Appendix A4.10 Monitoring and Control Plan

Kerdiffstown Landfill Remediation Project

Kildare County Council

KLRP Management Plan

Monitoring and Control

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Kerdiffstown Landfill Remediation Pro ect

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Drawings

Drawing Number	Revision	Title
32EW5604-00-002	2	Ground Investigation Locations
32EW5604-00-057	1	Groundwater Monitoring Locations
32EW5604-00-055	1	Surface Water Monitoring Locations
32EW5604-00-056	1	Landfill Gas Monitoring Locations
32EW5604-00-054	1	Leachate Monitoring Locations

1. Monitoring and Control Management Plan

1.1 Introduction

1.1.1 Current Status

Presently, only limited works are undertaken at Kerdiffstown Landfill site. Site management personnel oversee monitoring, maintenance of landfill gas and leachate infrastructure and coordination of third party consultants and contractors.

Management of the site is currently undertaken via Standard Operating Procedures (SOPs) which are held in the site office and issued to the affected party, or for use within reference in contractual documentation as necessary. These SOPs will remain in place until such time as the site is granted an Industrial Emissions Activities Licence (IEAL) for remediation works to commence. Thereafter this Management Plan will be reviewed to ensure that that any related conditions of the IEAL are fully embraced within the Management Plan. This document shall then supersede the existing SOPs.

The statements and work instructions set out in the following sections will be reviewed immediately following issue of the IEAL, with other Management Plans being prepared and embedded within one document for ease of reference.

The Management Plan is a live document and will be reviewed on a regular basis and upgraded accordingly. A record of revisions is included in the contents to the Management Plan. Monitoring is currently carried out for landfill gas, surface water, groundwater, leachate, odour, noise, particulate matter and topography.

The Operational / Aftercare stage of the site will commence following the remediation works when the site will be used as a multi-use pubic park and recreation amenity. The responsibility for the management of the site and the landfill infrastructure systems as well as park operation and maintenance will be retained by Kildare County Council (KCC) as documented by an updated Management Plan governed by the IEAL which will remain in place.

1.1.2 Proposed Works

Underpinning the approach to all monitoring at the site is the need to obtain high quality samples using a consistent approach in order to support the wider management objectives. A significant number of ground investigation locations have been installed at the site, to assist in the development of knowledge of site conditions and hydrogeological setting. The locations of ground investigation boreholes are shown on Drawing Number 32EW5604-00-002, with further background contained in the Baseline Report (refer to IEAL Application submission; 2017). Monitoring proposals for the site are based on identification of the primary locations for maintaining this understanding of site condition, primarily during the Remediation Phase, aligning with proximity to key receptors and taking cognisance of construction works to be undertaken on site.

Landfill monitoring will be carried out on and immediately around the licensed installation. The monitoring strategy will be kept under review with the Environmental Protection Agency (EPA) and the frequency varied taking into account the following considerations:

- Working areas (during the Remediation Phase);
- Changes in quality and quantity of determinants found during routine monitoring;
- Changes in control systems;
- Changes in the site environs (e.g. progressive remediation);
- Guidance given in EPA Landfill Monitoring Manual, 2nd Edition (EPA, 2003).

The adequacy of the monitoring regime required will be kept under review by Kildare County Council (KCC) staff experienced and competent in the interpretation of monitoring results. The results of monitoring will be available to the EPA and reported accordingly in compliance with the IEAL.

1.2 Groundwater Monitoring

1.2.1 Monitoring Locations

Borehole logs illustrating the construction and design of the monitoring boreholes are provided in the Baseline Report that accompanied the IEAL application for the site.

Generally, monitoring boreholes are constructed from a combination of 19mm and 50mm slotted well screen. The slotted well screen is surrounded by a gravel pack and / or a geosynthetic wrap. The monitoring boreholes are capped with a proprietary steel headwork or 'flush ground level' covers dependent on location within the licence boundary or on third party lands.

As significant earthworks are to be undertaken across the site as part of the Remediation Phase many ground investigation locations will be lost and a number of boreholes have been identified as 'at risk'. The location of groundwater monitoring locations is shown on Drawing Number 32EW5604/00/057.

Should any of the groundwater monitoring locations become damaged, e.g. during the remediation phase, to such an extent that the levels cannot be recorded or samples obtained, they will be either repaired or replaced within a timescale agreed by the EPA. The nature of any replacement being the drilling methods and installation details (to include location, depth, screen length and construction details), for any future groundwater monitoring boreholes will be subject to a Construction Quality Assurance Plan to be agreed by the EPA prior to any works being undertaken.

Those groundwater monitoring locations identified to be decommissioned as part of the remediation works will be subject to the "Good practice for decommissioning redundant boreholes and wells" produced by the Environment Agency (2012), detailed in a Construction Quality Assurance (CQA) Plan for agreement with the EPA.

1.2.2 Monitoring Measurements and Schedules

Groundwater monitoring will be carried out at the locations, frequency and for the analysis detailed in Table 1.1. Groundwater analysis has been categorised to the suites shown further below in Table 1.2.

Table 1.1: Groundwater Monitoring Locations and Frequencies

Location:	Frequency:			
	Monthly	Quarterly		Annually
Analysis:	Suite G 1	Suite G 1	Suite G 2	Suite G 3
Off-waste, down hydraulic gradient				
BB02	✓		✓	✓
DB02	✓		✓	✓
DB03	✓		✓	✓
EMW02		✓		
EMW03	✓		✓	✓
EMW04		✓		
EMW05	✓		✓	✓
EMW07		✓		
EMW18		✓		
EMW19	✓		✓	✓
EMW20	✓		✓	✓

Location:	Frequency:			
	Monthly	Quarterly		Annually
Analysis:	Suite G 1	Suite G 1	Suite G 2	Suite G 3
EMW22		✓		
EMW23		✓		
EMW24		✓		
EMW31		✓		
EMW33		✓		
Off-site, up-hydraulic gradient				
EMW27	✓		✓	✓
EMW29	✓		✓	✓
EMW30	✓		✓	✓
On-site				
BH2		✓		
BH6		✓		
BH7		✓		
BH26		✓		
BH42		✓		
BH68	✓		✓	✓
EMW11	✓		✓	✓
EMW13	✓		✓	✓
EMW15	✓		✓	✓
EMW16	✓		✓	✓
GW1D		✓		
GW2S		✓		
EMW14		✓		
EMW17		✓		
BH36B		✓		
Groundwater Levels only (monthly)				
BB04, DB01, DB03A, DB04 (D), DB05, DB07, DB08A, DB09, EMW06, EMW08, EMW21, EMW28, EMW32, RM1, RM2, RM3, RM4, RM5, RM6				

Notes: Ref – location at risk from remediation works. To be reinstated/ replaced if damaged.
Ref – location at risk from remediation works. To be monitored until removed/ decommissioned.

Table 1.2: Groundwater Analysis Suites

Determinant	Suite GW1	Suite GW2	Suite GW3
Field Measurements			
Water Levels, pH, Dissolved Oxygen, Electrical Conductivity, Redox (Eh), Temperature	✓	✓	✓
Laboratory Analysis			
Aluminium		✓	✓
Ammoniacal nitrogen	✓	✓	✓
Antimony		✓	✓
Arsenic		✓	✓
Barium		✓	✓
BOD	✓	✓	✓
Boron		✓	✓
Cadmium		✓	✓
Calcium		✓	✓
Chloride	✓	✓	✓
Chromium		✓	✓
COD	✓	✓	✓
Copper		✓	✓
Cyanide	✓	✓	✓
Electrical Conductivity	✓	✓	✓
Fluoride			✓
Formaldehyde			✓
Iron		✓	✓
Lead		✓	✓
Magnesium			✓
Manganese		✓	✓
Mercury		✓	✓
Nickel		✓	✓
Nitrate	✓	✓	✓
Nitrite	✓	✓	✓
Pesticides (OCP and OPP pesticides to include mecoprop)		✓	✓
pH	✓	✓	✓
Phenols (low level)		✓	✓
Orthophosphates			✓
Total Phosphorous			✓

Determinant	Suite GW1	Suite GW2	Suite GW3
Potassium		✓	✓
Selenium		✓	✓
Sodium		✓	✓
Sulphate	✓	✓	✓
Sulphide			✓
Total Organic Carbon			✓
TON	✓	✓	✓
Total alkalinity			✓
Total Nitrogen	✓	✓	✓
TPH (CWG) hydrocarbons			✓
Trace Organic Substances (refer to Tables D.2 of Landfill Monitoring Manual)			✓
Zinc		✓	✓

The groundwater monitoring programme and results will be subject to annual review throughout the operational and post-closure aftercare period of the site. Sampling frequencies and determinants will be modified and adjusted as appropriate.

If stable conditions are present, the frequency and / or number of determinants may be reduced in consultation with the EPA.

1.2.3 Control and Trigger Levels and Contingency Action Plan

a) Control and Trigger Levels

In advance of remediation works completion a groundwater monitoring plan will be developed to inform the site's long term management plan. This monitoring plan will set out the actions to be taken if the monitoring data shows adverse impacts to groundwater quality. Control and trigger levels will be set for a small number of key determinands.

In the context of groundwater monitoring definitions of control and trigger levels are as follows:

> *Control levels: these are specific assessment criteria that will be used to determine whether the site is performing as designed and are intended to bring to attention of site management to the development of adverse trends in the monitoring data. They are a test of the significance of a deviation from baseline groundwater conditions, where the baseline is considered as the existing monitoring data set. Control levels should be regarded as an 'early warning system' to enable appropriate investigation or corrective measures to be implemented, rather than as an indication that groundwater pollution has occurred.*
>
> *Trigger Levels: defined by the Landfill Directive 1999/31/EC (LFD) as levels at which significant (adverse) environmental effects have occurred. This relates to where the concentration has exceeded a level which means the environmental standard at a receptor will be breached and there is pollution. A trigger level is a value which, if exceeded, will require certain actions to be taken.*

The groundwater control and trigger values and actions to be taken should the values be exceeded would be produced within six months of the granting of the IEAL utilising the most up to date monitoring data from the ongoing monitoring programme for review and agreement with the EPA.

b) Contingency Action Plan

Control levels would identify any unusually elevated concentrations and actions taken should a control value be exceeded may include further monitoring of the borehole, monitoring of adjacent boreholes or sampling of nearby surface water receptors.

Exceedance of trigger levels would identify the need for immediate action and would be based on a sustained upward trend in the monitoring over a period of time (say two years), together with consideration of any impacts being recorded on surface water receptors (principally the Morell River). If significant adverse impacts on the surface water or other receptors were recorded, then the need for local remediation could be undertaken which would likely include ground investigation in the area of impact and local interception of groundwater discharging to the surface water. This groundwater could then be taken to the on-site leachate collection point for disposal and off-site treatment.

A contingency action plan embracing the assigned control and trigger levels will be developed within six months of the granting of the IEAL, for agreement by the EPA, and updated in this Management Plan.

1.2.4 Monitoring Methodology

a) General

Industry standard environmental sampling techniques and specific monitoring procedures will be employed to ensure that all collected samples are representative of groundwater at each location and also to ensure that the integrity of each sample is maintained until receipt at the approved laboratory. Only suitably trained personnel with experience of groundwater monitoring will be used to carry out monitoring and sampling in accordance with the procedures outlined below.

b) Pre-Monitoring Checks

Prior to undertaking groundwater monitoring, checks will be carried out to determine:

- The number of samples and analytical requirements;
- The size, type and number of bottles that are required and any fixative or preservative requirements;
- That all equipment is clean and in good working order; and
- That all necessary equipment is available.

c) On-Site Records

A record will be made of the following:

- Name of monitoring staff;
- Date of sampling;
- Sampling equipment and method used;
- On-site weather conditions;
- Observations including vegetation die back, leachate outbreaks, surface water ponding, damage to security fencing or accumulations of wind-blown litter; and
- Damage to borehole headworks or caps.

d) Monitoring Procedure

Water levels are dipped using a contact dip meter and recorded as metres below ground level (mbgl). These levels are further related to metres above Ordnance Datum (mOD). For boreholes to be sampled, the recording of levels will determine the volume to be purged from the borehole.

All groundwater wells will be purged and sampled using the existing down-hole inertia lift pumps. This will be achieved using a PP1 Power Pack Unit (or equivalent) and any inertia pumps if required during the monitoring programme to facilitate the collection of samples.

During purging all well-head measurements will be made using a multi-parameter water quality instrument, along with a closed flow-through cell (to prevent oxidative bias from contact between atmosphere and purged water during instrument measurement).

The stabilisation criterion used for this project, will be based on the instrument detection level and ASTM D6771 guidance. These water quality parameters will also help establish the principal redox processes in the aquifer(s) to assess the attenuation processes.

The groundwater sample obtained is put into appropriate containers with preservation (if required) and placed into a cooler box and stored at <4°C. Sample bottles not containing preservative are flushed out with the sample prior to filling. The sample bottles are filled to the brim to exclude air, the top secured firmly and bottle clearly labelled with the location and date.

All water purged from wells will be collected in drums during pumping and disposed of to the wastewater treatment system. Groundwater will not be disposed of at off-site locations.

Samples are then transported to an external laboratory at the earliest opportunity.

e) Data Management and Reporting

Comparison of monitoring data with control levels will be carried out each time monitoring data are collected. When an adverse trend or breach of a control level is indicated by the monitoring results, appropriate contingency actions will be implemented.

The groundwater level and quality monitoring results will be stored in both electronic and hard formats. A hard copy of the data will be submitted to the Agency for review on a quarterly basis.

Results and analysis of the data will also be included within an annual environmental monitoring report for submission to the Agency during March of each year.

f) Monitoring Quality Assurance

Monitoring equipment will be calibrated, serviced and maintained in line with the manufacturer's recommendations.

An ISO / IEC 17025:2005 accredited laboratory will carry out analysis of groundwater samples.

1.3 Surface Water Monitoring

1.3.1 Monitoring Locations

The location of surface water monitoring locations is shown on Drawing Number 32EW5604-00-055.

1.3.2 Monitoring Measurements and Schedules

Surface water monitoring will be undertaken at the locations and frequencies given in Table 1.3. Analysis for each period will be undertaken for the determinants listed in Table 1.4.

Table 1.3: Surface Water Monitoring Locations and Frequencies

Location:	Comment	Location Status	Frequency			
			Logger	Monthly	Quarterly	Annually
SW1	Existing	Morell River: upstream of the site		✓	✓	✓**
SW2	Existing	Morell River: upstream of the site		✓	✓	✓
SW3	Existing	Morell River: downstream of the site		✓	✓	✓
SW4	Existing	Morell River: downstream of the site		✓	✓	✓
SW5	Existing	Morell River: downstream of the site		✓	✓	✓**
SW6	Future	Outlet from Ponds to Morell River	✓	✓	✓	✓
SW7	Future	Outlet from Pond to soakaway		✓	✓	✓
SW10	Existing – to be discontinued following disconnection of SD1	Canal Feeder Stream: downstream of site discharge		✓	✓	✓
SW13	Existing – to be discontinued following disconnection of SD1	Canal Feeder Stream: upstream of site discharge		✓	✓	✓
SD1	Existing – to be disconnected during Remediation Phase	Site discharge location to Canal Feeder Stream		✓	✓	✓

Note points labelled SW8, SW11 and SW12 were sampled in the past. Sampling of these locations will cease given the extensive sampling programme proposed.

Table 1.4: Surface Water Monitoring Determinants

Frequency	Determinants
Monthly	**Field Measurements:** pH, Dissolved Oxygen, Electrical Conductivity, Temperature **Laboratory Analysis:** BOD, COD, Ammoniacal Nitrogen, Chloride, Total Oxidised Nitrogen, Suspended Solids*
Quarterly	**As Monthly plus:** Arsenic, Calcium, Iron, Manganese, Potassium, Sodium **Laboratory Analysis:** Total Alkalinity, Sulphate, Total Cyanide
Annually	**As Quarterly plus:** **Laboratory Analysis:** Boron, Cadmium, Total Chromium, Copper, Fluoride, Lead, Magnesium, Mercury, Nickel, Zinc Molybdate Reactive Phosphorous, Trace Organic Substances as per Table D.2 of Landfill Monitoring Manual ****Biological assessment:** requires monitoring between June and September

Notes: * Suspended Solids to be undertaken in Canal Feeder, SD1, Morell River and SW6 only.
** Biological assessment to be undertaken at SW1 (Morell River; upstream of the site) and SW5 (Morell River; downstream of the site).

The sampling and monitoring of surface water discharges will be required post remediation works to confirm that the runoff quality complies with the discharge parameters. A real time monitoring and control system will be provided at the outlet from Pond 3 in the south-eastern area, discharging to the Morell River. Sampling of the infiltration swale at the northern perimeter of the site will also be undertaken. Sampling of the Morell River upstream and downstream of the outfall from Pond 3 will continue (as a minimum). Real time monitoring will be undertaken at the outlet from the ponds for discharge to the Morell River via a supervisory control and data acquisition (SCADA) system. This monitoring will be for key indicators on the basis of risk from the pollution incidents at the site. The parameters to be measured will be confirmed during the Remediation Phase as baseline data from the clean run-off to be collected as the remediation works progress.

The frequency of the monitoring of the Morell River may be reduced following sufficient data to support ongoing assessment, in agreement with the EPA.

The surface water monitoring programme and results will be subject to annual review. Sampling frequencies and determinants will be reviewed and will be modified and adjusted as appropriate with agreement from the EPA.

1.3.3 Trigger Levels and Contingency Action Plan

a) Trigger levels

Trigger levels have not been established for surface waters. For future discharges from the site, being locations SW6 (to Morell River) and SW7 (to ground via soakaway) key indicator parameters and associated trigger levels will be agreed by the EPA within six months of issue of the IEAL.

b) Contingency Action Plan

A contingency action plan will be developed following detailed design of the discharge monitoring system, for agreement by the EPA, and updated in this Management Plan in advance of discharges from the site being permitted.

1.3.4 Monitoring Methodology

a) General

Industry standard environmental sampling techniques and specific monitoring procedures will be employed to ensure that all collected samples are representative of surface water at each location and also to ensure that the integrity of each sample is maintained until receipt at the approved laboratory. Only suitably trained personnel with experience of surface water monitoring will be used to carry out sampling in accordance with the procedures outlined below.

b) Pre-Monitoring Checks

Prior to undertaking surface water monitoring, checks will be carried out to determine:

- The number of samples and analytical requirements;
- The size, type and number of bottles that are required and any fixative or preservative requirements;
- That all equipment is clean and in good working order; and
- That all necessary equipment is available.

c) On Site Records

A record will be made of the following:

- Name of monitoring personnel;
- Date of sampling;
- Sampling equipment and method used;
- On-site weather conditions;
- Observations including vegetation die-back, leachate outbreaks, surface water ponding, damage to security fencing or accumulations of wind-blown litter.

d) Monitoring Procedure

Field monitoring including temperature, pH, dissolved oxygen and electrical conductivity will be carried out using portable instrumentation.

The surface water sample obtained is put into appropriate containers with preservation (if required) and placed into a cooler box for sample storage at <4°C. Sample bottles not containing preservative are flushed out with the sample prior to filling. Sample bottles are filled to the brim to exclude air, top secured firmly and bottle clearly labelled with the location and date.

Samples are then transported to an external laboratory at the earliest opportunity.

e) Data Management and Reporting

Comparison of monitoring data with relevant trigger levels will be carried out each time monitoring data are collected.

The surface water quality monitoring results will be stored in both electronic and hard formats. Reporting of the data to the EPA will be undertaken in compliance with the requirements of the IEAL.

f) Monitoring Quality Assurance

Surface water monitoring and sampling at the site will be undertaken in accordance with the monitoring procedure detailed above. Suitably trained personnel will undertake surface water monitoring.

Monitoring equipment will be calibrated, serviced and maintained in line with the manufacturer's recommendations.

An ISO / IEC 17025:2005 accredited laboratory will carry out analysis of surface water samples.

1.4 Landfill Gas Monitoring

1.4.1 Monitoring Locations

Landfill gas monitoring locations are shown on Drawing Number 32EW5604-00-056. Future locations including additional perimeter monitoring boreholes and gas extraction wells will be confirmed during the Remediation Phase.

Construction of any future gas monitoring locations will be subject to a Construction Quality Assurance Plan to be agreed by the EPA.

Should any of the gas monitoring points become damaged to such an extent that the levels cannot be recorded or samples obtained they will be either repaired or replaced within a timescale agreed by the EPA. The nature and location of any replacement, as well as the drilling methods to be used would be approved by the EPA prior to any works being undertaken.

1.4.2 Monitoring Measurements and Schedules

Landfill gas monitoring will be carried out at the locations, frequency and for the determinants detailed in Table 1.5.

Table 1.5: Landfill Gas Monitoring Locations, Frequency and Determinants

Monitoring	Location	Frequency	Determinants
In-waste monitoring and gas field balancing	Landfill gas wells/manifolds (Zones 1 & 3)	Monthly	CH_4, CO_2, O_2, N_2, gas balance, H_2S, CO, Relative pressure
	Zone 1 Zone 3	Annually	Representative sample from each Zone to be analysed for trace gases in accordance with guidance document LFTGN04 (Environment Agency).
	In-waste boreholes (Zones 2A & 2B)	Monthly	CH_4, CO_2, O_2, N_2, gas balance, H_2S, CO, Flow, Relative pressure
Perimeter	Perimeter boreholes	Weekly	CH_4, CO_2, O_2, N_2, gas balance, Flow, Relative pressure, Atmospheric pressure
Flare	Inlet	Automated continuous monitoring	Temperature, CH_4, CO_2, O_2, gas flow rate
	Inlet	Manual monitoring (monthly)	Inlet pressure CH_4, CO_2, O_2, N_2, gas balance, H_2S, CO
	Output	Annually	Emissions monitoring to include: NOx, CO and Total VOCs, plus any other species identified by air dispersion assessment (refer to Environmental Impact Assessment Report).
Gas Alarms	As installed in Site Buildings – TBC	Automated continuous monitoring	CH_4, CO_2, H_2S and CO (to be confirmed via risk assessment).
Surface emissions*	Zones 1, 2A, 2B & 3	Annually	VOC and CH_4 with FID

* Refer to EA LFTGN07 Guidance for Monitoring Surface Emissions for procedure. Walkover stage only required unless there is a requirement to quantify emissions through flux box analysis.

Additional perimeter gas monitoring boreholes are to be installed in advance of remediation works to permit assessment of gas migration. Monitoring of these will be added to the above schedule as required.

Remediation works to be undertaken at the site include re-profiling of the site levels and will require removal of existing in-waste gas wells and boreholes. Gas wells will be replaced at spacings to be determined from a gas pumping trial. Replacement boreholes will be considered based on a risk assessment according to capping profile and end-use, such as proximity to site buildings.

Prior to commencement of the Remediation Phase, the Contractor(s) appointed to undertake the remediation works shall prepare a Construction Environmental Management Plan (CEMP). The CEMP will identify phases of works where increases in gas monitoring frequencies may be required to ensure assessment of risk and that the effects of migration are recorded.

The installation of any new landfill gas infrastructure (gas wells, boreholes, flares) will be subject to agreement with the EPA, to be detailed in a CQA Plan.

1.4.3 Trigger Levels and Contingency Action Plan

a) Trigger Levels

Perimeter Boreholes

Monitoring data will be recovered from perimeter boreholes, to be installed in advance of the Remediation Phase, in order to determine a baseline for those locations. As the site is unlined in predominately sand and gravel deposits it is considered likely that gas migration may be recorded. However, with the installation of a capping system and gas extraction system it is anticipated that gas collection rates will be increased and migration managed.

In absence of borehole specific trigger levels at this time, the default trigger levels given in Table 1.6 shall be used. These trigger levels will also apply to measurements in any service duct or manhole on, at or immediately adjacent to the landfill.

Table 1.6: Landfill Gas Trigger Levels (perimeter boreholes)

Parameter	Trigger Limit
CH_4	1% v/v
CO_2	1.5% v/v
CO	50ppm

In-waste Wells and Boreholes

Trigger levels to be applied to in-waste wells and boreholes relates to carbon monoxide where 50 ppm may be indicative of a potential fire risk.

Surface Emissions

For surface emissions monitoring a trigger level for methane will be applied as greater than 100 ppmv over capped areas or 1,000 ppmv at discrete infrastructure (e.g. around gas wells). Where detected flux box analysis and trace gas analysis will also be considered to check for exposure risk.

Gas Flare

The IEAL will set out Emission Limit Values with respect to concentrations that cannot be exceeded for landfill gas flares at the site. Table 1.7 sets out the minimum expected.

Table 1.7: Landfill Gas Flare Emission Standards

Parameter	Emission Standard (mg/m^3)*
NOx**	150
CO	50
Total VOCs	10

Notes: * These limits are based on normal operating conditions and load. Temperature: 0°C (273K); pressure: 101.3 KPa; and oxygen: 3% (dry gas).

** NOx expressed as NO_2.

b) Contingency Action Plan

If monitoring should record value(s) above relevant trigger levels then the actions detailed in Table 1.8 will be implemented.

Table 1.8: Landfill Gas Contingency Action Plan

Incident	Actions
Landfill gas detected in perimeter boreholes above Trigger Levels	• Report incident to Site Manager. • Refer to Landfill Gas Management Plan
Landfill gas detected in buildings above trigger levels (1% methane v/v and 1.5% v/v carbon dioxide)	• Affected areas should be evacuated and Emergency services notified • Report incident to Site Manager • Monitoring should be undertaken to identify the point of gas ingress and control measures should be implemented to prevent further ingress.
Capping compromised (gas emissions detected during FID survey, air ingress or gas escape noted, settlement, or erosion issues etc.)	• Report incident to Site Manager. • Refer to Landfill Gas Management Plan for further instructions.
Landfill fire detected (trigger 100ppm CO)	• Report incident to Site Manager and emergency services if appropriate. • Refer to Landfill Gas Management Plan for further instructions.
Flare Emission Standards exceeded	• Report incident to Site Manager • Ensure gas wells have been re-balanced. • Ensure Flare maintenance has been completed and call service engineer if fault identified. • If the above does not resolve the issue hen further specialist assistance to be sought to recommend further actions.

1.4.4 Monitoring Techniques

a) General

Industry standard and specific monitoring procedures will be employed to ensure that all landfill gas monitoring is undertaken appropriately. Only suitably trained personnel with experience of landfill gas monitoring will be used to carry out monitoring in accordance with the procedures outlined below. Monitoring of gas flares will be undertaken in accordance with EPA Guidance Note on Landfill Flare and Engine Management and Monitoring (AG7).

b) Pre-Monitoring Checks

Prior to undertaking gas monitoring, the following checks will be carried out:

- In-line filters will be checked and replaced if necessary;
- Battery life will be checked to ensure there is sufficient charge to carry out the monitoring;
- The calibration status of the instrument will be checked.

c) On Site Records

A record will be made of the following:

- Name of monitoring staff;
- Date of sampling;
- Atmospheric pressure;
- Instrument type and serial number;
- On-site weather conditions;
- Observations including vegetation die-back, leachate outbreaks, surface water ponding, damage to security fencing or accumulations of wind-blown litter;
- Damage to borehole headworks, caps or taps.

d) Monitoring Procedure

Gas monitoring of boreholes and wells/ manifolds will be carried out using a portable gas analyser capable of reading methane, carbon dioxide, oxygen and atmospheric pressure. The instrument will be serviced in accordance with the manufacturer's recommendations.

- The sample tube will be attached to the sample tap;
- The tap will be opened and the analyser pump will be switched on;
- When constant readings are achieved, the data will be recorded on the logger and/or noted by the monitoring staff;
- Borehole pressure readings will be taken at gas extraction wells;
- The gas tap will be closed, the tube will be removed and the pump will be allowed to run to flush out any residual gas before taking the next sample;
- If water level data is required, the borehole cap will then be removed and a contact dip meter will be used to measure the water level relative to the cover level or other agreed datum point;
- The borehole tap and cap will be replaced in left in a closed position.

Monitoring of surface emissions will be carried out in accordance with the methods and procedures identified in relevant EPA guidance or alternative methods agreed by the EPA.

e) Data Management and Reporting Procedures

The Site Manager will be informed by the monitoring staff of any results in excess of the trigger levels or any problems recorded as part of the monitoring works.

Comparison of monitoring data with trigger levels will be carried out each time monitoring data are collected.

The monitoring results will be stored in both electronic and paper formats. A copy of the data will be submitted to the EPA in compliance with the requirements of the IEAL.

Results and analysis of the data will also be included within an annual environmental monitoring report for submission to the Agency during March of the following year.

f) Quality Assurance

Suitably trained and experienced personnel will undertake gas monitoring. Detection limits will be confirmed based on instruments to be utilised in monitoring works.

1.5 Leachate Monitoring

1.5.1 Monitoring Locations

Current locations comprise side wall risers in Zone 3 and a tanker draw off point positioned adjacent to Zone 3. Remediation works will include the construction of a new landfill infrastructure compound with leachate treatment plant (methane stripping) discharging to a transfer pipeline directing leachate to the public sewer network via Johnstown Pumping Station. A sample point will be located downstream of the treatment process to monitor compliance with the connection agreement to be in place with Irish Water. The remediation works will also include monitoring of leachate monitoring wells in the unlined area of Zone 1.

The location of all leachate monitoring locations is shown on Drawing Number 32EW5604-00-054.

1.5.2 Monitoring Measurements and Schedules

Leachate monitoring will be carried out at the locations, frequency and for the analysis detailed in Table 1.9. Leachate analysis has been categorised to the suites shown further below in Table 1.10.

Table 1.9: Leachate Monitoring Locations, Frequencies and Determinands

Type	Location	Frequency	Analysis
Leachate Monitoring Wells	LMW1 LMW2 LMW3 LMW4 LR1 LR2	Weekly	Leachate level
		Monthly	Suite L1
		Quarterly	Suite L2
		Annually	Suite L3
Leachate Discharge Points	LT1*	Monthly	Suite L1
		Quarterly	Suite L2
		Annually	Suite L3
	SE2	Daily	Flow, Methane+
		Monthly	*TBC*
		Quarterly	*TBC*

Notes: * LT1 (sample recovered from tank) will be removed on completion and commissioning of leachate transfer pipeline to Johnstown Pumping Station. SE2 will be the sample location thereafter.

+ / TBC: Leachate sampling requirements for discharge to sewer are to be agreed with Irish Water under a Connection Agreement.

Table 1.10: Leachate Analysis Suites

Determinant	Suite L1	Suite L2	Suite L3
pH	✓	✓	✓
Temperature (field measurement)	✓	✓	✓
Electrical Conductivity	✓	✓	✓
BOD		✓	✓
COD		✓	✓
Total Nitrogen		✓	✓
Ammoniacal Nitrogen	✓	✓	✓
TON		✓	✓
Nitrate		✓	✓
Nitrite		✓	✓
Chloride	✓	✓	✓
Sulphate		✓	✓
Total Metals (Cd, B, As, Zn, Cu, Cr, Pb, Se, Hg, Fe, Mn)		✓	✓
Orthophosphate			✓
Total Phosphorous			✓
Cyanide			✓
Fluoride			✓
Trace Organic Substances (as per table D.2 of EPA Landfill Monitoring Manual)			✓
Pesticides (OCP and OPP pesticides to include mecoprop)			✓

The leachate monitoring programme and results will be subject to annual review throughout the Remediation and Operational Phases. Sampling frequencies and determinants may therefore be modified and adjusted as appropriate in agreement with the EPA. If stable conditions are present (leachate levels or quality) the frequency and / or number of determinants may be reduced in consultation with the EPA.

1.5.3 Trigger Levels Discharge Limits and Contingency Action Plan

a) Trigger Levels

Currently leachate is transferred off site via road tanker for treatment at Ringsend Wastewater Treatment Works. No control or trigger levels are applicable to this process.

b) Discharge Limits

The construction of the new transfer pipeline will be under agreement with Irish Water. This agreement will include analysis to be undertaken, including frequencies and data management, and accordingly will set limits for the discharge of the treated leachate to the public sewer networks. Draft limits based on pre-IEAL application discussions are shown in Table 1.11 below, with frequencies of analysis to be confirmed.

Table 1.11: Draft Leachate Discharge Limits

Determinants	Limit	
Flow	Daily (max)	60 m^3
	Hourly (max)	6 m^3
pH	6 - 8.5	
Temperature	<30^{0}C	
	Concentration mg/l	**Load kg/d**
BOD	1,000	60
COD	5,000	300
Total N	2,500	125
Ammonia	TBC	
TON	TBC	
Chlorides	3,000	180
Sulphates (TBC)	100	6
Total Metals (Cd, B, As, Zn, Cu, Cr, Pb, Se, Hg)	2	0.12
Priority Substances	TBC	
Methane	0.14	
Pesticides	TBC	

c) Contingency Action Plan

In the event that Trigger Levels are exceeded in the discharge to sewer actions have been determined to cease discharge and manage the leachate within the site and to determine alternative disposal arrangements. These actions are detailed in the Leachate Management Plan for reference.

1.5.4 Monitoring Methodology

a) General

Monitoring will be carried out by suitably qualified monitoring staff in accordance with the procedures outlined below.

b) Pre-Monitoring Checks

Prior to undertaking surface water monitoring, checks will be carried out to determine:

- The number of samples and analytical requirements;
- The size, type and number of bottles that are required and any fixative or preservative requirements;
- That all equipment is clean and in good working order;
- That all necessary equipment is available including keys; and
- Bailers used for leachate sampling will be marked `leachate only' and will not be used for any other purpose.

c) On Site Records

A record will be made of the following:

- Name of monitoring personnel;
- Date of sampling;
- Sampling equipment and method used;
- On-site weather conditions;
- Observations including vegetation die-back, leachate outbreaks, surface ponding, damage to security fencing or accumulations of wind-blown litter;
- Damage to manhole / headworks of leachate extraction and monitoring points;
- The specific reference number of the leachate extraction / monitoring point;
- Depth to top of leachate (where applicable);
- Operational status of pumps; and
- Transducer readings (when available).

d) Monitoring Procedure

The following procedures will be implemented:

- Leachate levels are monitored using a transducer fed through the inclined riser in each cells and recorded as a pressure. These levels can then be related to metres above ordnance datum (mOD).
- Samples of leachate will be obtained from pump outlets installed as part of the leachate pumping system.
- The leachate sample obtained is put into appropriate containers with preservation (if required) and placed into a cooler box for storage at <4°C. Sample bottles not containing preservative are flushed out with the sample prior to filling. Sample bottles are filled to the brim to exclude air, top secured firmly and bottle clearly labelled with the location and date.
- Samples are then transported to an external laboratory at the earliest opportunity.

e) Data Management and Reporting

The leachate level will be calculated in relation to mOD and the depth of leachate above the cell base.

The Site Manager will be informed by the monitoring staff of any results in excess of the Trigger Levels or any problems recorded as part of the sampling works.

The leachate level and quality monitoring results will be stored in both electronic and paper formats. A copy of the data will be submitted to Irish Water and the EPA at frequencies to be agreed and set out in the IEAL.

Results and analysis of the data will also be included within an annual environmental monitoring report for submission to the EPA in compliance with the requirements of the IEAL.

f) Monitoring Quality Assurance

Leachate monitoring and sampling at the site will be undertaken in accordance with the monitoring procedure detailed above.

Suitably trained personnel will undertake leachate monitoring.

Monitoring equipment will be serviced and maintained in line with the manufacturer's recommendations.

An ISO /IEC 17025:2005 accredited laboratory will carry out analysis of leachate samples.

1.6 Odour Monitoring

1.6.1 Site Works

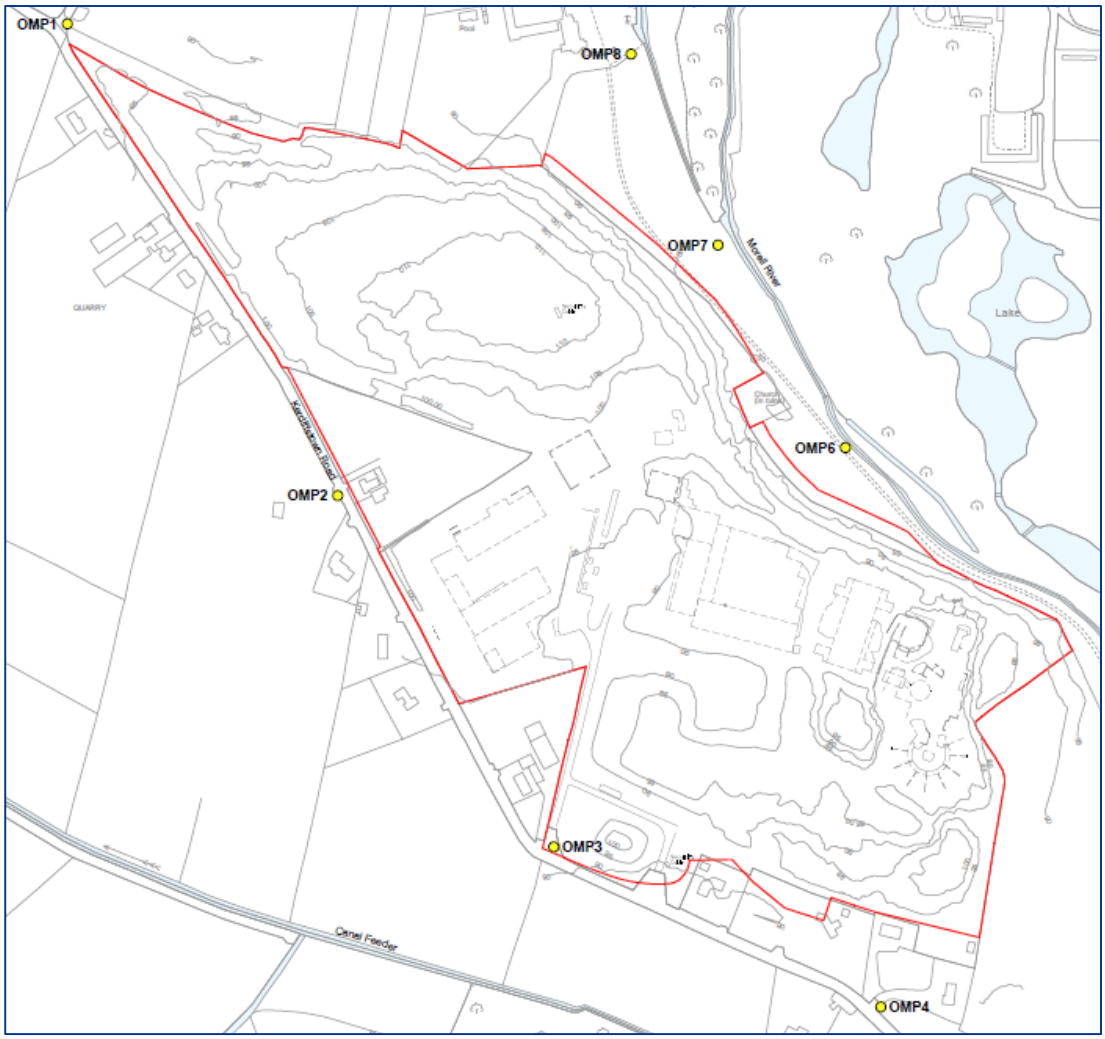
a) Current Operations

Odour monitoring is currently carried out at the locations and according to the frequency and for the determinants detailed in Table 1.12. The locations are shown in Figure 1 below.

Table 1.12: Current Odour Monitoring Locations, Frequency and Method

Locations	Frequency	Analysis Method
OMP1, OMP2, OMP3, OMP4, OMP5, OMP6, OMP7, OMP8, 250 flare	Monthly	As per EPA AG5 Guidance.

Figure 1: Current Odour Monitoring Locations



Monitoring at these locations will continue until commencement of the Remediation Phase.

b) Remediation Phase

The responsibility for undertaking odour monitoring will lie with KCC as operator of the site, with records made available to the EPA, and reported in accordance with the requirements of the IEAL. It is proposed that routine monitoring will continue to be undertaken on a monthly basis.

As the remediation works will include the excavation of waste, exposing waste, deposition of waste, reprofiling of slopes (with potential detection of leachate outbreaks), relocation of gas flares and disconnection of gas wells the generation of odour is likely. To maintain compliance with the site's IEAL further monitoring locations will be included to reflect positions where it can be shown that odour is not released beyond the licensed boundary, and will be targeted to be in proximity to key receptors. These locations will be informed by a review of the Construction Environmental Management Plan (CEMP) to be prepared by the contractor(s) appointed to undertake the remediation works. The Construction Environmental Management Plan (CEMP) will also include provision for an Odour Control Plan (OCP) and shall require:

- Maintenance of odour monitoring sheets, to include logging of weather conditions such as prevailing wind direction, speed, atmospheric pressure and precipitation, and findings from daily olfactory tests;
- Olfactory testing of odour characteristics on a daily basis at the site boundary immediately adjacent to the working face(s); and
- Weekly sampling of Total VOC concentrations using a FID handheld field detector at the site boundary immediately adjacent to the working face(s).

The OMP will be required to follow the guidance presented in the Environment Agency of England and Wales "Odour Management Guidance" (H4 Guidance, 2011). The odour monitoring and investigation aspects of the OMP will follow the EPA "Odour Impact Assessment Guidance for EPA Licensed Sites" (Guidance Note AG5, 2010).

The Site Manager will ensure that daily inspections are made of the working areas and the site perimeter in order to identify any sources of odour and to establish whether any odours are discernible at the site perimeter. Particular attention will be paid to the active waste deposition area(s), to areas where gas and leachate are actively being managed and to the perimeter of the installation which is close to sensitive receptors.

Site staff and third party monitoring staff will carry out odour monitoring. The role of monitoring staff that are not based at the site will essentially be to confirm the findings of the inspections carried out by site staff and thereby minimise the potential impacts of odour fatigue.

This recording of odour monitoring will be undertaken at least twice daily (am and pm) where activities relating to waste excavation, landfill gas or leachate infrastructure are being undertaken. Records will be maintained on site. Any odour problems detected will be immediately reported to the Site Manager.

c) Aftercare Phase

The requirement for monitoring odours during the aftercare phase will be scrutinised during the final months of the Remediation Phase when the site has been fully capped and the potential for odour nuisance has been significantly reduced. It is not anticipated that any diffuse odour impacts will occur during the Aftercare Phase, as the remediation, capping, and on-going landfill gas management of the site will prevent any odours from arising.

1.6.2 Contingency Action Plan

If odours are detected which can be related to the works being undertaken at the site an investigation will be undertaken by the Site Manager to determine the cause and need for any additional mitigation measures. If necessary works may be ceased and the workface contained with a temporary cover until adequate mitigation can be assured.

The extent of contingency actions will be dependent on a number of factors and would require an assessment but may include some of the following:

- Alter the operational procedures to ensure wastes are immediately buried and covered with soils;
- Provide additional cover to working areas, to be undertaken as soon as practicable;
- Verify integrity of landfill gas and leachate infrastructure, undertaking repairs to or replacement of any malfunctioning infrastructure, for example pipelines, wellheads, dewatering pots, flare etc;

- Logging any odour complaints, and investigating circumstances on the day the complaint was made. This includes correlating wind direction and speed, barometric pressure, and whether any site works were being carried out; and
- Notifying nearby sensitive receptors prior to any works being carried out, that may disturb the waste body and cause odours to be released.
- Collect and undertake analysis of air samples to determine the nature of any odours if necessary to investigate justified complaints; and
- Utilise odour masking sprays pending completion of local remedial works.

1.6.3 Monitoring Techniques

Olfactory inspection of odour is subjective. However, records are showing trends, intensities and the suspected source are recorded to assess potential impacts from the site.

a) On Site Records

A record will be made of the following:

- Name of monitoring personnel;
- Date of monitoring;
- On-site weather conditions including atmospheric temperature, atmospheric pressure and wind direction / speed;
- A description of odours detected including intensity and location;
- Observations including vegetation die-back, leachate outbreaks, other activities which may give rise to odour.

b) Monitoring Procedure

Olfactory inspections will be undertaken in accordance with Air Guidance Note 5 (AG5) Odour Impact Assessment Guidance for EPA Licensed Sites EPA, 2010.

c) Data Management and Reporting

Odour monitoring results will be stored in both electronic and hard formats. A hard copy of the data will be made available to the EPA. Results and analysis of the data will also be included within an annual environmental report for submission to the EPA in compliance with the requirements of the IEAL.

Notifications of complaints will be issued to the EPA as soon as practicable.

d) Monitoring Quality Assurance

Only suitably trained personnel will undertake odour monitoring.

1.7 Noise Monitoring

1.7.1 Site Works

a) Current Operations

The only current stationary noise emission points at the site are the landfill gas flares and a minor noise emission from the pump used for the removal of leachate from the lined cell in Zone 3. Baseline noise monitoring undertaken in September 2016 at eight offsite sensitive receptors indicated no audible noise emissions from the site. The main current noise source was traffic on local roads and the M7 motorway.

b) Remediation Phase

Remediation works are proposed to be carried out over a number of different phases as described in EIAR. The actual noise level produced by remediation works will vary at the boundary to the nearest sensitive receptor at any time depending upon a number of factors including the type of plant in use, plant location, duration of operation, hours of operation and intervening topography. This will be detailed in the Construction Environmental Management Plan (CEMP) to be prepared by the Contractor(s) appointed to undertake the remediation works.

Construction noise limits will be applied to the contractor(s) appointed to undertake the remediation works. Best practice control measures including choice of plant, scheduling of works on site, provision of temporary acoustic screening, on-site noise monitoring and other measures will be employed in order to ensure noise limits are not exceeded.

During the Remediation Phase the existing landfill gas flares will be moved around the site as required to permit continued gas extraction during the works. A new 600m^3/hr main flare will be installed in the Landfill Infrastructure Compound as well as a new backup flare. The leachate plant building will contain pumps and represents a further noise source.

Due to a combination of the mitigation measures proposed and good noise management practices which will be required of the appointed contractor noise impacts are below LAeq 55dB in all cases.

The applicable noise limits to be applied at the site and monitored accordingly are set out in Table 1.13.

Table 1.13: Recommended Noise Limit Criteria for the Remediation and Aftercare Phases

Scenario	Daytime Noise Criterion dB $L_{Ar,T}$ (07:00 to 19:00 hrs)	Evening Noise Criterion dB $L_{Ar,T}$ (19:00 to 23:00 hrs)	Night-time Noise Criterion dB $L_{Ar,T}$ (23:00 to 07:00 hrs)
Quiet Area	Noise from the licensed site to be at least 10dB below the average daytime background noise level measured during the baseline noise survey	Noise from the licensed site to be at least 10dB below the average evening background noise level measured during the baseline noise survey	Noise from the licensed site to be at least 10dB below the average night-time background noise level measured during the baseline noise survey
Areas of Low Background Noise	45dB	40dB	35dB
All other Areas	55dB	50dB	45dB

The frequency and locations of monitoring will be agreed by the EPA and undertaken in compliance with the requirements of the IEAL.

c) Aftercare Phase

The Aftercare Phase will comprise a multi-use public park with three sports pitches, walkways and a playground. The facility will be accessible by members of the public during daylight hours and noise emissions associated with amenity users will be similar to any town park and will be imperceptible in terms of significance. Detailed design will provide further detail on proposals, and the programme for the remediation works will directly influence when the Aftercare Phase will commence.

The Landfill Infrastructure Compound will generate very low levels of noise as the noise generating pumps will all be housed internally in the plant building and the only external noise will be associated with the operation of the gas flare.

This Management Plan will be revisited to address any changes in mitigation proposed in the EIAR and to confirm compliance with the IEAL.

1.7.2 Data Management and Reporting

Results of noise monitoring will be stored in both electronic and hard formats. A hard copy of the data will be submitted to the EPA in compliance with the requirements of the IEAL.

Only suitably trained personnel will undertake noise monitoring.

1.8 Other Environmental Aspects

1.8.1 Meteorological Data

An on-site weather station is located at the highest point of the site (291316E, 222333N). Data is downloaded on a monthly basis from a dedicated work station computer located in the site offices. Data from the Met Éireann weather station, Baldonnel – Casement Aerodrome, located approximately 14.7km northwest of the centre of the site is also used as reference for the weather dataset. Met Éireann Data is downloaded when available from the Met Éireann website (http://www.met.ie/).

The minimum data presented in Table 1.14 below is recorded.

Table 1.14: Meteorological Data

Parameter	Data Logging
Volume of precipitation	Daily
Temperature min/max, 14.00h CET	Daily
Direction and force of prevailing wind	Daily
Evaporation	Daily
Atmospheric pressure	Daily
Atmospheric humidity, 14.00h CET	Daily

Note: CET is Central European Time as specified in the Landfill Directive.

The meteorological data is collated into a bespoke spreadsheet with graphs showing trends over time, wind roses and comparison with historic data. The information is used to support monthly and annual environmental monitoring reports.

Use of the on-site weather monitoring station will continue during the remediation of the site. Remediation works may require relocation of the weather station to another position on site. This will be agreed in advance with the EPA.

Requirements for reporting will be in compliance with the IEAL as agreed by the EPA.

1.8.2 Dust / Particulate Matter

Dust monitoring has been undertaken routinely since June 2014, using Bergerhoff dust deposition gauges erected at eight sampling locations to 2016 and at nine sampling locations since 2016. Sampling locations are positioned in and around the site. These gauges are exposed to the ambient air for 28 days before being collected and sent to an accredited laboratory for analysis. This analysis is carried out twice per year with results showing that the site is not currently a source of nuisance from dust emissions.

The remediation works proposals detailed in the EIAR have been developed to include environmental protection measures to manage issues including dust. This management plan will be supported by a Construction Environmental Management Plan to be prepared by the Contractor(s) appointed to undertake the remediation works. The CEMP will embrace all mitigation detailed in the EIAR, conditions set out in the site's planning permission and the requirements of the IEAL.

The CEMP will contain a Dust Management Plan which will be prepared specifically for the Remediation Phase as the planned activities are likely to generate some dust emissions. The principal objective of the Dust Management Plan will be to ensure that dust emissions do not cause significant nuisance at receptors in the vicinity of the proposed Project. The most important features of the Dust Management Plan are summarised as follows:

- The design, and in particular the phasing of the remediation works will consider dust impact management and choose design approaches to minimise dust emissions;
- The remediation works will be carried out in phases so that all of the works with significant potential for generating dust emission will not all occur simultaneously;
- An effective training programme in dust management for site personnel will be implemented for the duration of the Remediation Phase;
- A strategy for ensuring effective communication with the local community will be developed and implemented;
- A programme of dust minimisation and control measures will be implemented and regularly reviewed; and
- A monitoring programme will be implemented.

A daily inspection programme will be formulated and implemented in order to ensure that dust control measures are inspected to verify effective operation and management.

A dust monitoring programme will be implemented at the site boundaries for the duration of the Remediation Phase in order to verify the continued compliance with relevant standards and limits. As a minimum, the dust monitoring programme will comply with the frequencies outlined in Table 1.15 below. However, a targeted programme of monitoring based on proximity to working areas, receptors and wind direction will require additional locations to be recorded.

Table 1.15: Dust / Particulate Matter Measurements

Parameter	Monitoring Frequency	Analysis Method/Technique
Dust (mg/m^2/day)	Four times a year Note 2	Standard Method Note 1
PM_{10} (mg/m^2/day)	Annually	See Note 3

Note 1: Standard method VDI2119 (Measurement of Dustfall, Determination of Dustfall using Bergerhoff Instrument (Standard Method) German Engineering Institute). Any modifications to eliminate interference due to algae growth in the gauge should be reported to the Agency.
Note 2: Twice during the period May to September.
Note 3: As described in prEN12341 or an equivalent agreed by the Agency.

The levels of fine particulate matter (PM_{10}) in ambient air will be measured at dust monitoring locations. Measurements will be over 24-hour intervals to allow direct comparison with the relevant air quality standard as specified in the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). Monitoring will be conducted over a five to seven day period.

Only suitably trained personnel will undertake dust monitoring.

1.8.3 Topography and Stability Monitoring

Visual observations and assessment of settlement or any ground movements are ongoing in addition to repeat topographical surveys.

Remediation works comprise the re-profiling of over-steep slopes and movement of wastes around the site to generate a suitable profile for installation of an engineered capping or cover system. To support the outline design, a Preliminary Capping and Waste Slope Stability Assessment and Waste Settlement Assessment have been undertaken. These assessments will be revisited as part of the detailed design phase of the works and a Stability Management Plan will then be developed.

During the remediation works topographical records of the site profile will be maintained, for review against the detailed design and requirements of a capping CQA Plan (for agreement with the EPA). The remediation works will be supported by a final CQA Report to confirm as-built details, including profiles, for the site.

Thereafter, annual topographical surveys will be undertaken to permit assessment of settlement and stability.

1.8.4 Ecology

Habitat mitigation measures are identified in the EIAR. Requirements to monitor effects on ecological habitats on and around the site will be agreed by the EPA and undertaken in compliance with the IEAL.

For the operational phase, key features are proposed to enhance the site's biodiversity, driven by local planning policy and guidance and national plans relating to the protection and enhancement of biodiversity. Proposals include:

- Installation of bat boxes on retained trees;
- Planting of wildflowers to benefit pollinators; and
- Creation of new and diverse wetland habitats, including reed beds and wet grassland swales.

1.8.5 Archaeology

During the remediation of the site all topsoil stripping associated with the proposed remediation works shall be monitored by a suitably qualified archaeologist.

Full provision will be made available for the preservation by record of any features or deposits that may be discovered, if that is deemed the most appropriate manner in which to proceed.

Records will be stored in both electronic and hard formats. A hard copy of the results of the archaeological supervision will be made available to the EPA.

Other requirements for monitoring of archaeological conditions at the site will be agreed with the EPA and undertaken in compliance with the IEAL.

1.9 Work Instructions

Duty of the Site Manager

- Review and approve CQA Plans with regards to installation and protection of all groundwater, leachate and landfill gas monitoring locations;
- Provide all borehole logs and construction details of new monitoring infrastructure with Ordnance Datum levels to the EPA within one month of installation;
- Ensure that all new perimeter environmental monitoring points are provided with secure lockable headworks;
- Ensure that groundwater infrastructure is protected during the Remediation Phase of the project as far as practicable;
- Ensure that access is maintained to the groundwater infrastructure for monitoring and sampling;
- Ensure up to date monitoring plans are available to monitoring technicians;
- Ensure that all necessary monitoring, as agreed by the EPA, is undertaken in compliance with the requirements of the IEAL;
- Ensure that a competent third party body undertakes all external analysis of surface water, groundwater and leachate samples;
- Ensure that monitoring data is reviewed timeously, assessed against relevant trigger levels and reported in compliance with the requirements of the IEAL;

- Where an apparent breach in a trigger level has been exceeded then ensure the relevant contingency plan is implemented;
- Ensure all monitoring results are issued to the EPA in compliance with the requirements of the IEAL.

Duty of Monitoring Staff

- Ensure all monitoring locations are clearly labelled;
- Immediately inform the Site Manager of any damage or restricted access to monitoring locations;
- Identify and report to the Site Manager any apparent breach of control and/ or trigger levels;
- Agree actions in compliance with the relevant Contingency Action Plan with the Site Manager regarding any re-sampling required in order to verify any apparent breach in control and/ or trigger levels;
- Ensure that all monitoring infrastructure is left in a secure manner post-monitoring.

Appendix A. Monitoring and Sampling Locations Tabular Data

GROUNDWATER MONITORING						
Location Ref	**Type**	**Easting**	**Northing**	**Verified***	**Pollutant**	**Comment**
BB02	Sampling	291361	222419	No	**	Replace if lost during remediation works.
BB04	Monitoring	291713	222076	No	**	
BH02	Sampling	291358	221880	No	**	Monitor until removed during remediation works.
BH06	Sampling	291700	221906	No	**	Monitor until removed during remediation works.
BH07	Sampling	291681	221982	No	**	Monitor until removed during remediation works.
BH26	Sampling	291136	222407	No	**	Monitor until removed during remediation works.
BH36B	Sampling	291286	222308	No	**	Monitor until removed during remediation works.
BH42	Sampling	291543	221929	No	**	Monitor until removed during remediation works.
BH68	Sampling	291358	222040	No	**	
DB01	Monitoring	290983	222525	No	**	
DB02	Sampling	291142	222495	No	**	
DB03	Sampling	291280	222505	No	**	
DB03A	Monitoring	291153	221986	No	**	
DB04 (D)	Monitoring	291335	222448	No	**	
DB05	Monitoring	291488	222303	No	**	
DB07	Monitoring	291759	221980	No	**	
DB08A	Monitoring	291737	221869	No	**	
DB09	Monitoring	291606	221773	No	**	
EMW02	Monitoring	291476	222357	No	**	Combined gas and groundwater borehole.
EMW03	Sampling	291439	222356	No	**	Replace if lost during remediation works.
EMW04	Sampling	291464	222330	No	**	Replace if lost during remediation works.
EMW05	Sampling	291471	222391	No	**	
EMW06	Monitoring	291376	222413	No	**	
EMW07	Sampling	291518	222210	No	**	Replace if lost during remediation works.
EMW08	Monitoring	291546	222221	No	**	
EMW11	Sampling	291178	222107	No	**	
EMW13	Sampling	291211	222464	No	**	
EMW14	Sampling	291443	222257	No	**	Monitor until removed during remediation works.
EMW15	Sampling	291543	222134	No	**	Replace if lost during remediation works.
EMW16	Sampling	291692	222061	No	**	Replace if lost during remediation works.
EMW17	Sampling	291746	221992	No	**	Monitor until removed during remediation works.
EMW18	Sampling	291643	222110	No	**	Replace if lost during remediation works.
EMW19	Sampling	291548	222166	No	**	Replace if lost during remediation works.
EMW20	Sampling	291529	222283	No	**	
EMW21	Monitoring	291411	222509	No	**	
EMW22	Sampling	291194	222563	No	**	
EMW23	Sampling	291194	222559	No	**	
EMW24	Sampling	290937	222546	No	**	
EMW27D	Sampling	291086	221781	No	**	
EMW28	Monitoring	291087	221780	No	**	
EMW29	Sampling	291515	221706	No	**	
EMW30	Sampling	291749	221823	No	**	

Location Ref	Type	Easting	Northing	Verified*	Pollutant	Comment
EMW31	Sampling	291545	222362	No	**	
EMW32	Monitoring	291695	222476	No	**	
EMW33	Sampling	291492	222494	No	**	
GW1D	Sampling	291339	221873	No	**	Monitor until removed during remediation works.
GW2S	Sampling	291634	221913	No	**	Monitor until removed during remediation works.
RM1	Monitoring	291471	222503	No	**	
RM2	Monitoring	291460	222463	No	**	
RM3	Monitoring	291480	222368	No	**	
RM4	Monitoring	291507	222333	No	**	
RM5	Monitoring	291552	222256	No	**	
RM6	Monitoring	291602	222182	No	**	

SURFACE WATER MONITORING						
Location Ref	**Type**	**Easting**	**Northing**	**Verified***	**Pollutant**	**Comment**
SW1	Sampling	291901	221639	No	**	Existing
SW10	Sampling	291268	221711	No	**	Existing
SW13	Sampling	291447	221650	No	**	Existing
SW2	Sampling	291839	222005	No	**	Existing
SW3	Sampling	291542	222293	No	**	Existing
SW4	Sampling	291475	222456	No	**	Existing
SW5	Sampling	291482	222592	No	**	Existing
SW6	Sampling	291696	222059	No	**	Future
SW7	Sampling	290972	222498	No	**	Future

LEACHATE MONITORING						
Location Ref	**Type**	**Easting**	**Northing**	**Verified***	**Pollutant**	**Comment**
LMW 1	Monitoring	291048	222417	No	**	Leachate Monitoring Well - Zone 1
LMW 2	Monitoring	291095	222303	No	**	Leachate Monitoring Well - Zone 1
LMW 3	Monitoring	291251	222367	No	**	Leachate Monitoring Well - Zone 1
LMW 4	Monitoring	291370	222334	No	**	Leachate Monitoring Well - Zone 1
LR 1	Sampling	291370	222022	No	**	Leachate Riser (Zone 3)
LR 2	Sampling	291343	221912	No	**	Leachate Riser (Zone 3)
LT 1	Sampling	291383	221885	No	**	Leachate Tanks
SE 2	Sampling	291537	221808	No	**	Leachate Sampling Point [Future]

Key:
* Yes = GPS used; No = GPS not used.
** Refer to appropriate section of Monitoring and Control Management Plan.

LANDFILL GAS MONITORING						
Location Ref	**Type**	**Easting**	**Northing**	**Verified***	**Pollutant**	**Comment**
Gas Monitoring Boreholes						
BH66	Monitoring	291389	222209	No	**	
BH73	Monitoring	291707	221812	No	**	
BH75	Monitoring	291226	222108	No	**	
BH76	Monitoring	291368	222103	No	**	
BH77	Monitoring	291351	222167	No	**	
BH78	Monitoring	291413	222044	No	**	
DB14A	Monitoring	291176	222233	No	**	
GMW25	Monitoring	291304	222001	No	**	
EMW09	Monitoring	291001	222380	No	**	
EMW10	Monitoring	291030	222336	No	**	
EMW02	Monitoring	291476	222357	No	**	Combined gas and groundwater borehole.
EMW03	Monitoring	291439	222356	No	**	Combined gas and groundwater borehole.
EMW04	Monitoring	291464	222330	No	**	Combined gas and groundwater borehole.
EMW05	Monitoring	291471	222391	No	**	Combined gas and groundwater borehole.
EMW06	Monitoring	291376	222413	No	**	Combined gas and groundwater borehole.
EMW07	Monitoring	291518	222210	No	**	Combined gas and groundwater borehole.
EMW08	Monitoring	291546	222221	No	**	Combined gas and groundwater borehole.
Gas Extraction Wells						
G3a	Monitoring	291369	222278	No	**	Existing. To be replaced during remediation works.
G4	Monitoring	291359	222273	No	**	Existing. To be replaced during remediation works.
G5a	Monitoring	291336	222252	No	**	Existing. To be replaced during remediation works.
G25	Monitoring	291356	222252	No	**	Existing. To be replaced during remediation works.
G26	Monitoring	291366	222260	No	**	Existing. To be replaced during remediation works.
G28	Monitoring	291379	222268	No	**	Existing. To be replaced during remediation works.
G30	Monitoring	291393	222270	No	**	Existing. To be replaced during remediation works.
G31	Monitoring	291408	222235	No	**	Existing. To be replaced during remediation works.
G32	Monitoring	291392	222233	No	**	Existing. To be replaced during remediation works.
G33	Monitoring	291374	222232	No	**	Existing. To be replaced during remediation works.
G34	Monitoring	291409	222209	No	**	Existing. To be replaced during remediation works.
G35	Monitoring	291394	222206	No	**	Existing. To be replaced during remediation works.
G36	Monitoring	291382	222203	No	**	Existing. To be replaced during remediation works.
GEW-1	Monitoring	291320	222291	No	**	Existing. To be replaced during remediation works.
GEW-2	Monitoring	291291	222308	No	**	Existing. To be replaced during remediation works.
GEW-3	Monitoring	291339	222308	No	**	Existing. To be replaced during remediation works.
GEW-4	Monitoring	291277	222325	No	**	Existing. To be replaced during remediation works.
GEW-5	Monitoring	291242	222330	No	**	Existing. To be replaced during remediation works.
LG1	Monitoring	291019	222394	No	**	Existing. To be replaced during remediation works.

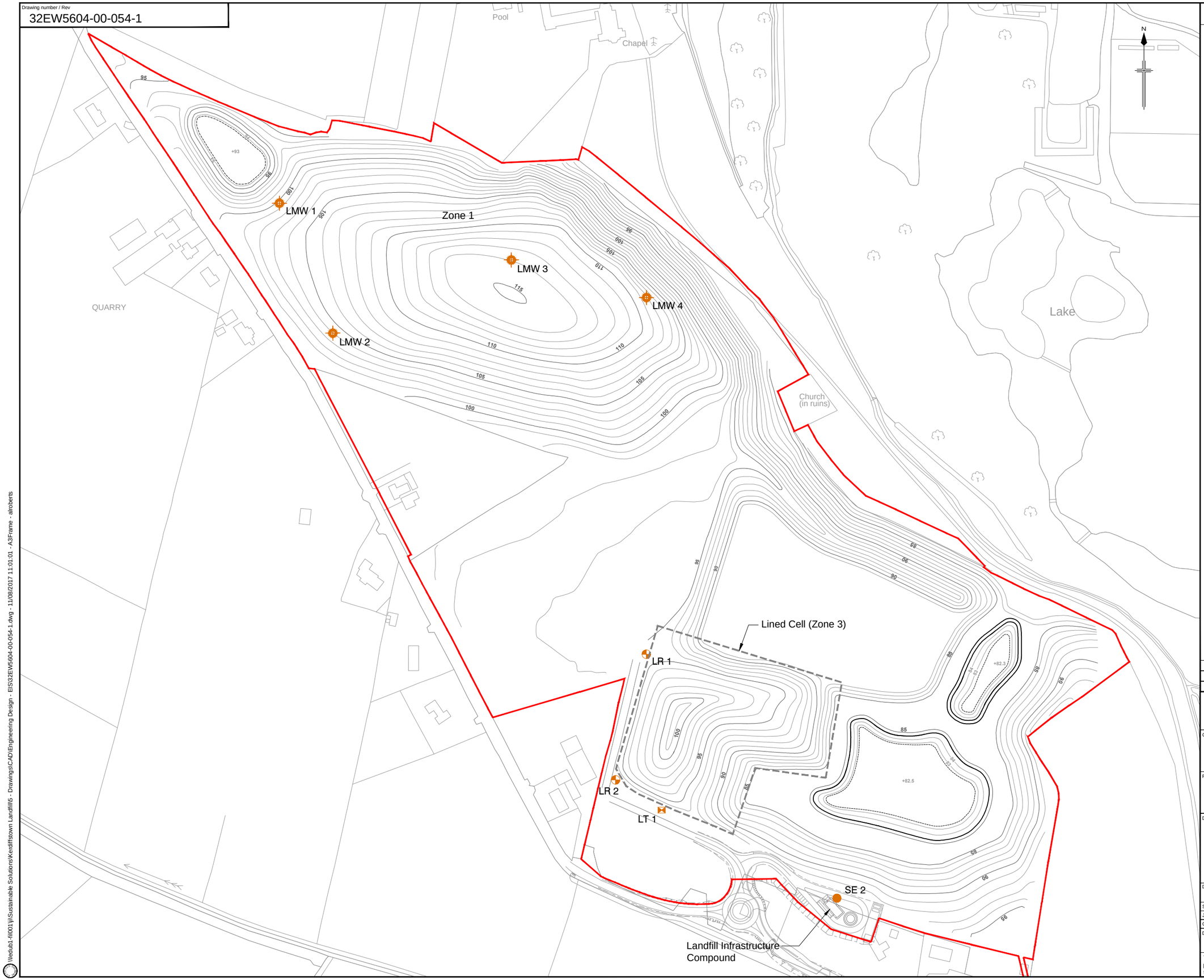
Location Ref	Type	Easting	Northing	Verified*	Pollutant	Comment
LG2	Monitoring	291033	222371	No	**	Existing. To be replaced during remediation works.
LG3	Monitoring	291048	222352	No	**	Existing. To be replaced during remediation works.
LG4	Monitoring	291039	222403	No	**	Existing. To be replaced during remediation works.
LG5	Monitoring	291060	222390	No	**	Existing. To be replaced during remediation works.
LG6	Monitoring	291080	222376	No	**	Existing. To be replaced during remediation works.
LG7	Monitoring	291098	222356	No	**	Existing. To be replaced during remediation works.
LG8	Monitoring	291102	222386	No	**	Existing. To be replaced during remediation works.
LG9	Monitoring	291082	222400	No	**	Existing. To be replaced during remediation works.
LG10	Monitoring	291062	222414	No	**	Existing. To be replaced during remediation works.
LG11	Monitoring	291390	222012	No	**	Existing. To be replaced during remediation works.
LG12	Monitoring	291419	222006	No	**	Existing. To be replaced during remediation works.
LG13	Monitoring	291445	221999	No	**	Existing. To be replaced during remediation works.
LG14	Monitoring	291473	221993	No	**	Existing. To be replaced during remediation works.
LG15	Monitoring	291500	221987	No	**	Existing. To be replaced during remediation works.
LG16	Monitoring	291480	221974	No	**	Existing. To be replaced during remediation works.
LG17	Monitoring	291481	221948	No	**	Existing. To be replaced during remediation works.
LG18	Monitoring	291457	221954	No	**	Existing. To be replaced during remediation works.
LG19	Monitoring	291457	221978	No	**	Existing. To be replaced during remediation works.
LG20	Monitoring	291428	221987	No	**	Existing. To be replaced during remediation works.
LG21	Monitoring	291402	221987	No	**	Existing. To be replaced during remediation works.
LG22	Monitoring	291387	221976	No	**	Existing. To be replaced during remediation works.
LG23	Monitoring	291382	221953	No	**	Existing. To be replaced during remediation works.
LG24	Monitoring	291374	221929	No	**	Existing. To be replaced during remediation works.
LG25	Monitoring	291129	222358	No	**	Existing. To be replaced during remediation works.
LG26	Monitoring	291109	222338	No	**	Existing. To be replaced during remediation works.
LG27	Monitoring	291123	222347	No	**	Existing. To be replaced during remediation works.
LG28	Monitoring	291142	222356	No	**	Existing. To be replaced during remediation works.
LG29	Monitoring	291117	222327	No	**	Existing. To be replaced during remediation works.
LG30	Monitoring	291130	222336	No	**	Existing. To be replaced during remediation works.
LG31	Monitoring	291151	222339	No	**	Existing. To be replaced during remediation works.
LG32	Monitoring	291136	222326	No	**	Existing. To be replaced during remediation works.
LG33	Monitoring	291126	222317	No	**	Existing. To be replaced during remediation works.
LG34	Monitoring	291121	222305	No	**	Existing. To be replaced during remediation works.

Key:
* Yes = GPS used; No = GPS not used.
** Refer to appropriate section of Monitoring and Control Management Plan.

Appendix B. Drawings

Drawing number / Rev

32EW5604-00-054-1



Notes:

1. Profile shown to be constructed during the Remediation Phase.
2. Telemetry location to be provided at Johnstown Pumping Station connection - as agreed with Irish Water.

KEY:

Licence Boundary

Existing:

LMW — Leachate Monitoring Wells

LR — Leachate Riser

LT — Leachate Tank

Future:

SE — Leachate Sampling Point

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
1	07/08/2017	EIAR SUBMISSION	AR	CD	UD	RR
0	13/07/2017	FOR CLIENT REVIEW	KMA	CD	UD	RR

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Client: Kildare County Council
Comhairle Contae Chill Dara

Project: KERDIFFSTOWN LANDFILL REMEDIATION PROJECT

Drawing title: MONITORING & CONTROL MANAGEMENT PLAN
LEACHATE MONITORING LOCATIONS

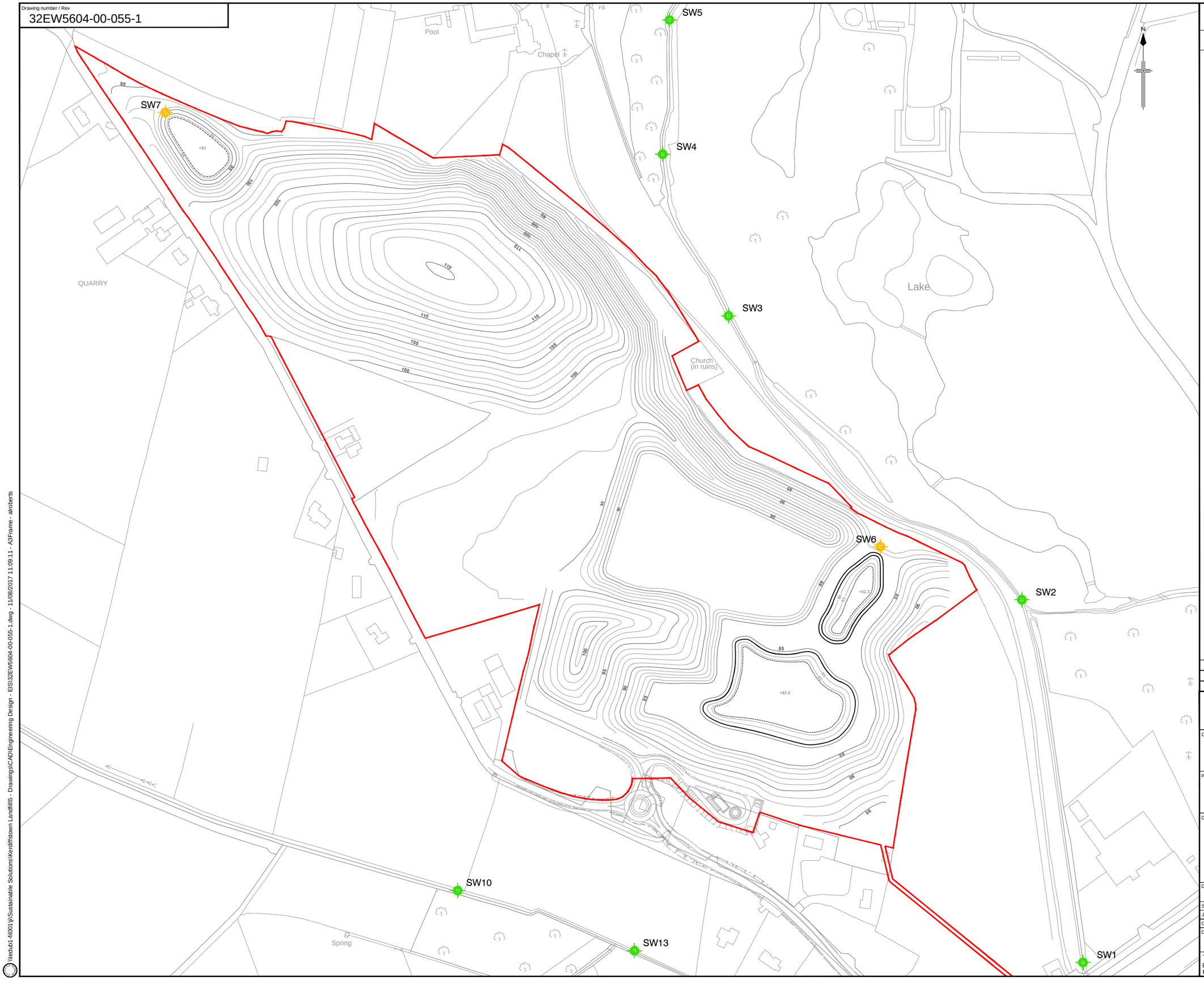
Drawing status: EIAR SUBMISSION

Scale	NTS @A3	DETAILS SHOWN ARE NOT FOR CONSTRUCTION PURPOSES HENCE DRAWING SHOULD NOT BE SCALED
Jacobs No.	32EW5604	
Client No.	6286	

Drawing number: 32EW5604-00-054
Rev: 1

Drawing number / Rev

32EW5604-00-055-1



Notes:

1. Profile shown to be constructed during the Remediation Phase.
2. Future locations to be confirmed during Remediation Phase.
3. Points previously sampled (SW8, SW11 and SW12) removed from monitoring programme due to extensive coverage proposed via other locations.

KEY:

Licence Boundary

Existing:

SW — Surface Water Monitoring Locations

Future:

SW — Surface Water Monitoring Locations

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Revd	Apprv'd
1	07/08/2017	EIAR SUBMISSION	KMA	CD	UD	RR
0	13/07/2017	FOR CLIENT REVIEW	KMA	CD	UD	RR

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Client: Kildare County Council / Comhairle Contae Chill Dara

Project: KERDIFFSTOWN LANDFILL REMEDIATION PROJECT

Drawing title: MONITORING & CONTROL MANAGEMENT PLAN SURFACE WATER MONITORING LOCATIONS

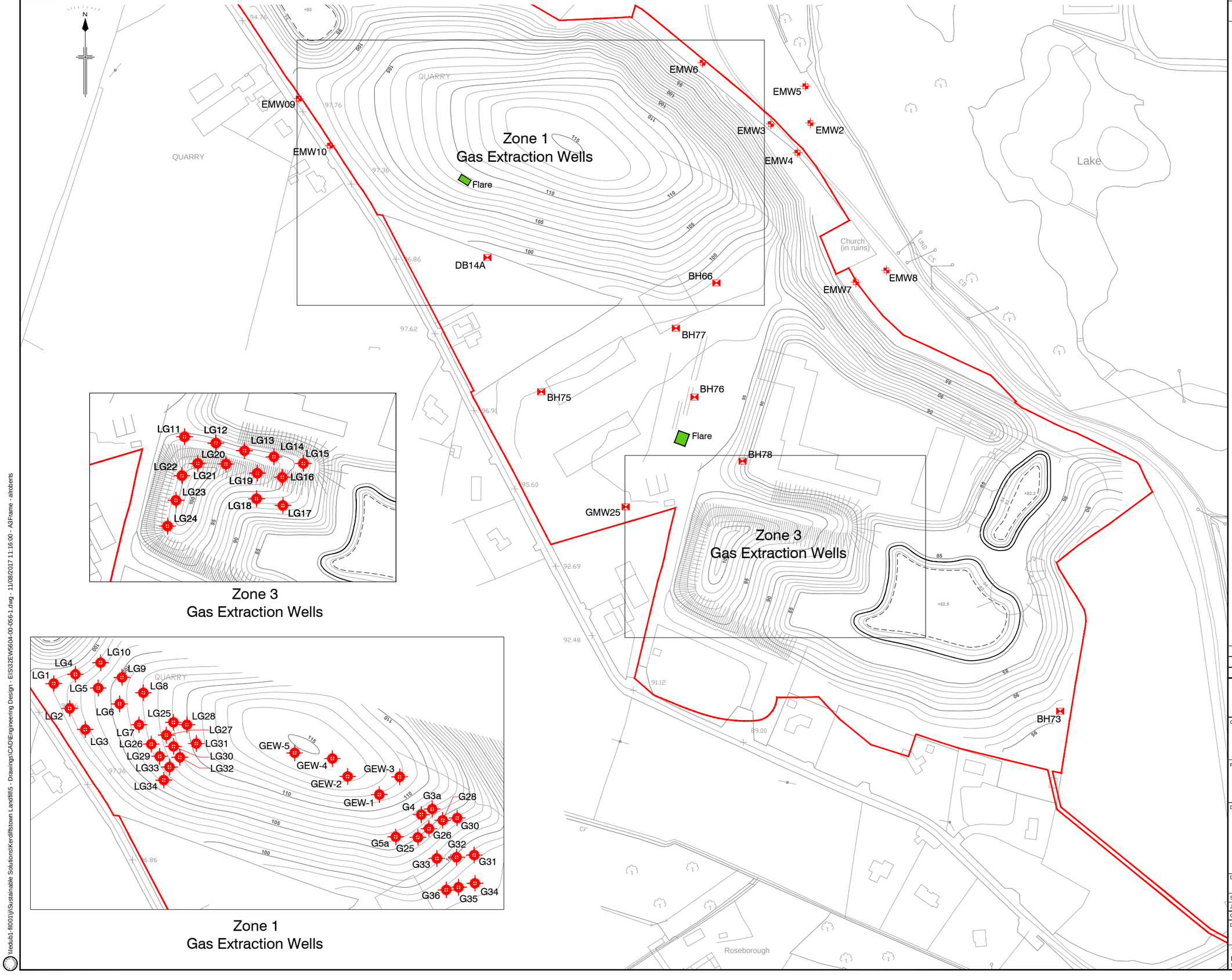
Drawing status: EIAR SUBMISSION

Scale	NTS @A3	DO NOT SCALE
Jacobs No.	32EW5604	
Client No.	6286	

Drawing number: 32EW5604-00-055 Rev: 1

Drawing number / Rev

32EW5604-00-056-1



Notes:

1. Profile shown to be constructed during the Remediation Phase.
2. Future locations of gas wells and flares to be confirmed during Remediation Phase.
3. Locations of existing gas flare will be adjusted during Remediation Phase to suit working areas.
4. Locations of future perimeter gas monitoring boreholes to be confirmed following installation.

KEY:

- Licence Boundary
- Gas Extraction Well
- Gas Monitoring Borehole
- Groundwater/Gas Monitoring Borehole
- Flare

1	07/08/2017	EIAR SUBMISSION	AR	CD	UD	RR
0	13/07/2017	FOR CLIENT REVIEW	KMA	CD	UD	RR
Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd

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Project

KERDIFFSTOWN LANDFILL
REMEDIATION PROJECT

Drawing title

MONITORING & CONTROL
MANAGEMENT PLAN
LANDFILL GAS
MONITORING LOCATIONS

Drawing status

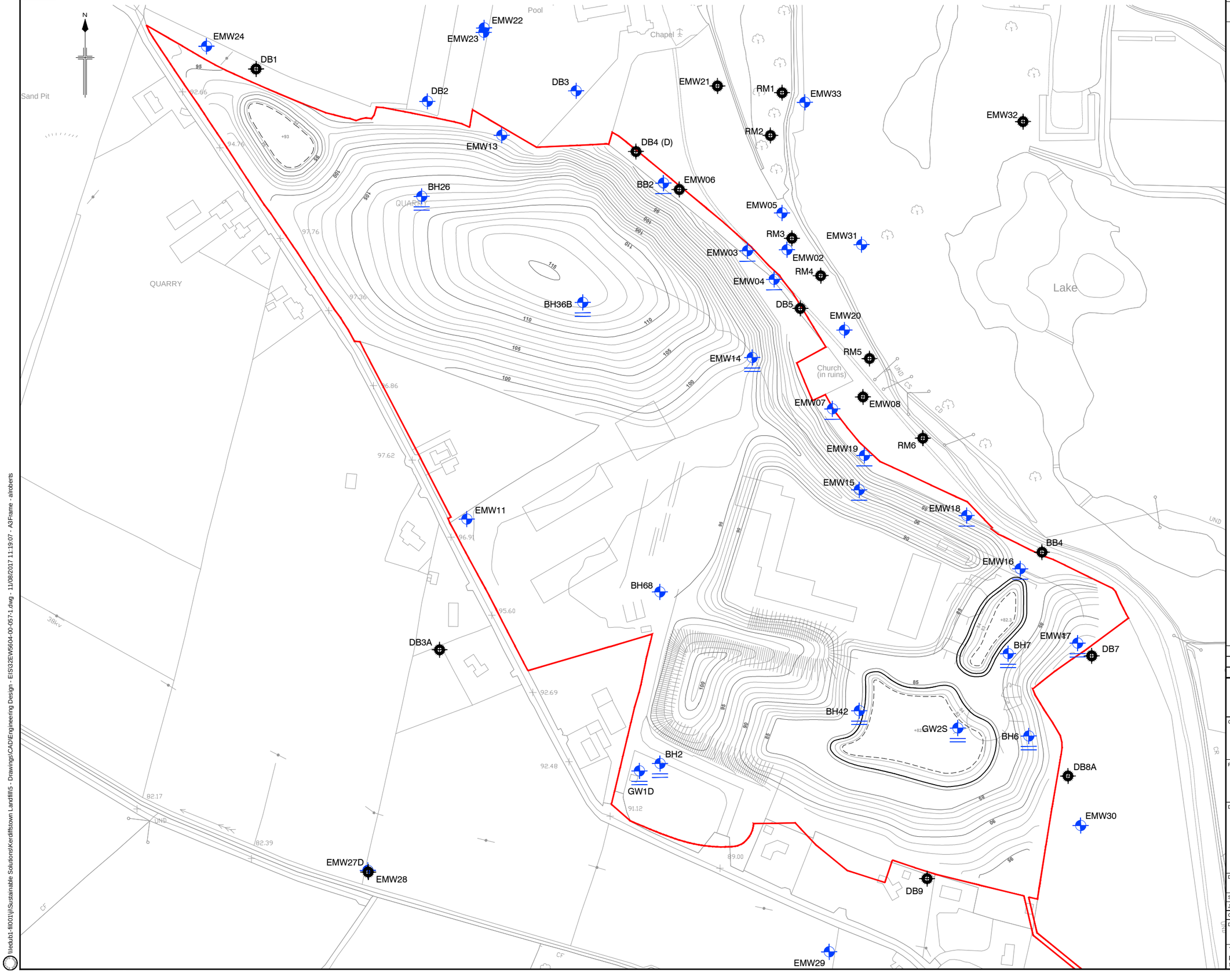
EIAR SUBMISSION

Scale	NTS @A3	DETAILS SHOWN ARE NOT FOR CONSTRUCTION PURPOSES HENCE DRAWING SHOULD NOT BE SCALED
Jacobs No.	32EW5604	
Client No.	6286	

Drawing number: 32EW5604-00-056 — Rev: 1

Drawing number / Rev

32EW5604-00-057-1



Notes:

1. Profile shown to be constructed during the Remediation Phase.
2. Future locations to be confirmed during Remediation Phase.
3. Existing gas flare locations will be adjusted during Remediation Phase to suit working areas.
4. Locations of future perimeter gas monitoring boreholes to be confirmed following installation.

KEY:

- Licence Boundary
- Groundwater Monitoring Boreholes. (Levels Only).
- Groundwater Monitoring Boreholes. (Level and Samples).
- Boreholes at risk due to remediation works. To be retained / replaced.
- Boreholes at risk due to remediation works. No replacement required.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
1	07/08/2017	EIAR SUBMISSION	KMA	CD	UD	RR
0	13/07/2017	FOR CLIENT REVIEW	KMA	CD	UD	RR

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Project

KERDIFFSTOWN LANDFILL
REMEDIATION PROJECT

Drawing title

MONITORING & CONTROL
MANAGEMENT PLAN
GROUNDWATER
MONITORING LOCATIONS

Drawing status

EIAR SUBMISSION

Scale	NTS @A3	DETAILS SHOWN ARE NOT FOR CONSTRUCTION PURPOSES HENCE DRAWING SHOULD NOT BE SCALED
Jacobs No.	32EW5604	
Client No.	6286	

Drawing number: 32EW5604-00-057

Rev: 1