheric dispersion and dilution at surface. No buildings proposed to be constructed on waste bodies. Landfill gas known to be present onsite however no credible dataset available. No
				R8	Construction Workers	Likely	Severe	High Risk	

Source		Pathway		Receptor		Likelihood of Occurrence	Severity of Consequence	Risk Classification	Comments
				R9	Adjacent Buildings and Structures	Likely	Severe	High Risk	offsite monitoring completed. Age, extent, volume and composition of waste known. Water level and effect on gassing regime known. Potential for exposure to construction workers during excavations. Potential for ingress to existing and proposed buildings and structures. Vegetation die back noted.
				R10	Vegetation Stresses/Ecology	Likely	Minor	Very Low/Low Risk	
S4	Landfill Gas	P8	Existing & Proposed Services Routes	R9	Adjacent Buildings and Structures	Likely	Severe	Moderate Risk	Offsite gas monitoring known to have been completed. No buildings proposed to be constructed on waste bodies.

Appendix E

Conceptual Site Model – Site 2



Client

Comhairle Contae Chill Mhantáin

General Notes

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(ii) All Levels refer to Ordnance Survey Datum, Malin Head.

(iii) DO NOT SCALE, use figured dimensions only, if in doubt ask.

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Date	May 2016
Scale	NTS @ A1 NTS @ A3

Project: **FASSAROE HISTORIC LANDFILL**

Title: CONCEPTUAL SITE MODEL SITE 2

Job No.	File Ref.	Drg. No.	Rev.
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